Appendix A Consultation & Communications

Appendix A.1

Notice of Commencement & PIC #1

City of London
Long Term Water Storage
Municipal Class Environmental Assessment

NOTICE OF PROJECT COMMENCEMENT & PUBLIC INFORMATION CENTRE #1

The City of London is supplied with water from two lake based sources, the Lake Huron Regional Water Supply System and the Elgin Area Water Supply System (Lake Erie). In the event of a disruption or reduction in water supply, and to supply adequate water pressure, the City has reservoirs to maintain uninterrupted service. These reservoirs are shown in Figure 1 and include the Arva Reservoir and Pump Station, the Springbank Reservoirs and Pump Station, and the Southeast Reservoir and Pump Station. To address future water storage needs, the City is undertaking a Municipal Class Environmental Assessment (EA) study to determine a preferred site (or sites) for additional water storage to meet future growth and ongoing emergency supply and distribution needs. Additionally, this project will consider the feasibility of retiring the existing Springbank Reservoir #2 and the McCormick Reservoir disconnected previously, as well as options for standby power for the water distribution pumps at the existing Arva Pump Station.

Public Information Centre

Public involvement is an important part of the Class EA process. Comments and information regarding this project are being collected to assist the project team in meeting the requirements of the Environmental Assessment Act. Residents and community organizations are encouraged to participate by providing input and attending the Public Information Centres (PICs). The first of two PICs will be held to present background information and the issues to be addressed through the Class EA process. Project team members will be available to discuss the project and to receive your input. This PIC will be a drop-in event with no formal presentation.

You are invited to attend the PIC to be held:

Date: Wednesday June 20, 2018
Time: 5pm to 7pm
Location: City Hall, 300 Dufferin Avenue, London (Committee Room #1, Second Floor)

Display materials will be available on the City of London website.

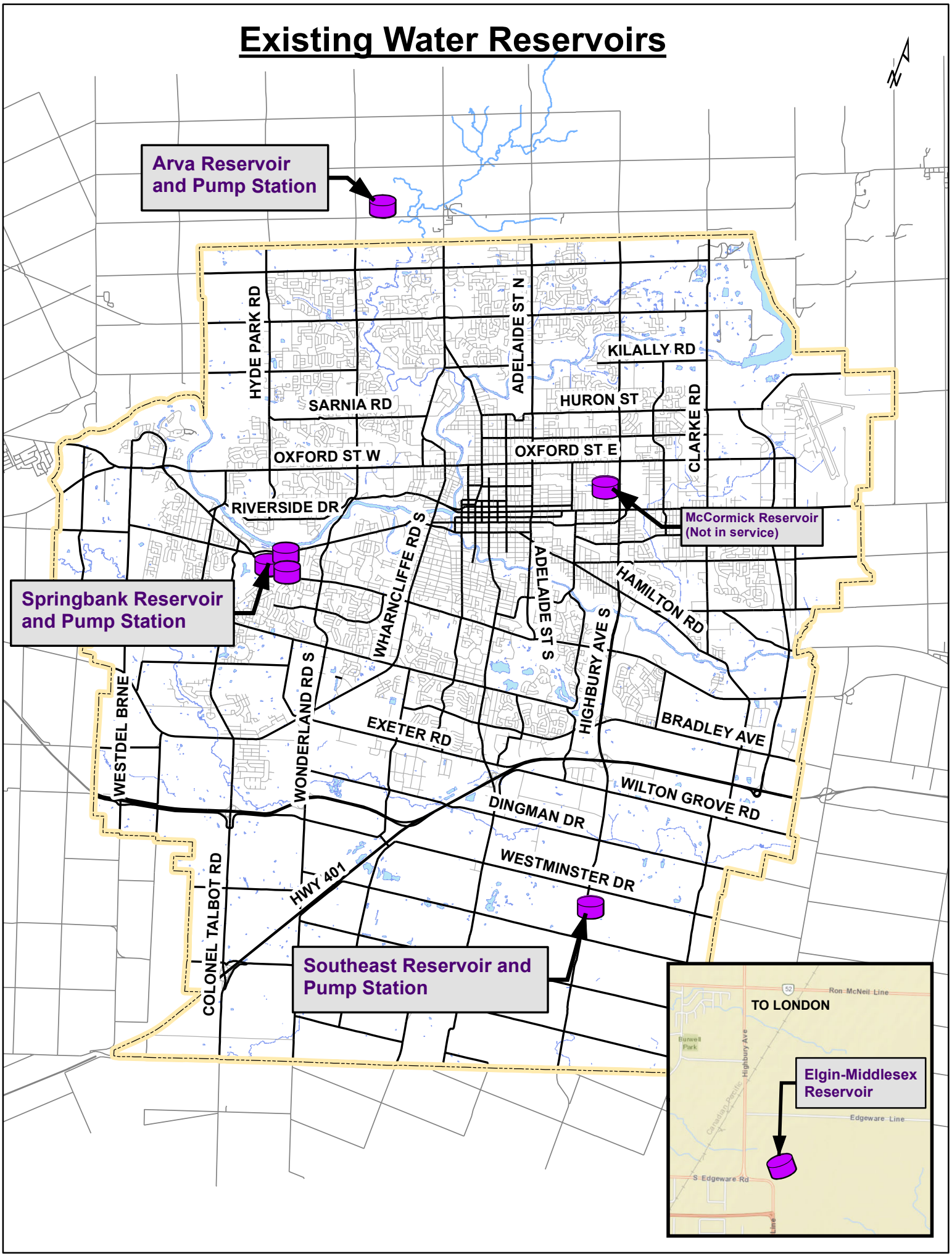
To provide comments, receive additional information or be added to the study mailing list, please visit http://www.london.ca/residents/Environment/EAs/Pages/default.aspx or contact either of the following team members below:

Pat Lupton
Project Manager,
Corporation of the City of London
300 Dufferin Avenue
London ON, N6A 4L9
Tel: 519-661-CITY (2489) x. 5613
Email: plupton@london.ca

Nancy Martin
Environmental Planner,
AECOM Canada
250 York Street, Suite 410
London ON, N6A 6K2
Tel: 519-963-5862
Email: nancy.martin@aecom.com

With the exception of personal information, all comments will become part of the public record of the study. The study is being conducted according to the requirements of the Municipal Class Environmental Assessment, which is a planning process approved under Ontario's Environmental Assessment Act.

Existing Water Reservoirs



Welcome
City of London
Long Term Water Storage

Municipal Class Environmental Assessment
Public Information Centre #1

June 20, 2018

The purpose of this Public Information Centre (PIC) is to:

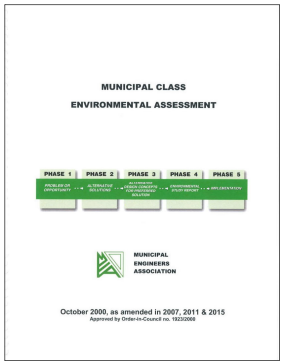
- Introduce the project;
- Communicate the need for a long term water storage strategy to service the City;
- Provide an overview of the Class Environmental Assessment process;
- Describe existing and future conditions;
- Present the alternative reservoir locations to be considered; and
- Meet the project team and get your feedback.

Please take a comment form and a pen. As you review the information presented today, we encourage you to ask questions and provide feedback.

Municipal Class Environmental Assessment

What is a Municipal Class Environmental Assessment?

- A Municipal Class Environmental Assessment (EA) is a process approved under Ontario's ***Environmental Assessment Act.***
- It enables municipal infrastructure projects to be planned with a proven process for protecting the environment.
- This project is following the Municipal Class EA process for **Schedule 'B'** projects.
- Schedule 'B' projects must follow **Phases 1 and 2** of the Class EA process.
- At the end of the EA process, a Project File report will be prepared for public review and comment.



What is the Purpose of this Class EA?

To select a preferred storage location through a comprehensive, environmentally sound planning process that is open to public participation.

Municipal Class Environmental Assessment Process

Phase 1
Identify the Problem and Opportunity Statement

See Board 4

Phase 2
Identify Alternative Solutions to address the Problem and Opportunity Statement

See Boards 5-8

WE ARE HERE

Phase 3
Identify Alternative Design Concepts

Phase 4
Prepare Environmental Study Report

Schedule 'C' Projects Only

Phase 5
Implement the Solution

See Board 10

Background

- The City of London is supplied with water from two lake based sources:
  - Lake Huron Regional Water Supply System,
  - Elgin Area Water Supply System (Lake Erie).
- Lake water travels through a network of treatment plants, reservoirs, pumping stations and pipes before ending up in our homes.

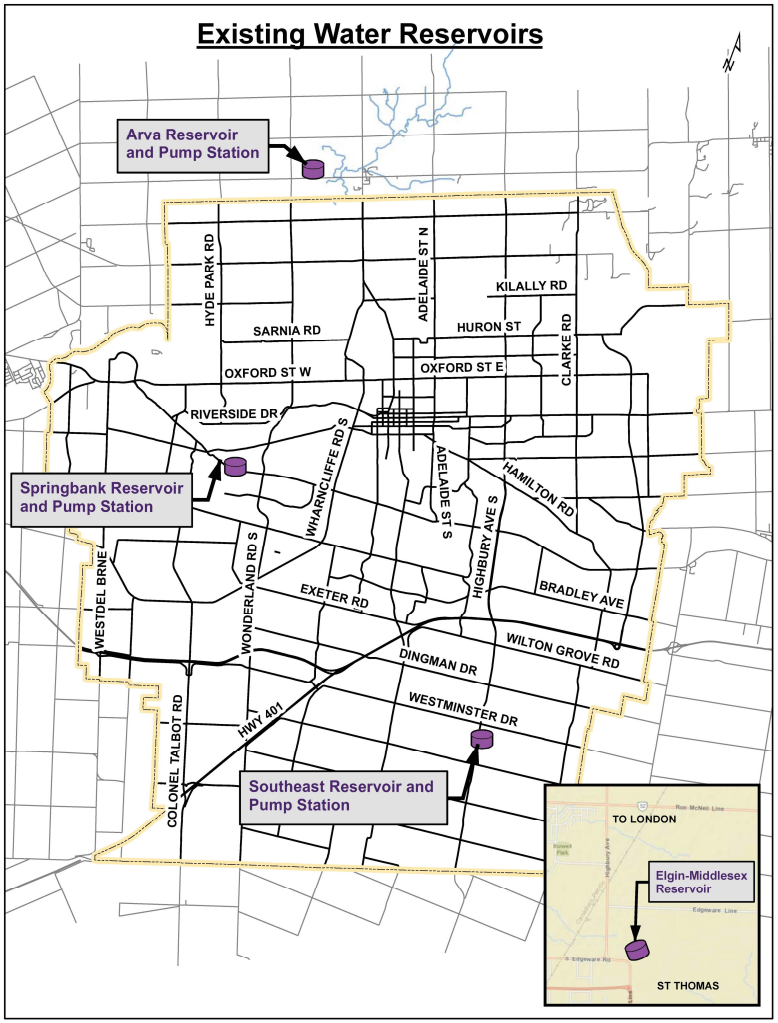
Water Reservoirs

- The City has water reservoirs in four locations:
  - Arva Reservoir and Pumping Station,
  - Elgin-Middlesex Reservoir and Pumping Station,
  - Southeast Reservoir and Pumping Station,
  - Springbank Reservoir Complex.

Springbank Reservoir Complex

- Springbank has three reservoirs (1, 2 and 3),
- Reservoir 2 was built in 1920 and is nearing the end of its service life.

More information on the City of London water system can be found at: http://www.london.ca/residents/Water/Water-System/Pages/Water-System.aspx



Problem and Opportunity Statement

Problems and Opportunities

- The City of London's water system provides safe drinking water to residents, businesses and industries within the City limits.
- Springbank Reservoir #2 requires continued maintenance and repair and is reaching the end of its service life. The City would like to consider retiring the facility when it reaches the end of its life expectancy anticipated in 2022. As a result, comparable reservoir capacity (45ML) will need to be replaced or better located within the City's water system.
- The Arva Reservoir and Pumping Station can pump water from the Lake Huron Water Supply System to the entire City during a power outage. However, the water supply rate and pressure is reduced compared to normal operating conditions and emergency needs.
- The City needs to have adequate standby power to operate the Arva distribution pumps to the City and be able to utilize the volume of water in storage at the Arva Reservoir.
- Additional water storage is necessary to meet future growth demands to 2054 and beyond.
- The City must also consider the potential of a disruption or reduction in water supply during emergency situations in planning for the storage needs of the City's water system, as well as Ministry of Environment and Climate Change fire balancing and daily peak demand needs.

Problem and Opportunity Statement

The City of London provides water storage and distribution from the Arva, Elgin-Middlesex, Southeast and Springbank reservoirs. From these sources, water is provided for drinking water, daily household use, business and industrial needs and fire protection. Water can also be provided during water disruptions or if pressures within the City's water system are reduced. However, the existing water system is not able to provide flows at a supply rate and pressure necessary to meet peak demand, fire and/or emergency needs based on future growth. Additionally, Reservoir #2 at Springbank is subject to ongoing maintenance associated with this aging facility and is nearing the end of its service life.

This Class EA study will examine opportunities to address these issues and determine a preferred solution for future water storage that will contribute to the overall City water system daily operation and emergency needs, and meet future growth.

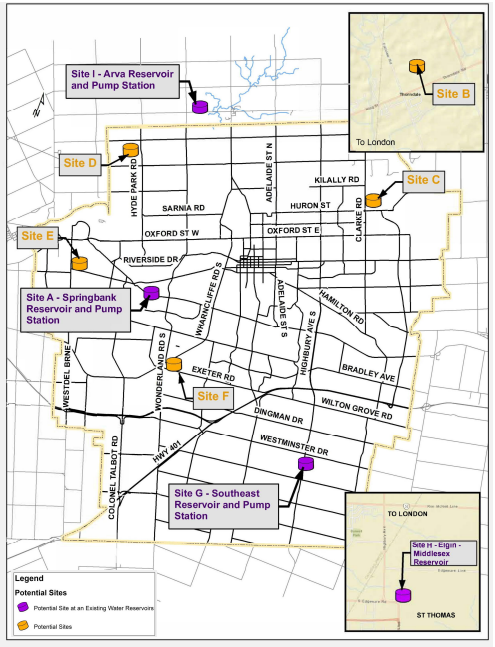
Long-List Candidate Locations and Evaluation

Step 1: Long-List Candidate Location Identification Criteria

To address the Problem and Opportunity Statement (Board 4), a Long List of potential general locations for water reservoir storage were identified based on high-level screening criteria:

- Property that is currently vacant land or open space,
- Meets storage size and configuration requirements,
- Site elevation (determines potential type of storage facility – pumped or floating).

Nine locations were selected and evaluated as potential **Long-List Candidate Locations.**



Step 2: Long-List Candidate Location Evaluation (see Board 6)

The Long-List Candidate Locations were then evaluated to determine their suitability based on:

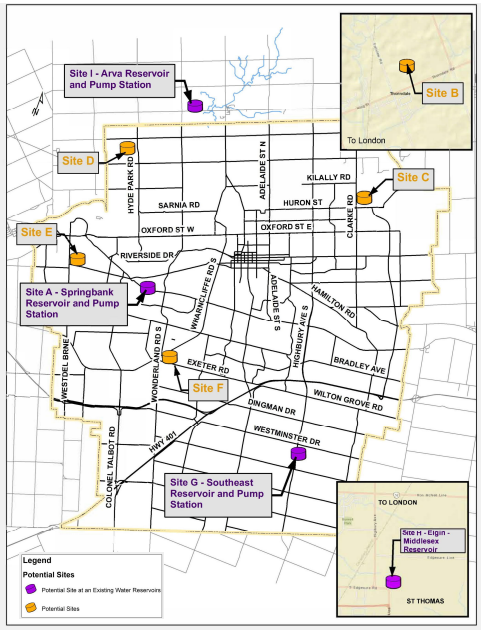
- **Socio-Economic:** property ownership, impacts to the existing and future use of the property, archaeology and cultural heritage,
- **Natural Environment:** aquatic, terrestrial, source water protection, climate change,
- **Technical Considerations:** hydraulics, energy, transients, operations, infrastructure requirements, ability to meet future growth needs.

A Note About the Do Nothing Alternative:

- Do Nothing is an alternative always considered in the Class EA process.
- No improvements or changes would be undertaken to address current and future water storage requirements.
- Do Nothing represents what would likely occur if none of the alternative solutions were implemented.
- Do Nothing does not address the **Problem and Opportunity Statement** (Board 4) and is evaluated but not considered for the preferred solution or implementation.

Long-List Candidate Locations Evaluation

Impacts	Long-List Candidate Locations								
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Socio-Economic • Property Ownership • Impacts to existing or future land use • Archaeology and Cultural Heritage									
Natural Environment • Aquatic • Terrestrial • Source Water Protection • Climate Change									
Technical Considerations • Hydraulics • Energy • Transients • Operations • Infrastructure requirements • Ability to meet future needs									
Carried Forward for Additional Evaluation	YES	NO	YES	NO	NO	NO	YES	NO	YES



Short-Listed Candidate Locations (see Board 7)

Legend

- No major issues
- Minor to moderate issues
- Likely significant issues

Short-Listed Candidate Sites

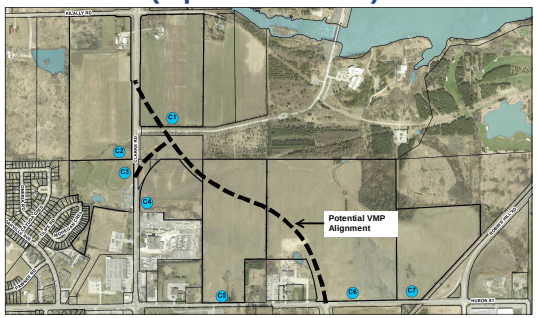
These are the 4 Short-Listed Candidate Locations. Within 2 of these locations, multiple sites were identified for further assessment.

Site A: Springbank Reservoir (2 potential options)

Site A: Option 1 - Reservoir on Reservoir #2 footprint

Site A: Option 2 - Reservoir adjacent to Reservoir #2 footprint

Site C: City Northeast (7 potential sites)



Site G: Southeast Reservoir (1 potential site)

Site I: Arva Reservoir (1 potential site)

Short-Listed Candidate Sites Evaluation

Step 3: Short-Listed Candidate Sites Evaluation Criteria

The **Short-Listed Candidate Sites** (Board 7) will be further evaluated to determine a recommended site.

Criteria for evaluating the sites will include the following:

- **Social-Economic Environment :** impacts to residents, businesses and the community, impacts to archaeological and built heritage resources,
- **Natural Environment:** impacts to terrestrial and aquatic resources and species, Species at Risk, Source Water Protection and Climate Change,
- **Technical Environment:** technical suitability and constructability, impacts to existing infrastructure and utilities,
- **Economic:** capital and operating costs.

Background Studies

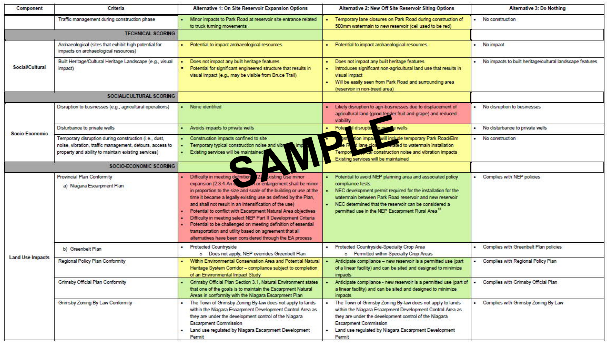
Additional studies will be undertaken that will provide information necessary for the evaluations. This information will be presented at the next PIC, tentatively scheduled for the Fall 2018.

Studies include:

- Natural Environment,
- Archaeological & Cultural Heritage,
- Geotechnical,
- Hydrogeological.

Step 4: Short-Listed Candidate Sites Evaluation Matrix

The Short-List Candidate Sites will be presented in an evaluation matrix to determine the recommended reservoir location.

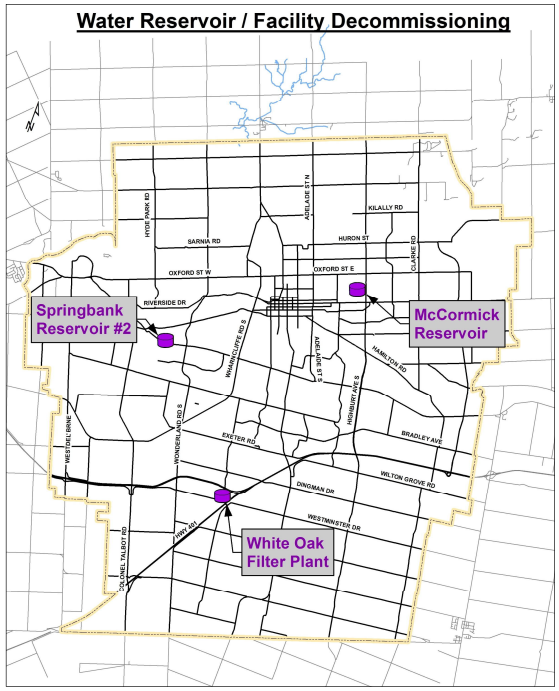


Water Reservoir/Facility Decommissioning

Water reservoir or facility **decommissioning** occurs when a facility is taken out of service or when an 'offline' facility is being physically removed.

As part of this study, the City is considering decommissioning three water facilities to better optimize the overall water system for the City. Each of these facilities have been or will be considered no longer necessary for operational purposes.

Location	Date of Construction	Anticipated End of Service Life	Replacement
Springbank Reservoir #2	1920	2022	Replace capacity at new reservoir (TBD)
McCormick Reservoir	1935	Not in service	No replacement necessary
White Oak Filter Plant	1959	Not in service	New Southeast Pressure Zone



The Municipal Engineers Association Municipal Class EA document defines decommissioning as:

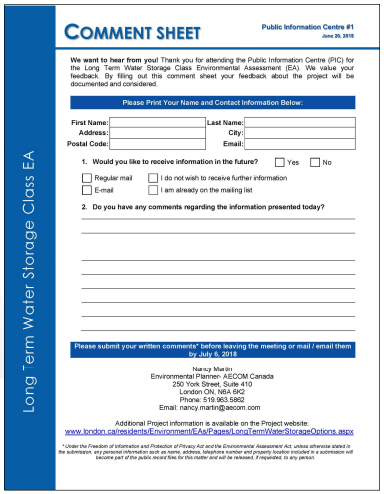
> *'taking out of operation, abandonment, removal, demolition or disposal of a road, sewage, stormwater management or water facility for which approval under the Environmental Assessment Act would have been necessary for its establishment and includes, sale, lease, or other transfer of the facility for purposes of taking out of operation, abandonment, removal, demolition or disposal'.*

Each of the above facilities were constructed prior to the initiation of the *Environmental Assessment Act***,** however, the implementation of each of these projects would have required approval under the Act. As such, it is determined that the decommissioning of each of these facilities is considered an Schedule A+ Class EA undertaking.

Schedule A+ projects require that the public be notified of the work prior to construction or decommissioning occurring.

Next Steps

- Comments received from the general public, stakeholders, the City and Approval Agencies will be considered.
- Candidate Sites will be further evaluated to determine a recommended reservoir location.
- The second public meeting will be held to present the results to the public.
- A report will be prepared and made available for public review for 30 days.
- If no issues are raised within the 30 days review period, the City will proceed to detailed design, approvals and construction.



Long Term Water Storage Class EA

COMMENT SHEET

Public Information Centre #1
June 28, 2018

We want to hear from you! Thank you for attending the Public Information Centre (PIC) for the Long Term Water Storage Class Environmental Assessment (EA). We value your feedback. By filling out this comment sheet your feedback about the project will be documented and considered.

Please Print Your Name and Contact Information Below:

First Name: Last Name:
Address: City:
Postal Code: Email:

1. Would you like to receive information in the future? ☐ Yes ☐ No

☐ Regular mail ☐ I do not wish to receive further information
☐ E-mail ☐ I am already on the mailing list

2. Do you have any comments regarding the information presented today?

Please submit your written comments* before leaving the meeting or mail / email them by July 6, 2018

Nancy Martin
Environmental Planner- AECOM Canada
250 York Street, Suite 410
London ON, N6A 6K2
Phone: 519.963.5862
Email: nancy.martin@aecom.com

Additional Project information is available on the Project website:
www.london.ca/residents/Environment/EAs/Pages/LongTermWaterStorageOptions.aspx

* Under the Freedom of Information and Protection of Privacy Act and the Environmental Assessment Act, unless otherwise stated in the submission, any personal information such as name, address, telephone number and property location included in a submission will become part of the public record files for this matter and will be released, if requested, to any person.

Please remember to drop off your completed comment form before you leave or send it to us before **July 6, 2018**.

Thank You for Attending

- We appreciate the time you have taken to learn more about the Project.
- We value your input to this study and encourage you to stay connected.
- Please visit the City's website: http://www.london.ca/residents/Environment/EAs/Pages/LongTermWaterStorageOptions.aspx
- Join our mailing list: leave us an email or mailing address so we can keep you up-to-date as the project progresses.
- Contact us with additional comments or questions at any time.

Pat Lupton, P.Eng.,
Project Manager - City of London
300 Dufferin Avenue
London ON, N6A 4L9
Tel: 519-661-CITY (2489) x 5613
Email: plupton@london.ca

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Email: nancy.martin@aecom.com

Nancy Martin
Environmental Planner – AECOM Canada
250 York Street, Suite 410
London ON, N6A 6K2

July 2, 2018

Bruce Johnson
Owner, Thamesdale Farms
1511 Clarke Road
London, Ontario
N5V 5B4

Ms. Martin,

Thank you for sharing the information about the long-term water storage needs for the City of London at the public information centre held June 18, 2018. I have the following comments and concerns about the proposed location of a water reservoir.

I am the owner of the licensed dairy farm located at 1511 Clarke Road. If the reservoir was to be located were proposed there would be a negative impact to our current dairy operation. We would have insufficient land to pasture cows, grow feed and grow sweet corn for our established trade. Manure would be spread on the land adjacent to the proposed reservoir and we question if you would be able to meet the minimum distance separation requirements. We are not keen on selling all or part of our land as it has been in our family for over a century.

As a city of London taxpayer, I urge the city to consider placing the reservoir on city owned land along Huron Street as there would not be the capital cost of acquisition incurred. Failing that, consider the east side of Clarke Road which is already owned by speculators. Please also consider the existing Arva pumping station where the city would not have to acquire lands or pumps. Selecting the Arva pumping location for the proposed reservoir would also prevent the city from installing a water reservoir near the ABB plant that had PCB contamination.

Bruce A. Johnson

Long Term Water Storage Class EA

COMMENT SHEET

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June 20, 2018

We want to hear from you! Thank you for attending the Public Information Centre (PIC) for the Long Term Water Storage Class Environmental Assessment (EA). We value your feedback. By filling out this comment sheet your feedback about the project will be documented and considered.

Please Print Your Name and Contact Information Below:

First Name:	Rob	**Last Name:**	Koldenhof
Address:	40-800 Commissioners Rd W	**City:**	London.
Postal Code:	N6K 1C2.	**Email:**	

1. **Would you like to receive information in the future?** ☑ Yes ☐ No

☐ Regular mail ☐ I do not wish to receive further information
☑ E-mail ☐ I am already on the mailing list

2. **Do you have any comments regarding the information presented today?**

Good information. Didn't hear anything that would negatively affect me or the condo development I live in.
Patricia who presented info to me, did a great job.

Please submit your written comments before leaving the meeting or mail / email them by July 6, 2018

Nancy Martin
Environmental Planner- AECOM Canada
250 York Street, Suite 410
London ON, N6A 6K2
Phone: 519.963.5862
Email: nancy.martin@aecom.com

Additional Project information is available on the Project website:
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We use this information for record purposes only. Your personal information will remain confidential in accordance with the *Freedom of Information and Protection of Privacy Act.*

Appendix A.2

Public Information Centre #2

City of London
Long Term Water Storage
Municipal Class Environmental Assessment

NOTICE OF
PUBLIC INFORMATION CENTRE #2

The City of London is supplied with water from the Lake Huron Regional Water Supply System and the Elgin Area Water Supply System. In the event of a disruption or reduction in water supply, and to supply adequate water pressure, the City has reservoirs to maintain uninterrupted service. These reservoirs include the Arva Reservoir and Pump Station, the Springbank Reservoirs and Pump Station, and the Southeast Reservoir and Pump Station. To address future water storage needs, the City is undertaking a Municipal Class Environmental Assessment (EA) study to determine a preferred site (or sites) for additional water storage to meet future growth and ongoing emergency supply and distribution needs. Additionally, this project will consider the feasibility of retiring the existing Springbank Reservoir #2, the McCormick Reservoir, which was disconnected previously, and the White Oak Filter Plant. The City is also considering standby power options for the water distribution pumps at the existing Arva Pump Station as part of this process.

Public Information Centre

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You are invited to attend the PIC to be held:

Date: Wednesday November 28, 2018
Time: 5pm to 7pm
Location: City Hall, 300 Dufferin Avenue, London (Committee Room #1, Second Floor)

Display materials will be available on the City of London website.

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Project Manager,
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Welcome
City of London
Long Term Water Storage

Municipal Class Environmental Assessment
Public Information Centre #2

November 28, 2018

The purpose of this Public Information Centre (PIC) is to:

- Present an overview of the results from PIC #1 (June 2018);
- Summarize the work undertaken since June;
- Present the evaluation of reservoir locations;
- Present the preferred alternatives; and,
- Meet the project team and get your feedback.

Please take a comment form and a pen. As you review the information presented today, we encourage you to ask questions and provide feedback.

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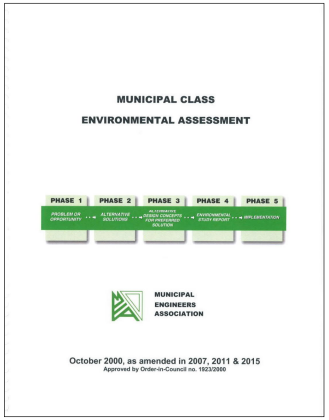

What is the Purpose of this Class EA?

To select a preferred storage location through a comprehensive, environmentally sound planning process that is open to public participation.

Municipal Class Environmental Assessment Process

Phase 1
Identify the Problem and Opportunity Statement

See Board 3

Phase 2
Identify Alternative Solutions to address the Problem and Opportunity Statement

See Boards 4-12

WE ARE HERE

Phase 3
Identify Alternative Design Concepts

Phase 4
Prepare Environmental Study Report

Schedule 'C' Projects Only

Phase 5
Implement the Solution

See Board 13

Problems and Opportunities

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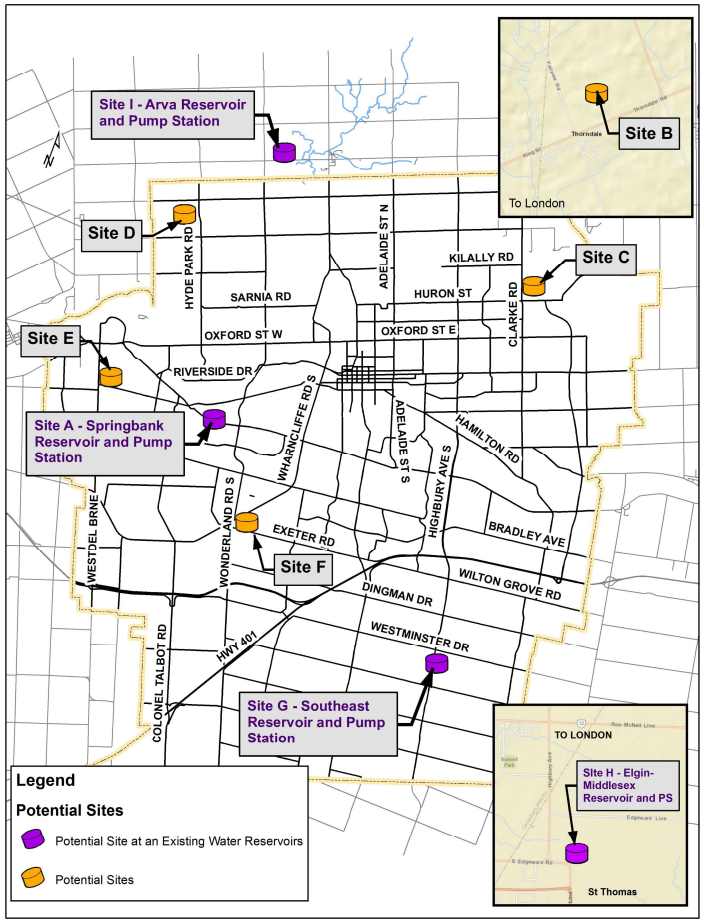
This Class EA study will examine opportunities to address these issues and determine a preferred solution for future water storage that will contribute to the overall City water system to meet daily operation and emergency needs, to meet future growth.

PIC #1 Summary

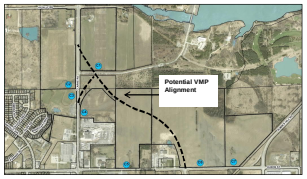
The Long List of Candidate Reservoir Locations (9) were evaluated and reduced to a Short List of Candidate Reservoir Locations (4).

Within 2 of these locations (Site A and Site C), multiple sites were identified.



Site A: Option 1 – Reservoir on top of and adjacent to the Reservoir #2 footprint

Site A: Option 2 - Reservoir adjacent to the Reservoir #2 footprint



Site C: City Northeast (7 potential sites)

Site G: Southeast Reservoir (1 potential site)

Site I: Arva Reservoir (1 potential site)

Natural Heritage, Archaeology and Cultural Heritage

Natural Heritage

- A preliminary background review was conducted to identify existing natural heritage features at the four candidate sites. Species at Risk (SAR), Species of Conservation Concern (SOCC) and relevant Official Plan Schedules outlining natural heritage land use designations were utilized to inform the review. (See boards 8-9 for results and rankings)

- Previous reports undertaken by AECOM within the study area were also used and include:
    - *North Huron Subject Land Status Report (AECOM, 2015)*
    - *Southeast Reservoir Subject Lands Status Report (Earth Tech Canada Inc., 2004)*
    - *Southeast Reservoir & Pumping Station Environmental Impact Study (Earth Tech Canada Inc, 2005)*

Archeology

- A preliminary background review was conducted to document the archaeological and land use history as well as the existing conditions at the four candidate sites. Data sources included recent historical maps, previous archaeological assessments, The Ministry of Tourism Culture and Sport's and Ontario Heritage Trust Databases and the City of London's heritage register mapping. (See board 8 for results and rankings)

Cultural Heritage

- A preliminary background review was conducted to determine whether the four candidate sites have the potential to impact cultural heritage resources. Data sources included the City of London's Inventory of Heritage Properties, Ontario Heritage Trust's online inventory, the Canadian Register of Historic Places and the Directory of Federal Heritage Designations. (See board 8 for results and rankings)

Geotechnical and the Evaluation of Long Term Storage Requirements

Geotechnical

- A background review was conducted to document the historical geotechnical and hydrogeological data obtained during various field investigations completed. Reports completed in the vicinity of the proposed locations were referenced to establish location suitability. (See boards 9 for results and rankings)

Evaluation of Long Term Storage Requirements

- A preliminary background review was conducted to review and confirm system design criteria, such as minimum pressures under emergency supply conditions as well as storage sizing criteria, in general and for future growth. Available storage, estimates for storage capacity requirements for each design year and potential storage locations and configurations were also identified. An analysis of the results for each alternative storage site was completed. (Boards 10-11 outline the results and rankings)

- Previous reports reviewed by AECOM within the study area were also used and include:
  - *2002 Water Supply Reliability Assessment, Final Report (Dillon, 2002)*
  - *2008 City of London Water Master Plan Update (City of London, 2008)*
  - *2014 City of London Water Master Plan Update (City of London, 2014)*
  - *Elgin Area Primary Water Supply System – 2008 Water Master Plan Update (Delcan, 2010)*
  - *Lake Huron Primary Water Supply System – 2008 Water Master Plan Update (Delcan, 2010)*
  - *City of London InfoWater hydraulic model (AECOM, 2014)*

Evaluation Framework and Criteria

A qualitative evaluation was undertaken for the evaluation of alternatives based on the reports presented on Boards 5 and 6. Table 1 summarizes the criteria and measures including environmental components that address the broad definition of the environment as described in the Environmental Assessment Act, used for evaluation purposes, to assist in determining the best possible solution.

Evaluation of Long Term Storage Requirements

- A detailed assessment of each short listed alternative solution was completed based on the previously described evaluation components and criteria. The evaluation approach used to consider the suitability and feasibility of alternative solutions for the study was a qualitative assessment. In this evaluation approach, trade-offs consider the advantages and disadvantages of each alternative to address the problem and opportunity statement with the least environmental effects and the most technical benefits for relative comparison between alternatives. This formed the rationale for identification of the preferred alternative.

- A comprehensive evaluation in a matrix format was prepared and used to present the evaluation of alternative solutions as shown in Boards 8 - 12.

Table 1 – Evaluation Framework

Category	Criteria	Indicator
Public Health	Long/short Term Impacts	• Noise quality • Air quality
Social and Cultural Evaluation	Property Impacts and Acquisition	• Need for Land Purchase in part or in whole
	Residential Land Use	• Potential long or short-term impacts to surrounding neighbourhoods/land use - due to project and/or construction
	Built and Cultural Heritage Resources	• Potential impacts to built and cultural heritage resources
Natural Environment	Terrestrial	• Potential Effects on flora, fauna and associated habitat. • Potential Effects to Species at Risk (SAR).
	Aquatic	• Number and nature of water crossings, including upgrade requirements. • Potential Effects on aquatic species and associated habitat. • Potential Effects to Aquatic SAR.
	Ground and Surface Water	• Impacts to water quality
Engineering	Hydraulics	• Ability to service northeast London
	Energy Optimization	• Optimizes Energy use and transient protection • Need for booster pumping and backup power
	Operations Improvement	• Ease of normal system operation, water turnover and quality.
	Infrastructure	• Use of existing infrastructure • Distribution routing/ New Water System infrastructure
	Climate	• Water supply source and system/ climate resilience
Economic and Financial	Operating Costs	• Total project costs (design and construction) • Operating and Maintenance Costs • Land Costs

Impact Criteria	Indicators	Reservoir Location				
		Site A Vicinity of Existing Springbank Reservoir and PS		Site C North East System: Clarke Road and Huron Road Area	Site G Existing Southeast Reservoir and PS	Site I Existing Arva Reservoir and PS
		A1	A2			
Public Health and Safety	Long/Short Term Impacts due to air and noise quality	-Little to no change from existing for long term. Some impacts due to construction given residential proximity	-Some change from existing for long term with impacts due to construction in closer proximity to residents.	-Some change from existing in long term and due to construction subject to which of 7 sites is chosen. -More significant for those options closer to existing residences.	-No change from existing in long term or due to construction in short term due to remote location.	-No change from existing in long term. -Some impacts due to construction in short term given proximity to some nearby residences.
						
Public Health and Safety Evaluation Summary						
Social and Cultural	Need for Land Purchase in part or in whole	-City owned land for purpose, currently used as open space.	-City owned land for purpose, but currently used as open space.	-Some City owned land with some sites having to be purchased. -Land Intended for industrial or residential development.	-City owned land ready for purpose.	-Outside of City boundary but is owned by the Regional Water System with London being the major user. (Potential to provide land at no low cost if the decision is to have storage here to optimize the City's water supply). -Currently used as open space.
						
	Potential long or short term impacts to surrounding neighbourhoods/land use – due to project and/or construction.	-Impact to existing due to: loss of open space that can be replaced in part; reservoir closer to residences and higher slopes; Infrastructure work across Commissioners Road impacts roadway and the work onsite is closer to existing residences.	-Impact to existing due to: loss of open space; reservoir much closer to residences; and even higher slopes; Infrastructure work across Commissioners Road impacts roadway and the work onsite is much closer to existing residences.	-Impact to existing residents/businesses and land use (now and/or future), which could be mitigated to some extent based on which of 7 locations chosen. -Impacts to City's industrial land strategy by reducing available land. - New site requires extensive work on Clarke road for inlet/outlet, watermains, construction and permanent access.	-No impacts to surrounding land uses. -No impacts to existing residences/businesses. -Minimal construction impact given all works are setup for the site and it is well away from existing residents.	-Minor impacts to existing area and/or land use with nearest residence being greater than 300m away from a potential expansion, which is a more than adequate buffer. -Minimal impact due to construction to nearby residences. Available site with no road works other than increased construction traffic.
						

Low Impact is considered preferred compared to moderate or high impact.

Legend	Low Impact	Low to Moderate Impact	Moderate Impact	Moderate to High Impact	High Impact	Most Preferred
						

Impact Criteria	Indicators	Reservoir Location				
		Site A Vicinity of Existing Springbank Reservoir and PS		Site C North East System: Clarke Road and Huron Road Area	Site G Existing Southeast Reservoir and PS	Site I Existing Arva Reservoir and PS
		A1	A2			
	Potential impact to archaeological / heritage resources. (2)	-Moderate impact – Stage 1 archaeological work completed, requires Stage 2 study. -CHER or HIA may be required to fully evaluate cultural heritage impacts.	-Moderate impact – Stage 1 archaeological work completed, requires Stage 2 study. -CHER or HIA may be required to fully evaluate cultural heritage impacts.	-Slight impact – Stage 1 archaeological work completed for the most part except for 2 sites. -Depending on the site chosen, CHER or HIA may be required to fully evaluate cultural heritage impacts.	-No impact. Stage1 /2 archaeological work completed. -CHER or HIA may be required to fully evaluate cultural heritage impacts.	-Low to Moderate impact, archaeological potential with Stage 1/2 required. -No Cultural Heritage impacts.
Social and Cultural Evaluation Summary						
Natural Environment (3)	Terrestrial – ecological impacts resulting from removal or damage to vegetation and trees (Species at Risk).	- Woodland is a total of 9.77 hectares of which ~0.70 ha will be potential affected by proposed works. - Approximately 35 trees may be affected to extend the reservoir to the east into existing open space area.	- Woodland is a total of 9.77 hectares of which ~1.25 ha will be potential affected by proposed works. - Approximately 80 trees may be affected to extend the reservoir to the east into existing open space area. - More green space and natural areas impacted.	- Candidate sites primarily agricultural, however, unevaluated wetlands and woodlands are present. Any proposed facility should be kept away from wetlands/woodlots of significant value. If not, additional assessment and mitigation work is required. - Park impacts for 1 potential site.	- Natural Feature is approximately 15 hectares in size, with approximately 1.56 ha falling within the study area. Low amount of impact based on Natural Heritage review and that proposed works can be implemented without impacts to the wooded area already allowed for by previous assessments and work.	- Natural Feature is approximately 14 ha with 1.29 ha falling within the study area. Least amount of impact based on Natural Heritage review and that proposed work can be implemented without impacts to woodland areas; however, the boundary of the existing woodland would need to be confirmed through field investigations.
	Impacts to Wildlife (Species at Risk)	- Potential impacts to 18 SAR Of these, 15 (10 Endangered (END), 5 Threatened (THR)) are protected under the *Endangered Species Act* (2007). The other 3 species are listed as Species of Conservation Concern (SCC) and do not have any permitting implications.	- Potential impacts to 18 SAR Of these, 15 (10 END, 5 THR) are protected under the *Endangered Species Act* (2007). The other 3 species are listed as SCC and do not have any permitting implications.	- Potential impacts to 20 SAR Of these, 11 (5 END, 6 THR) are protected under the *Endangered Species Act* (2007); The other 9 species are considered SCC and do not have any permitting implications.	- Potential impacts to 13 SAR Of these, 8 (5 END, 3 THR) are protected under the *Endangered Species Act* (2007). The other 5 species are considered SCC and do not have any permitting implications. - Potential impacts are limited to 3 SAR cultural meadow species (3 THR) based on the proposed reservoir footprint. - Some impacts for 9 SAR were pre-assessed and mitigated during the Subject Land Status Report (Earth Tec, 2004).	- Potential impacts to 11 SAR Of these, 10 (5 END, 5 THR) are protected under the *Endangered Species Act* (2007). The other 1 species is considered SCC and does not have any permitting implications. - Potential impacts are limited to 5 SAR cultural meadow species (4 THR and 1 SCC) based on the proposed reservoir footprint.

Low Impact is considered preferred compared to moderate or high impact.

Legend	Low Impact	Low to Moderate Impact	Moderate Impact	Moderate to High Impact	High Impact	Most Preferred

Impact Criteria	Indicators	Reservoir Location				
		Site A Vicinity of Existing Springbank Reservoir and PS		Site C North East System: Clarke Road and Huron Road Area	Site G Existing Southeast Reservoir and PS	Site I Existing Arva Reservoir and PS
		A1	A2			
	Aquatic – ecological impacts resulting from construction in or near water with potential to harm aquatic species (watermain crossings, Species at Risk).	- No watercourses were observed within 100 m of the proposed reservoir. There are no anticipated impacts to SAR; however, potential impacts cannot be determined without further study.	- No watercourses were observed within 100 m of the proposed reservoir. There are no anticipated impacts to SAR; however, potential impacts cannot be determined without further study.	- 1 SAR species (THR) was flagged by NHIC during the background review; however, suitable aquatic habitat was not identified during aquatic surveys in within the Site C study area (AECOM, 2015). The Thames River is located approximately 100 metres north of the study area and contains SAR. - Impacts cannot be determined without further study. A moderate impact will be assumed until proposed reservoir footprints are established.	- A small portion of Perl Drain was identified in the southwest corner of the study area and therefore also falls within the KCCA's Regulation Limit. Aquatic SAR were not identified in the 2004 report (Earth Tec, 2004). There are no anticipated impacts to SAR. - Impacts cannot be determined without further study, however they are less likely given the proposed location of the reservoir.	- 1 SAR species was identified during the NHIC background review; however DFO mapping did not flag any aquatic SAR species. There are no anticipated impacts to SAR species. - Impacts cannot be determined without further study; however, they are less likely given the proposed location of the reservoir.
	Impacts to ground/surface water quality (1)	- Minimal ground or surface water impacts but should be confirmed given soil type / groundwater conditions in the area.	- Minimal ground or surface water impacts but should be confirmed given soil type / groundwater conditions in the area.	-Higher ground and/or surface water impacts subject to the preferred site location of the 7 options.	-No groundwater/surface water quality impacts. Already addressed as part of initial facility construction and allowance for expansion.	-Minimal ground or surface water impacts anticipated. Subject to onsite confirmation at later project stages. -Water ponds onsite/adjacent to site due to poor drainage currently being addressed by adjacent landowners.
Natural Environment Summary						
Technical Considerations (4)	**Ability to service northeast London (Hydraulics)**	-Does not improve operation and pressure under peak/emergency response in NE London, but maintains water supply above minimum MOEC pressures.	-Does not improve operation and pressure under peak/emergency response in NE London, but maintains water supply above minimum MOEC pressures.	-Best addresses systemic operation and peak/emergency response and hydraulic issues in NE London.	-Does not improve operation and peak/emergency response in NE London.	-Addresses system operation and peak/emergency response hydraulics issues in NE London for the most part.

Low Impact is considered preferred compared to moderate or high impact.

Legend	Low Impact	Low to Moderate Impact	Moderate Impact	Moderate to High Impact	High Impact	Most Preferred

Impact Criteria	Indicators	Reservoir Location				
		Site A Vicinity of Existing Springbank Reservoir and PS		Site C North East System: Clarke Road and Huron Road Area	Site G Existing Southeast Reservoir and PS	Site I Existing Arva Reservoir and PS
		A1	A2			
	Optimizes Energy use and transient protection	-No improvement or detriment to transient protection under peak/emergency conditions. Much reduced energy costs due to gravity feed and somewhat improved operations with the Arva PS.	-No improvement or detriment to transient protection under peak/emergency conditions. Much reduced energy costs due to gravity feed and somewhat improved operations with the Arva PS.	-Decreased transient protection with increased energy needs (highest of all the alternatives)	-No improvement or detriment to transient protection or increase in energy costs but pumping intensive.	-No improvements or detriment to transient protection but pumping intensive. Energy costs can be optimized at PS with storage in place.
	Operational Improvement (ease of normal system operation, water turnover and quality)	-No significant improvement or detriment to existing operations. Longer water residence time necessitating operational changes at the Arva PS. Gravity based operation.	-No significant improvement or detriment to existing operations. Longer water residence time necessitating operational changes at the Arva PS. Gravity based operation.	-Water system operation more complex with a 4th major reservoir and PS. Maintains water quality but increases water turnover necessitating Arva PS operational changes.	-No significant improvement or detriment to existing operations. New storage not fully utilized and reliant on Elgin water supply expansion. Additional pumping capacity required.	-No significant improvement or detriment to existing City water operations, with improved potential for Regional Water Supply for filling. Maximizes new reservoir volume use with pumping capacity optimized.
	Use of existing infrastructure	-Replaces existing 50ML being retired. An additional 50ML can be constructed on available land and connected to the existing reservoir with some height and slope issues.	-Replaces existing 50ML being retired. An additional 50ML can be constructed on available land and connected to the existing reservoir with greater height, proximity and slope issues.	-New greenfield, land to be purchased and revised land use for City owned. -Does not maximize use of existing infrastructure.	-Existing infrastructure already in place as facility is designed for 113 ML expansion. Additional pumping capacity required.	-Connecting to existing reservoir on existing land for purpose.
	Need for booster pumping and backup power.	-No PS or backup power required (gravity system).	-No PS or backup power required gravity system).	-Yes, a new PS and backup power is required.	-No new PS or backup power is required but additional pumping capacity is needed.	-No new PS or pumping capacity is required, but emergency backup power is needed to access full reservoir capacity.
	Distribution routing / New Water System infrastructure	-Interconnection to existing PS and Reservoirs only.	-Interconnection to existing PS and Reservoirs only.	-New infrastructure and connections required to the Clarke Road watermain.	-No new infrastructure required.	-Interconnection to existing PS and Reservoir only.

Low Impact is considered preferred compared to moderate or high impact.

Legend	Low Impact	Low to Moderate Impact	Moderate Impact	Moderate to High Impact	High Impact	Most Preferred

Impact Criteria	Indicators	Reservoir Location				
		Site A Vicinity of Existing Springbank Reservoir and PS		Site C North East System: Clarke Road and Huron Road Area	Site G Existing Southeast Reservoir and PS	Site I Existing Arva Reservoir and PS
		A1	A2			
	Water Supply Source and System/Climate Resilience	Lake Huron supply, gravity based servicing to all of London under all conditions. Lowest climate impacts.	Lake Huron supply, gravity based servicing to all of London under all conditions. Lowest climate impacts.	Lake Huron supply for NE London only. New infrastructure and pumping required with backup power for emergency operations. Increased climate impacts.	Lake Erie supply for SE London, with infrastructure and backup power in place for pumped operations. Current storage necessitates additional supply from Lake Erie. Greatest impact to climate.	Lake Huron supply with pump based operations to the entire City. Backup power required for improved emergency operations to that currently available, with some climate impacts.
						
Technical Considerations Evaluation Summary						
Economic and Financial	Capital and Land Costs	- Lowest capital cost with no land cost.	- 3rd Lowest capital cost but with no land cost.	-2nd Highest capital and land costs of all alternatives.	-Lowest capital cost of all alternatives with no land costs. -However necessitates Elgin Water system expansion at highest cost.	-2nd lowest capital cost with no land cost and some potential capital cost that could be mitigated with Regional Water Supply.
						
	Operating Costs	-Lowest operating cost.	-Lowest operating cost.	-Highest operating cost.	-3rd lowest operating cost.	-2nd lowest operating.
						
Economic and Financial Evaluation Summary						
Overall Summary / Recommendation						

Notes:

(1) Geotechnical and Hydrogeotechnical Summary (October 2018)
(2) Water Storage Options EA – Draft Preliminary Background Review – Archaeology /Cultural Heritage (October 2018)
(3) Water Storage Options EA – Draft Preliminary Background Review – Natural Heritage Background Review (October 2018)
(4) Evaluation of Long Term Storage Requirements (October 2017)

Low Impact is considered preferred compared to moderate or high impact.

Legend	Low Impact	Low to Moderate Impact	Moderate Impact	Moderate to High Impact	High Impact	Most Preferred
						

Springbank Reservoir: Site A1

- 100ML of additional storage capacity be implemented at the existing Springbank Reservoir Site (Option A1) by 2024 to replace the existing 45 ML of storage to be retired, and meet storage deficit/growth projections to that point in time as per table 4.1 from the Evaluation of Long Term Storage Requirements Study.

Evaluation of Long Term Storage Requirements
Table 4.1 – Required Storage Capacity – 48 hour Emergency

Year		Demands (ML/d) (1)		Emergency - MDD / ADD (2 days)					
		ADDw	MDD	Required Storage (ML)	Elgin Supply Volume (ML)	Total Supply (ML)	Net Required Storage (ML)	Available Storage (ML)	Storage Surplus (defecit) (ML)
	Existing	133.2	267.3	482.7	80.0	80.0	403	312	-91
0	2014	134.4	269.8	486.9	115.0	115.0	372	312	-60
5	2019	140.1	281.5	507.1	115.0	115.0	392	312	-80
10	2024	145.9	293.3	527.4	115.0	115.0	412	283	-130
15	2029	151.6	304.9	547.4	170.0	170.0	377	283	-95
20	2034	157.4	316.9	568.0	170.0	170.0	398	283	-115
25	2039	163.3	328.9	588.7	170.0	170.0	419	283	-136
30	2044	169.4	341.4	610.2	170.0	170.0	440	283	-157
35	2049	175.8	354.4	632.5	170.0	170.0	462	283	-180
40	2054	182.4	367.8	655.7	170.0	170.0	486	283	-203

Future Storage

- A further 100ML of additional storage capacity to be implemented at the existing Arva Reservoir Site (Option I) by 2044 to meet storage deficit/growth projections to that point in time as per Table 4.1 from the Evaluation of Long Term Storage Requirements Study dated October 2017.
- Additional Storage capacity to be implemented at the existing Southeast Reservoir Site (Option G) once the Elgin Water Supply System treatment and supply capacity is expanded to meet future growth needs in addition to or as part of the further 100ML of additional storage capacity recommended at the Arva Reservoir Site (Option I).

Mitigation

Natural Environment

- Work with the UTRCA/MNRF/DFO/City of London to address potential impacts to natural features.
- Ensure all regulatory requirements to protect the environment are followed.
- Ensure construction occurs outside of the nesting bird window.
- Ensure opportunities to provide a net benefit to ecosystem function be explored.
- Consideration of the London Invasive Plant Management Strategy (Clean Equipment Protocol).

Social Environment

- Access to existing park amenities, businesses, institutions and commercial areas are maintained (where possible) during and after construction.
- Meet with affected property owners during detailed design to explain how and when construction is expected to take place.
- Comply with City of London noise by-law (day time works)
- Provide advanced notification to affected property owners prior to construction, including estimated timing/durations and project contact information for asking questions and requesting information.

Archeological

- A Stage 2 archaeological assessment must be conducted for all lands determined to retain archaeological potential that will be used for construction or that will be subject to ground disturbance.

Economic

- Ensure UTRCA and City resources are allocated effectively.

Restoration

- All disturbed areas will be restored to equal or greater than existing condition.

Monitoring

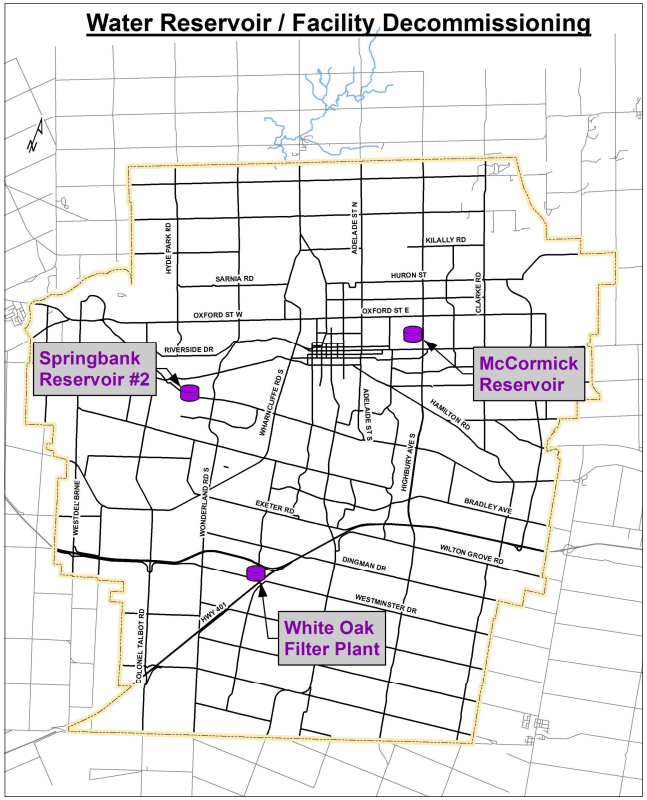
- Monitor post construction performance to ensure effectiveness.
- Take corrective actions as required.

Water Reservoir/Facility Decommissioning

Water reservoir or facility **decommissioning** occurs when a facility is taken out of service or when an 'offline' facility is being physically removed.

As part of this study, the City is considering decommissioning three water facilities to better optimize the overall water system for the City. Each of these facilities have been or will be considered no longer necessary for operational purposes.

Location	Date of Construction	Anticipated End of Service Life	Replacement
Springbank Reservoir #2	1920	2022	Replace capacity at new reservoir (TBD)
McCormick Reservoir	1959	Not in service	No replacement necessary
White Oak Filter Plant	1959	Not in service	No replacement of treatment or reservoir capacities is proposed. Future bulk water facility and chamber for the new Pressure Zone.



The Municipal Engineers Association Municipal Class EA document defines decommissioning as:

> *'taking out of operation, abandonment, removal, demolition or disposal of a road, sewage, stormwater management or water facility for which approval under the Environmental Assessment Act would have been necessary for its establishment and includes, sale, lease, or other transfer of the facility for purposes of taking out of operation, abandonment, removal, demolition or disposal'.*

Each of the above facilities were constructed prior to the initiation of the *Environmental Assessment Act***,** however, the implementation of each of these projects would have required approval under the Act. As such, it is determined that the decommissioning of each of these facilities is considered an Schedule A+ Class EA undertaking.

Schedule A+ projects require that the public be notified of the work prior to construction or decommissioning occurring.

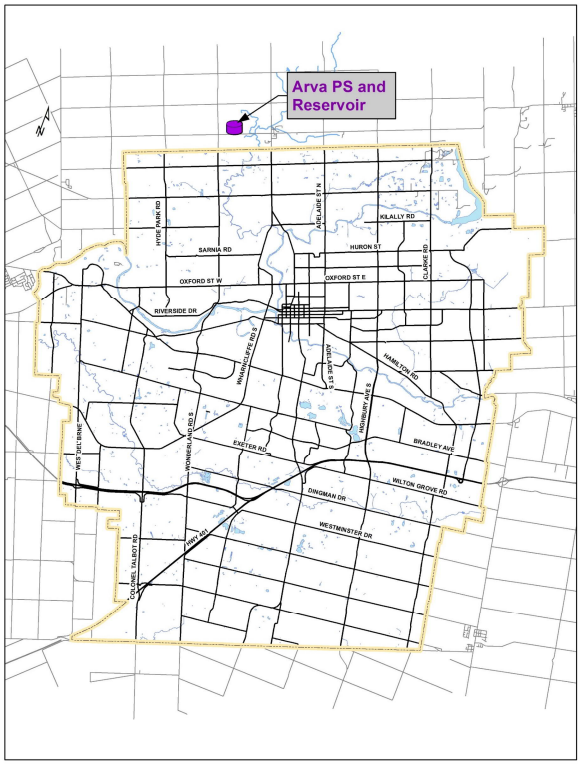
Backup Power – Standby Power Systems

Backup Power or **standby power systems** are needed to ensure pumping can maintain service in the event that primary power supplies fail.

Currently, no backup power supply exists for the Arva PS. In the event of an emergency and/or to service under day to day or peak water need conditions, water supply and minimal pressure would be provided by the Lake Huron Water Supply System to the City of London water system by opening by pass valves at the Arva PS. As part of this study AECOM assessed:

- Dual power supplies from London Hydro and/or Hydro One from separate feeds, complete with the required transmission and/or switchgear infrastructure needed to provide backup power to the Arva PS.
- The provision of a standby generator set in a new or existing structure to provide backup power to the Arva PS.

Both alternatives would allow the Arva PS to meet the City's day to day, peak or emergency needs.



O.Reg. 524/98 Environmental Compliance Approvals defines standby power systems as:

> *"standby power system" means any apparatus, mechanism, equipment or other thing, and any related fuel tanks and piping, that includes one or more generator units and that is intended to be used only for the provision of electrical power during power outages or involuntary power reductions;*

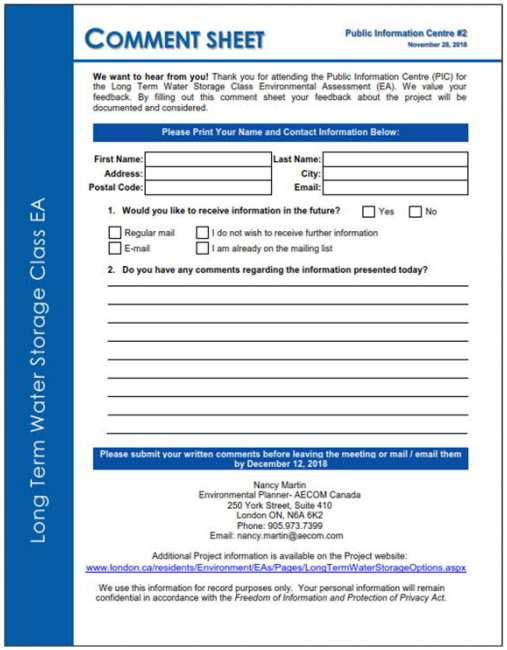
The Arva PS was constructed prior to the initiation of the *Environmental Assessment Act***,** however, the implementation of this project would have required approval under the Act. As such, it is determined that the installation of standby power equipment located in a new building or structure is considered an Schedule A Class EA undertaking. Should the standby power equipment be installed in an existing building the undertaking would be considered a Schedule A+ Class EA.

Schedule A+ projects require that the public be notified of the work prior to construction or decommissioning occurring.

Schedule A projects are preapproved activities whereby the proponent may proceed without following the procedures set out in this Class EA.

Next Steps

- Comments received from the general public, stakeholders, the City and Approval Agencies will be considered.
- The preferred servicing strategy will be confirmed.
- A report will be prepared and made available for public review for 30 days.
- If no issues are raised within the 30 days review period, the City can proceed to detailed design, approvals and construction.



Long Term Water Storage Class EA

COMMENT SHEET

Public Information Centre #2
November 28, 2018

We want to hear from you! Thank you for attending the Public Information Centre (PIC) for the Long Term Water Storage Class Environmental Assessment (EA). We value your feedback. By filling out this comment sheet your feedback about the project will be documented and considered.

Please Print Your Name and Contact Information Below:

First Name: Last Name:
Address: City:
Postal Code: Email:

1. Would you like to receive information in the future? ☐ Yes ☐ No

☐ Regular mail ☐ I do not wish to receive further information
☐ E-mail ☐ I am already on the mailing list

2. Do you have any comments regarding the information presented today?

Please submit your written comments before leaving the meeting or mail / email them by December 12, 2018

Nancy Martin
Environmental Planner- AECOM Canada
250 York Street, Suite 410
London ON, N6A 6K2
Phone: 905.973.7399
Email: nancy.martin@aecom.com

Additional Project information is available on the Project website:
www.london.ca/residents/Environment/EAs/Pages/LongTermWaterStorageOptions.aspx

We use this information for record purposes only. Your personal information will remain confidential in accordance with the *Freedom of Information and Protection of Privacy Act.*

Please remember to drop off your completed comment form before you leave or send it to us before **December 12 2018**.

Thank You for Attending

- We appreciate the time you have taken to learn more about the Project.
- We value your input to this study and encourage you to stay connected.
- Please visit the City's website: http://www.london.ca/residents/Environment/EAs/Pages/LongTermWaterStorageOptions.aspx
- Join our mailing list: leave us an email or mailing address so we can keep you up-to-date as the project progresses.
- Contact us with additional comments or questions at any time.

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PUBLIC INFORMATION CENTRE REGISTRY

Long Term Water Storage
Class Environmental Assessment
Public Information Centre #2
November 28, 2018

Please sign in. We use this for record purposes only. Your personal information will remain confidential in accordance with the *Freedom of Information and Privacy Protection Act*. **If you would like to be added to our mailing list, please provide your contact information on a Comment Form.**

Name (Printed)	Signature
Bob Free	
Jason Jordan	
Maureen Zunti	

To be added to the project mailing list, please provide your contact information on a **Comment Form.**

Long Term Water Storage Class EA

AECOM

London CANADA

Appendix A.3

Notice of Completion

Appendix A.4

Agency Correspondence

Ministry of the Environment and Climate Change

733 Exeter Road
London ON N6E 1L3
Tel': 519 873-5000
Fax: 519 873-5020

Ministère de l'Environnement et de l'Action en matière de changement climatique

733, rue Exeter
London ON N6E 1L3
Tél.: 519 873-5000
Fax: 519 873-5020

Ontario

June 8th, 2018

Corporation of the City of London
300 Dufferin Avenue
London, Ontario
N6A 4L9

Attention: Ms. Patricia Lupton, Project Engineer

Re: MOECC Response To Notice of Commencement and Public Information Centre #1, Long Term Water Storage, Municipal Class Environmental Assessment

Dear Ms. Patricia Lupton:

This letter acknowledges this ministry's receipt of the Notice of Commencement and Notice of Public Information Centre #1, for the City of London's Long Term Water Storage Municipal Class Environmental Assessment.

It is this ministry's understanding that the City of London is undertaking this Municipal Class EA to determine a preferred site (or sites) for additional water storage to meet future growth and ongoing emergency supply and distribution needs. Additionally, this project will reportedly consider the feasibility of retiring the existing Springbank Reservoir #2 and the McCormick Reservoir disconnected previously, as well as options for standby power for the water distribution pumps a the existing Arva Pump Station.

Source Water Protection

As per the recent amendments to the Municipal Engineers Association (MEA) Class Environmental Assessment parent document approved October 2015, proponents undertaking a Municipal Class EA project must identify early in the process whether a project is occurring within a source water protection vulnerable area. This must be clearly documented in a Project File report or ESR. If the project is occurring in a vulnerable area, then there may be policies in the local Source Protection Plan (SPP) that need to be addressed (requirements under the Clean Water Act). The proponent should contact and consult with the appropriate Conservation Authority/Source Protection Authority (CA/SPA) to discuss potential considerations and policies in the SPP that apply to the project.

Please include a section in the report on Source Water Protection. Specifically, it should discuss whether or not the project is located in a vulnerable area or changes or creates new vulnerable areas, and provide applicable details about the area. If located in a vulnerable area, proponents should document whether any project activities are a prescribed drinking water threat and thus pose a risk to drinking water (this should be consulted on with the appropriate CA/SPA). Where an activity poses a risk to drinking water, the proponent must document and discuss in the Project File Report/ESR how the project adheres to or has regard to applicable policies in the local SPP. If creating or changing a vulnerable area, proponents should document whether any

existing uses or activities may potentially be affected by the implementation of source protection policies. This section should then be used to inform and should be reflected in other sections of the report, such as the identification of net positive/ negative effects of alternatives, mitigation measures, evaluation of alternatives etc. As a note, even if the project activities in a vulnerable area are deemed not to be a drinking water risk, there may be other policies that apply and so consultation with the local CA/SPA is important.

Climate Change

The Municipality is strongly encouraged to include climate change in this EA. Climate change should be considered in the context of mitigation and the context of adaptation. The Ministry has recently released a guidance document to support proponents in including climate change in environmental assessments. The guide can be found online:

https://www.ontario.ca/page/considering-climate-change-environmental-assessment-process

It should be noted that Climatic Features are identified in Appendix 2 of the Municipal Class EA page 2-7 (2015).

Conclusion

Thank you for the opportunity to comment on this project. Please keep this office fully informed of the status of this project as it proceeds through the Class EA process.

Please send all future correspondence with respect to this project to my attention, as I am this ministry's one window contact for this project: Craig Newton, Regional Environmental Planner / Regional EA Coordinator at the address below; email address:craig.newton@ontario.ca; telephone number: 519-873-5014.

A draft copy of the Environmental Study Report should be forwarded to my attention prior to the filing of the final report, allowing a minimum of 30 days for the ministry's technical reviewers to provide comments. Please also forward the Notice of Completion and final ESR to me when completed. Thank you in advance.

Yours truly,

Craig Newton
Regional Environmental Planner / Regional EA Coordinator
Ministry of Environment and Climate Change
733 Exeter Road
London ON, N6E 1L3
519 873-5014

Copy: Ms. Nancy Martin, Environmental Planner, AECOM Canada, London.
Mr. Rob Wrigley, District Manager, MOECC London District
Mr. Adam Grant, Acting Supervisor, Safe Drinking Water Branch, MOECC London District
Mr. Neville Rising, Drinking Water Inspector, Safe Drinking Water Branch, MOECC London District

Martin, Nancy

From:	Lupton, Patricia <PLUPTON@London.ca>
Sent:	Wednesday, June 27, 2018 2:32 PM
To:	Henderson, Mark; Warner, Bill; McIntosh, Chris
Cc:	Baar, Bryan; Rozentals, Aaron; Haasen, John; Martin, Nancy; Awde, Neil; Morris, Michelle; Koshowski, Scott; Simon, John
Subject:	RE: PIC#1 Final

Mark,

Thank you for the information you provided regarding the City's Industrial Land Development Strategy (ILDS) and land use zoning in the Clarke Road/Huron Street/VMP area, and expressing your concerns regarding the supply availability and marketability of these lands.

Whether Area C (the Clarke Road/Huron Street/VMP area) is a viable alternative (or not) for the 100ML of storage capacity required by 2025, or for a further 100ML required by 2054, will be determined as part of the next step of the Class EA process as we complete the socio-economic, natural environment and technical review aspects for each area and assess each comparatively to identify a preferred (or number of preferred), alternatives. Your comments will be considered as part of this assessment.

If Area C is a viable alternative moving forward, then one of the sites within Area C would be identified based on a comparative assessment of socio-economic, natural environment and technical considerations including land use and market availability concerns. We would point out the need for the additional storage is three fold:

1. Replace storage to be decommissioned at the Springbank Reservoirs (45ML)
2. Provide additional storage for short term growth needs (100ML by 2025), and long term growth needs by 2054 (another 100ML) for flow balancing, fire protection and emergency response conditions (48 hr. supply impact from Lake Huron); and
3. Area C is being considered because of historical pressure and volume issues in the North east London area.

It is appropriate to consider all potential sites in the area. As a result of our last discussion we revised the sites to be considered to include private properties in the area, including 1588 and 1511 Clarke Road as well as a property owned by Brantam Excavating Inc., and the Ted Early Sports Complex. At this time it is appropriate to consider all possible sites, and have options in the event that negotiations with individual land owners are necessary. It is very difficult to have a negotiation with a private land owner if City owned lands are not considered.

As a result, the City owned industrial land site alternatives should not be taken out of consideration at this time until our Class EA work progresses.

We would be more than happy to meet with you during this next stage of the process and in advance of determining preferred alternatives in the area (f a preferred location), in the fall before further public review if of ongoing concern to you and the ILDS.

Pat

From: Henderson, Mark
Sent: Thursday, June 21, 2018 10:29 AM
To: Lupton, Patricia <PLUPTON@London.ca>; Rozentals, Aaron <arozenta@london.ca>
Cc: Baar, Bryan <bbaar@london.ca>; McIntosh, Chris <cmcintosh@london.ca>; Warner, Bill <biwarner@london.ca>
Subject: RE: PIC#1 Final

Pat and Aaron,

As noted at our meeting June 13/18, the Industrial Land Development (ILD) team does not support the reservoir being located on City owned industrial lands anywhere in the City.

In particular we do not support the reservoir being located in the Huron/VMP area as noted on Board 7, Site C.

As you are aware Council has directed the ILD to implement the Industrial Land Development Strategy which is supported by the Official Plan, Strategic Plan, Economic Road Map… which means we must have an adequate supply of pre-zoned and serviceable land that is zoned Light/Heavy and General Industrial.

The Huron/VMP lands are zoned Heavy and General Industrial and are very marketable and in high demand - we simply can't take them off the market.

It is the ILD teams preference that these lands not be included in the PIC.

Regards,

Mark Henderson
Director, Business Liaison
Industrial Land Development Strategy
Development and Compliance
City of London

300 Dufferin Ave. P.O. Box 5035, LONDON, ON., N6A 4L9
P: 519.661.CITY (2489) x 5992 | Cell: 519.619.0863 | Fax: 519.661.4981
mhenders@london.ca | www.london.ca

From: Lupton, Patricia
Sent: Thursday, June 21, 2018 9:52 AM
To: Henderson, Mark <mhenders@London.ca>; Warner, Bill <biwarner@london.ca>; McIntosh, Chris

<cmcintosh@london.ca>
Cc: Baar, Bryan <bbaar@london.ca>
Subject: FW: PIC#1 Final

This information will be posted shortly to the City of London Website, but please find attached for your information the display boards and comments sheets for the
City of London Long Term Water Storage Options Environmental Assessment.
Board 7 which which displays the Short-Listed Candidate Sites, and Site C:city Northeast may be of particular interest.

Bryan – fyi only– notices were provided to property owners wrt Site C. Which is also in the vicinity of the Clark Road and VMP Road works projects.

From: Martin, Nancy [mailto:Nancy.Martin@aecom.com]
Sent: Thursday, June 21, 2018 9:28 AM
To: Lupton, Patricia <PLUPTON@London.ca>
Subject: PIC#1 Final

Hi Pat

Here is the material from our meeting last night to be added to the project website.

Thanks

Nancy Martin
Environmental Planner, Environment
D +1-519-963-5862
nancy.martin@aecom.com

AECOM
250 York Street, Citi Plaza
Suite 410
London, ON N6A 6K2, Canada

45 Goderich Road, Suite 201
Hamilton, ON L8E 4W8, Canada
aecom.com

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P.O. Box 5035
300 Dufferin Avenue
London, ON
N6A 4L9

June 27, 2018

G. Kotsifas
Managing Director, Development and Compliance Services and Chief Building Official

M. Corby
Senior Planner

P. Lupton
Environmental Service Engineer

I hereby certify that the Municipal Council, at its meeting held on June 26, 2018 resolved:

That the following actions be taken with respect to the 7th Report of the London Advisory Committee on Heritage from its meeting held on June 13, 2018:

a) on the recommendation of the Managing Director, Planning & City Planner, with the advice of the Heritage Planner, the following actions be taken with respect to the request for demolition of the heritage listed property located at 2154 Richmond Street:

i) the Chief Building Official BE ADVISED that Municipal Council consents to the demolition of this property;

ii) 2154 Richmond Street BE REMOVED from the Register (Inventory of Heritage Resources);

iii) the property owner BE REQUESTED to commemorate the historic contributions of the McCormick-Brickenden-Greenway family in the future development of this property; and,

iv) the property owner BE REQUESTED to salvage any materials that have architectural value during the demolition process;

it being noted that the presentation appended to the 7th Report of the London Advisory Committee on Heritage from K. Gonyou, Heritage Planner, as well as the verbal delegation from P. Hinde, Tridon Group, with respect to this matter, were received;

b) M. Corby, Senior Planner, BE ADVISED that the London Advisory Committee on Heritage does not support the conclusions of the Heritage Impact Statement, dated April 2018, with respect to the property located at 147 Wellington Street, for the following reasons:

- the lack of compatibility and sympathy with the adjacent heritage listed and designated properties with respect to setback, material and design, particularly as it relates to the property located at 143 Wellington Street;
- it does not encourage active commercial uses at grade in order to continue to support the historically commercial streetscape; and,
- it does not properly consider the potential cultural heritage value of the on-site building at 147-149 Wellington Street;

The Corporation of the City of London
Office 519.661.2500 x4856
Fax 519.661.4892
hlysynsk@london.ca
www.london.ca

c) P. Lupton, Environmental Service Engineer, City of London and N. Martin, AECOM Canada, BE ADVISED that the London Advisory Committee on Heritage requests the assurance that Cultural Heritage Resources are considered as part of the Environmental Assessment process as it relates to the City of London Long Term Water Storage Municipal Class Environmental Assessment, which should include Stage 1 Archaeological Assessment and a Cultural Heritage Screening Report; and,

d) clauses 1.1, 2.2 to 2.4, 3.1, 3.3, 3.5, 5.1 and 5.2, BE RECEIVED. (5.1/11/PEC)

C. Saunders
City Clerk
/lm

cc. J. Fleming, Managing Director, Planning and City Planner
Chair and Members, London Advisory Committee on Heritage
K. Gonyou, Heritage Planner
L. Dent, Heritage Planner
External cc list in the City Clerk's Office

The Corporation of the City of London
Office 519.661.2500 x4856
Fax 519.661.4892
hlysynsk@london.ca
www.london.ca

Appendix A.5

Indigenous Consultation

Martin, Nancy

From: Lupton, Patricia <PLUPTON@London.ca>
Sent: Thursday, June 07, 2018 3:35 PM
To: Martin, Nancy
Cc: Morris, Michelle
Subject: RE: Long Term Water Storage-Municipal Class Environmental Assessment
Attachments: doc03558120180607144348.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: London Storage

From: Peggy Pyke-Thompson [mailto:peggy.pyke@akwesasne.ca]
Sent: Thursday, June 07, 2018 3:32 PM
To: Lupton, Patricia <PLUPTON@London.ca>
Subject: Fwd: Long Term Water Storage-Municipal Class Environmental Assessment

Good afternoon,

Your project falls outside of Mohawk Council of Akwesasne's area of interest. The location indicated on the maps is much closer to the Oneida of the Thames, Six Nations of the Grand River and to the Chippewa of the Thames. There may be others that I have missed, we are found at the easternmost point of Ontario.

Peggy

From: "Rosemary Square" <rosemary.square@akwesasne.ca>
To: "April Adams-Phillips" <chief.april.adams-phillips@akwesasne.ca>, "Chief Connie Lazore" <chief.connie.lazore@akwesasne.ca>, "Chief Darryl Lazore" <chief.darryl.lazore@akwesasne.ca>, "Chief Dennis Chaussi" <chief.dennis.chaussi@akwesasne.ca>, "Chief Joe Lazore" <chief.joe.lazore@akwesasne.ca>, "Chief Karen Loran" <chief.karen.loran@akwesasne.ca>, "Chief Louise Thompson" <chief.louise.thompson@akwesasne.ca>, "Chief Ryan Jacobs" <chief.ryan.j.jacobs@akwesasne.ca>, "Chief Steve Thomas" <chief.steve.thomas@akwesasne.ca>, "Chief Tim Dooley Thompson" <chief.tim.thompson@akwesasne.ca>, "Chief Troy Thompson" <chief.troy.thompson@akwesasne.ca>, "Chief Vince Thompson" <chief.vince.thompson@akwesasne.ca>, "Grand Chief Abram Benedict" <grand.chief@akwesasne.ca>
Cc: "Jay Benedict" <jay.benedict@akwesasne.ca>, "Joe Francis" <joe.francis@akwesasne.ca>, "Cactus Sunday" <cactus.sunday@akwesasne.ca>, "Henry Lickers" <henry.lickers@akwesasne.ca>, "Peggy Pyke-Thompson" <peggy.pyke@akwesasne.ca>, "Chelsea Francis" <chelsea.francis@akwesasne.ca>, "Adrianne Jacobs" <adrianne.jacobs@akwesasne.ca>, "Kuyra Chaussi"

<kuyra.chaussi@akwesasne.ca>
Sent: Thursday, June 7, 2018 3:02:10 PM
Subject: Long Term Water Storage-Municipal Class Environmental Assessment

---

From: MoGvt-Copier@akwesasne.ca
To: "Rosemary Square" <rosemary.square@akwesasne.ca>
Sent: Thursday, June 7, 2018 2:43:55 PM
Subject: Sent from MoGvt-Copier

TASKalfa 6052ci
[00:17:c8:28:7f:a9]

--
Peggy

Peggy Pyke-Thompson
Environment Program Manager
Mohawk Council of Akwesasne
Tehotiiennawakon--Environment Program
PO Box 90
Akwesasne, QC
H0M 1A0

613 575 2250 ext 1038

Martin, Nancy

From: Hollie Nolan <hollien@ramafirstnation.ca> on behalf of Chief Rodney Noganosh <chief@ramafirstnation.ca>
Sent: Tuesday, June 12, 2018 2:40 PM
To: plupton@london.ca; Martin, Nancy
Subject: re: London Canada – City of London – Long Term Water Storage – Municipal Class Environmental Assessment – Notice of Project Commencement and Public Information Centre 1.

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: London Storage

Dear Pat & Nancy;

Thank you for your letter re: London Canada – City of London – Long Term Water Storage – Municipal Class Environmental Assessment – Notice of Project Commencement and Public Information Centre 1.

Please be advised that we reviewed your letter. I have shared it with Council and we've forwarded the information to Karry Sandy McKenzie, Williams Treaties First Nation Process Co-ordinator/Negotiator. Ms. McKenzie will review your letter and take the necessary action if required. In the interim, should you wish to contact Ms. McKenzie directly, please do so at k.a.sandy-mckenzie@rogers.com

Thank you,

Chief Rodney Noganosh

Hollie Nolan
Executive Assistant to the Chief, Administration
Chippewas of Rama First Nation
(ph) 705-325-3611,1216
(cell)
(fax) 705-325-0879
(url) www.ramafirstnation.ca

Martin, Nancy

From: Lupton, Patricia <PLUPTON@London.ca>
Sent: Monday, November 26, 2018 12:13 PM
To: 'Sharday James'
Cc: Martin, Nancy; McNaughton, Emily; Alikakos, Mary
Subject: RE: Long Term Water Storage

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: London Storage

Thank you for your comments.
We have also contacted First Nations Communities in the area.

From: Sharday James [mailto:shardayj@ramafirstnation.ca]
Sent: Monday, November 26, 2018 12:12 PM
To: Lupton, Patricia <PLUPTON@London.ca>
Subject: Long Term Water Storage

Hello,
Thank you for contacting the Chippewas of Rama First Nation. I am sending this email in regards to a notice we received from you about long term water storage for the City of London. This area is outside our traditional territory and at this time we have no comments regarding this project. I suggest you contact First Nations communities closer to your location for their input.

Thank you,

Sharday James
Community Consultation Worker, Communications
Chippewas of Rama First Nation
(ph) 705-325-3611, 1633
(cell)
(fax)
(url) www.ramafirstnation.ca

CHIPPEWAS OF THE THAMES FIRST NATION

July 5, 2018

Patrcia Lupton, P.Eng.
Water Engineering Division
City of London
300 Dufferin Avenue
London, ON N6A 4L9

RE: Long Term Water Storage
MCEA Notice of Commencement & PIC

Ms. Lupton,

On June 1, 2018, we have received information concerning the abovementioned project. The proposed work will be conducted within the London Township Treaty (1796) area to which Chippewas of the Thames First Nation (COTTFN) is a signatory. The proposed work is also located within the Big Bear Creek Additions to Reserve (ATR) land selection area, as well as COTTFN Traditional territory.

After screening this project, we have identified it to be of moderate concern. At this time, I am requesting further information to the project. Please contact myself at 519-289-5555 ext. 252 or email at rsmith@cottfn.com.

We look forward to continuing this open line of communication. To implement meaningful consultation, COTTFN has developed its own protocols — a document and a process that will guide positive working relationships. We would be happy to meet with you to review COTTFN's Consultation Protocols.

Please do not hesitate to contact me if you need further clarification of this letter.

Sincerely,

Rochelle Smith
A/Consultation Coordinator
Chippewa of the Thames First Nation
(519) 289-5555 Ext. 252
rsmith@cottfn.com

Martin, Nancy

From:	Lupton, Patricia <PLUPTON@London.ca>
Sent:	Thursday, July 19, 2018 4:07 PM
To:	'rsmith@cottfn.com'
Cc:	Martin, Nancy
Subject:	Long Term Water Storage Municipal Class Environmental Assessment
Attachments:	PIC 1 Final Boards.pdf

Rochelle Smith by email

Thank you for your response.
For your information please find attached the information boards presented at the Public meeting held on June 20, 2018. These can also be found on the City of London Website with the following link http://www.london.ca/residents/Environment/EAs/Pages/LongTermWaterStorageOptions.aspx.

The information boards from PIC 1 provide further information relating to:
- the Problem and Opportunity statement for the project,
- identify the Long-List Candidate Locations and Evaluation and screen these sites,
- identify the Short-Listed Candidate Sites which are at this time being considered further, and
Identify the Water Reservoir/Facility Decommissioning proposed.
If you have any questions about this information, I would be pleased to discuss with you further.
Your further comments and input are welcomed.

At this time, the City and it's consultant Aecom are conducting background studies with respect to the Short-Listed Candidate sites. It is anticipated that further information will be available late summer or early fall.

The City would also appreciate the opportunity to receive a copy of the Chippewas of the Thames First Nation Consultation Protocols document indicated in your letter dated July 5, 2018.

Patricia Lupton, P.Eng
Environmental Services Engineer
Water Engineering Division
City of London

300 Dufferin Avenue N5A 4L9
P: 519.661.CITY (2489) x 5613 | Cell: 226.688.7291 | Fax: 519.661.2354
plupton@london.ca | www.london.ca

P.O. Box 5035
300 Dufferin Avenue
London, ON
N6A 4L9

June 27, 2018

G. Kotsifas
Managing Director, Development and Compliance Services and Chief Building Official

M. Corby
Senior Planner

P. Lupton
Environmental Service Engineer

I hereby certify that the Municipal Council, at its meeting held on June 26, 2018 resolved:

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a) on the recommendation of the Managing Director, Planning & City Planner, with the advice of the Heritage Planner, the following actions be taken with respect to the request for demolition of the heritage listed property located at 2154 Richmond Street:

i) the Chief Building Official BE ADVISED that Municipal Council consents to the demolition of this property;

ii) 2154 Richmond Street BE REMOVED from the Register (Inventory of Heritage Resources);

iii) the property owner BE REQUESTED to commemorate the historic contributions of the McCormick-Brickenden-Greenway family in the future development of this property; and,

iv) the property owner BE REQUESTED to salvage any materials that have architectural value during the demolition process;

it being noted that the presentation appended to the 7th Report of the London Advisory Committee on Heritage from K. Gonyou, Heritage Planner, as well as the verbal delegation from P. Hinde, Tridon Group, with respect to this matter, were received;

b) M. Corby, Senior Planner, BE ADVISED that the London Advisory Committee on Heritage does not support the conclusions of the Heritage Impact Statement, dated April 2018, with respect to the property located at 147 Wellington Street, for the following reasons:

- the lack of compatibility and sympathy with the adjacent heritage listed and designated properties with respect to setback, material and design, particularly as it relates to the property located at 143 Wellington Street;
- it does not encourage active commercial uses at grade in order to continue to support the historically commercial streetscape; and,
- it does not properly consider the potential cultural heritage value of the on-site building at 147-149 Wellington Street;

The Corporation of the City of London
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www.london.ca

c) P. Lupton, Environmental Service Engineer, City of London and N. Martin, AECOM Canada, BE ADVISED that the London Advisory Committee on Heritage requests the assurance that Cultural Heritage Resources are considered as part of the Environmental Assessment process as it relates to the City of London Long Term Water Storage Municipal Class Environmental Assessment, which should include Stage 1 Archaeological Assessment and a Cultural Heritage Screening Report; and,

d) clauses 1.1, 2.2 to 2.4, 3.1, 3.3, 3.5, 5.1 and 5.2, BE RECEIVED. (5.1/11/PEC)

C. Saunders
City Clerk
/lm

cc. J. Fleming, Managing Director, Planning and City Planner
Chair and Members, London Advisory Committee on Heritage
K. Gonyou, Heritage Planner
L. Dent, Heritage Planner
External cc list in the City Clerk's Office

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AECOM

Appendix B Background Reports

B.1 Evaluation of Long Term Storage Requirements

B.2 Natural Heritage Background Review

B.3 Archaeological Assessment

B.4 Cultural Heritage Assessment Report

B.5 Geotechnical and Hydrogeological Summary

AECOM

Appendix B.1

Evaluation of Long Term Storage Requirements

Water AECOM

City of London

Evaluation of Long Term Storage Requirements

Prepared by:

AECOM
410 – 250 York Street, Citi Plaza 519 673 0510 tel
London, ON, Canada N6A 6K2 519 673 5975 fax
www.aecom.com

Project Number:

60275661

Date:

October, 2017

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to Consultant which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

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This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2012-01-06

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
	Y	City of London

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	EE	February 29, 2016	Draft Report
2	EE	October 13, 2017	Final Report

AECOM Signatures

Report Prepared By:

Eppo Eerkes, P. Eng.
Senior Hydrotechnical Engineer

Report Reviewed By:

John Haasen, PMP, CET
Senior Vice President

Table of Contents

List of Figures

List of Tables

1. Introduction

The City of London relies on terminal and distribution storage at the Arva, Southeast, Elgin-Middlesex and Springbank Reservoirs. The City requested an evaluation of long term water system storage requirements to satisfy both MOE fire and balancing as well as under an emergency Regional Water Supply interruption. Also, the City is concerned that the existing storage site at Springbank Reservoirs may not effectively supply all portions of the distribution system under an emergency due to its location. Also, we understand that Cell 2 of the Springbank Reservoir is not consistently available and should be assumed to be taken off-line for the analysis. The City's intent is to replace this reservoir by 2023 due to reliability and safety concerns. This cell has a storage volume of 45 ML.

In order to assess the supply hydraulic capability of alternative storage sites, extended period simulations (EPS) of emergency supply scenarios were conducted using the hydraulic model. The hydraulic analysis reviewed emergency supply scenarios to determine the effectiveness of existing and new storage facilities in providing an effective and reliable supply to the system, including critical customers such as hospitals, major industries and dialysis locations.

Previous reports related to storage requirements were reviewed. This included the most recent Water Master Plan Update (WMP), as well as the 2002 Dillon Reliability report [1]. Also, AECOM previously completed an analysis of emergency supply with existing storage and well supply previously. This report was reviewed and updated as part of this work.

The following tasks were conducted:

- Background information review.
- Review and confirm system design criteria, such as minimum pressures under emergency supply conditions (e.g. Huron or Elgin supply off line), in particular for critical customers, as well as storage sizing criteria.
- Determine available storage.
- Estimate storage capacity requirements for each design year.
- Determine potential storage locations and configuration.
- Conduct alternative storage site hydraulic evaluations, including storage supply to the system, normal operational requirements, impact on pumping energy requirements and cost.
- Compare analysis results for each alternative storage site.

2. Background Information

Previous studies are listed as follows. These are referenced in the report body as shown.

1) 2002 Water Supply Reliability Assessment, Final Report, Dillon, 2002.
2) 2008 City of London Water Master Plan Update
3) 2014 City of London Water Master Plan Update
4) Elgin Area Primary Water Supply System – 2008 Water Master Plan Update, Delcan, 2010.
5) Lake Huron Primary Water Supply System – 2008 Water Master Plan Update, Delcan, 2010.
6) City of London InfoWater hydraulic model, AECOM, 2014.

3. Design Criteria

Assumptions for the storage evaluation were reviewed and confirmed with the City of London in the following sections.

3.1 Storage Sizing Criteria

The Water Master Plan was based on a 20 year design horizon (2034), however storage requirements were estimated to a design year forecast of 40 years (2054). Storage sizing was based on the following components:

Emergency supply storage:

- This should be sized based on an acceptable emergency condition. The previous critical emergency scenarios used included:
    - LHPWSS water supply off-line for two (2) average days, or a duration of 48 hours.
    - LHPWSS water supply off-line for one (1) maximum day followed by one (1) average day, or a duration of 48 hours.
    - LHPWSS water supply off-line for one (1) maximum day, followed by two (2) average days, or a duration of 72 hours.
    - LHPWSS water supply off-line for 130% (95^{th} percentile) of one (1) average day followed by two (2) average days, or a duration of 72 hours.
- The second scenario is preferred for the evaluation, based on a 48 hour emergency duration.
- Previous studies use the winter average day demand (ADDw), which generally comprises indoor water use and is typically 93% of the annual average day demand. This was used for the storage evaluation.

MOE fire storage

- A fire flow demand of 378 L/s was used, with two (2) fires occurring, with a duration of 6 hours.

MOE balancing storage

- The MOE criteria uses a value of 25% of the maximum day demand.
- The balancing portion could be incorporated within the above emergency supply storage volume, however it is recommended that a portion of the MOE balancing storage be included in the storage calculations for unforeseen events, however this could be reduced. A value of 25% of the combined average of the MDD and ADD_w is suggested, which is about 74% of the MOE criterion.

MOE emergency storage

- A value of 25% of the above balancing and fire storage is used.

3.2 London Demands

Existing and forecasted London demands used for the storage sizing calculations were reviewed, including existing and growth demand factors, peaking factors and non-revenue water:

- Table 3.1 shows the winter average day demand based on the 2014 Water Master Plan to the year 2034. Beyond this year, an increase of 4% every 5 years was assumed, based on the growth rate prior to 2034.
- Maximum day demands were based on a peaking factor of 1.9, applied to the average day demand, which was assumed for the Water Master Plan. This is likely conservative based on a review of historical demands, which generally range from 1.3 to 1.5.
- Connection to the Dorchester system is not included in the analysis.
- A heavy water user in Innovation Park was included with a demand of 4.5 ML/d (un-peaked). This was added to the values shown in Table 1.1.

Table 3.1 – London Demand Forecasts for Storage Evaluation

Year	Winter Average Day Demand (ML/d)					
	Residential	Commercial	Institutional	Industrial	NRW	Total
Existing	80.0	20.8	5.0	9.4	13.5	**128.6**
2014	82.7	20.8	5.2	9.5	11.7	**129.8**
2019	87.2	20.8	5.5	9.8	12.2	**135.6**
2024	92.0	20.8	5.6	10.2	12.7	**141.3**
2029	96.5	20.9	5.8	10.6	13.2	**147.0**
2034	100.9	21.0	6.1	11.0	13.8	**152.9**

Notes:
- Excludes heavy water user add-on demand
- Based on a demand factor of 0.93 applied to annual average day demand

3.3 System Supply - Emergency

Storage sizing was evaluated based on the following supply:

- The LHPWSS supply is assumed to be off-line.
- Arva PS / Reservoir is available for use during the emergency. It is assumed that sufficient standby power would be available to operate the pumps.
- The emergency supply wells are assumed to be off-line.
- EAPWSS supply to London is assumed to be as follows:
    - Existing supply is 40 ML/d. It is noted that only the 'B' Line (900 mm) will be in operation for the next 5 years, however this capacity can be used.
    - With both the A and B lines in operation, it can supply 70 ML/d to London for the first 24 hours of the emergency and then 45 ML/d, sustained after the first 24 hours.
    - With an expanded Elgin WTP, the supply is 85 ML/d. For the purpose of this study, the expansion is assumed to occur by the year 2028. Storage requirements are very sensitive to the timing of this supply increase.
- EMPS and SERPS are assumed to be in operation for the emergency.

3.4 Available Storage Capacity

The available effective reservoir capacity for the City of London is discussed as follows. Storage capacity is reduced based on the following rationale:

- Hydraulics and configuration of the outlet and pump NPSH requirements for pumped storage. Reservoir storage is reduced for each facility as follows:
    - EMPS – Low alarm (pump shutoff) level.
    - SERPS – Low alarm (pump shutoff) level.
    - Springbank Reservoir – The minimum allowable water level is equivalent to 45 ML for the three cells. This amounts to the 22% level for the total storage. In addition, Cell 2 is assumed to be off-line after 2023, or a further reduction of 45 ML. Springbank Reservoir Cell 2 was upgraded with a new floating cover, which is estimated to last for 10 years. The City intends to replace Cell 2 by 2023 due to reliability and safety concerns. Therefore this reservoir cell was not included in the available storage for scenarios after 2024.
    - Arva Reservoir storage is pumped to the City system via the Arva Pumping Station. During the emergency, Arva PS pumping will occur with either the large (900 HP) or smaller (700 HP) pumps, or no pumping. This was based on current or projected Springbank levels and system pressures. The bottom 2 metres is considered to be unusable with the large (900 HP) pump in operation and the bottom 1 metre is unusable with the smaller (700 HP) pumps in operation. For the first day of the emergency (MDD), the large pump is required during the PHD, when reservoir levels would likely be above 2 m. For the second day (assumed as ADD), only the smaller pump would be required, so the bottom 1 meter is considered to be unusable under this condition. Some of the Arva Reservoir volume should be allocated to secondary LHPWSS customers. The minimum levels discussed above should be sufficient for this.
- Reservoirs are rarely 100% full, so a conservative assumption is required. Based on a review of 2012 / 2013 SCADA data for Springbank Reservoir levels, a frequency analysis was conducted as shown on Figure 3.1. This shows that, the storage is higher than 95% full less than 5% of the time, 90% full only 20% of the time and 50% of the time it is above 85% full. Previous analysis assumed a storage reduction factor of 10%, however, based on a lower likelihood that the storage will be above 90% full, a reduction factor of 15% is recommended.

Table 3.2 shows available storage capacity based on the above assumptions.

3.5 Hydraulic Criteria

The current City of London InfoWater all-pipe hydraulic model was utilized for the analysis. The model was used to evaluate the ability of the storage locations to supply all portions of the City's Water System during an emergency condition. In order to confirm this, the model results will be compared with the following hydraulic design criteria for each storage location alternative:

- Minimum pressure during an emergency is as follows:
    - 275 kPa (40 psi) for domestic flow.
    - Maximum day demand plus fire flow – 140 kPa (20 psi) at the most critical hydrant lateral or fire service connection.
- Maximum pressure is 690 kPa (100 psi) under any demand condition.

- For new watermain sizing, the maximum velocity should be 1.5 m/s during the peak hour demand condition or 2.4 m/s under the maximum day plus fire flow condition.
- A headloss criterion of 2.3 m/km was utilized for new mains.

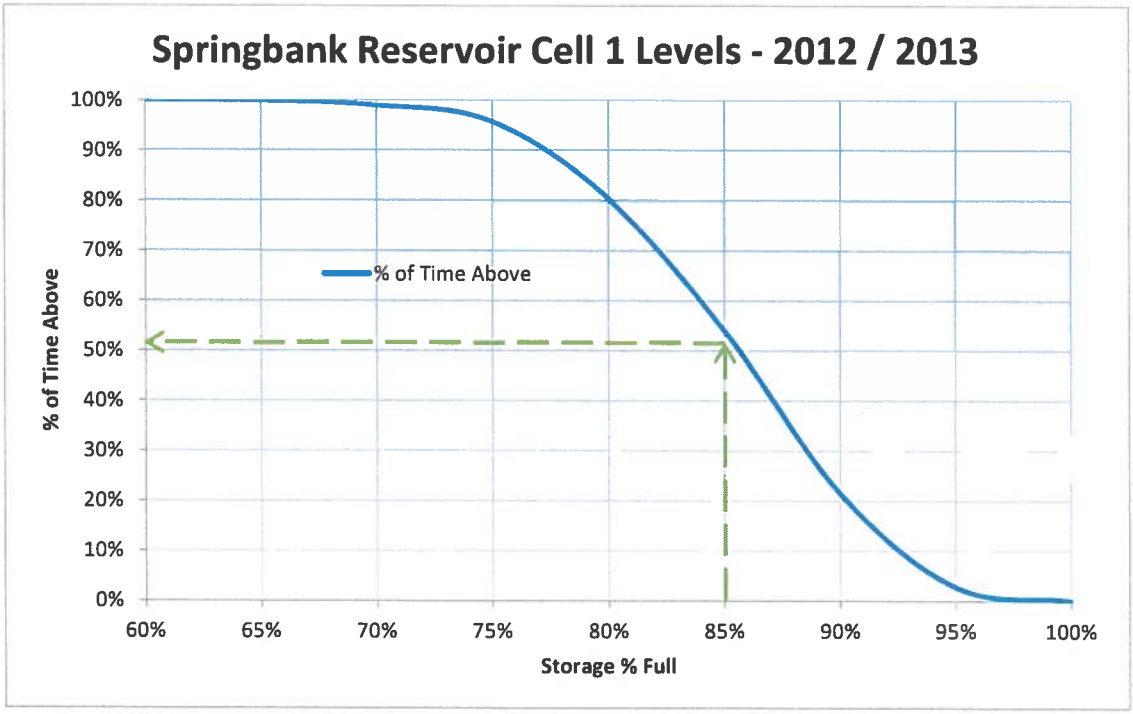


Figure 3.1: Springbank Reservoir Level Frequency Analysis

Table 3.2 – Available Storage Capacity

Reservior	Total Storage Capacity (ML)	Reduction Factor based on Probability Above 85% (%)	Reduction Factor for Minimum Pumped Storage Level (%)	Useable Storage Capacity for London (ML)	Comments
Arva Reservoir	109.0	*15%*	*15%*	76.4	Assumes entire reservoir capacity allocated to London; Unavailable storage based on bottom 1.0 metres unusable storage
Springbank Reservoirs - Cells 1 and 3					
Cell 1	81.8	*15%*	*22%*	52.0	Note: 45 ML (22%) of storage considered unavailable
Cell 2	45.6	*15%*	*22%*	28.9	Note: Cell 2 considered to be out of service for available storage calculations beyond 2023
Cell 3	81.8	*15%*	*22%*	52.0	
Total Springbank Reservoirs	**209.2**			**132.8**	
Southeast Reservoir	113.0	*15%*	*11%*	83.3	Unavailable storage based on pump shutoff (LAL) level
Elgin-Middlesex Reservoir	27.0	*15%*	*14%*	19.2	This is volume allocated to London. The other cell (27 ML) is allocated to other EAPWSS customers. Unavailable storage based on pump shutoff (LAL) level
TOTAL - Pre 2023	**458.2**			**311.7**	Includes Springbank Cell 2
TOTAL - Post 2024	**458.2**			**282.8**	Excludes Springbank Cell 2

15% Reduction factor for based on probability above 85%

4. Storage Capacity Requirements

Based on the storage criteria discussed above, storage capacity requirements were determined to the year 2054. Requirements were determined for both 48 hour (one (1) maximum day and one (1) average day) and a 72 hour emergency event (one (1) maximum day and two (2) average days). Table 4.1 shows required storage for the 48 hour emergency. Table 4.2 shows required storage for the 72 hour emergency.

The storage evaluation was based on the analysis for a 48 hour emergency, for which 100 ML of storage is recommended for the short term (assumed by 2023), with provision for an additional future 100 ML by 2054, for a total of 200 ML of storage.

Figure 4.1 and Figure 4.2 show graphically the storage requirements and deficit for existing storage and with the additional storage to the year 2054, respectively.

Table 4.1 – Required Storage Capacity - 48 hour Emergency

Year		Demands (ML/d) (1)		Required Storage - Emergency (Arva Supply Interuption)										
				Emergency - MDD / ADD (2 days)										
		ADDw	MDD	Emergency Supply Storage (ML)	MOE Balancing Storage (Reduced) (ML)	MOE Fire Storage (ML)	MOE Emergency Storage (ML)	Required Storage (ML)	Well Supply Volume (ML)	Elgin Supply Volume (ML)	Total Supply (ML)	Net Required Storage (ML)	Available Storage (ML)	Storage Surplus (defecit) (ML)
	Existing	133.2	267.3	400.5	49.5	16.3	16.4	482.7	0.0	80.0	80.0	403	312	-91
0	2014	134.4	269.8	404.2	49.9	16.3	16.6	486.9	0.0	115.0	115.0	372	312	-60
5	2019	140.1	281.5	421.6	52.1	16.3	17.1	507.1	0.0	115.0	115.0	392	312	-80
10	2024	145.9	293.3	439.1	54.3	16.3	17.6	527.4	0.0	115.0	115.0	412	283	-130
15	2029	151.6	304.9	456.5	56.4	16.3	18.2	547.4	0.0	170.0	170.0	377	283	-95
20	2034	157.4	316.9	474.3	58.6	16.3	18.7	568.0	0.0	170.0	170.0	398	283	-115
25	2039	163.3	328.9	492.2	60.8	16.3	19.3	588.7	0.0	170.0	170.0	419	283	-136
30	2044	169.4	341.4	510.8	63.2	16.3	19.9	610.2	0.0	170.0	170.0	440	283	-157
35	2049	175.8	354.4	530.1	65.6	16.3	20.5	632.5	0.0	170.0	170.0	462	283	-180
40	2054	182.4	367.8	550.2	68.1	16.3	21.1	655.7	0.0	170.0	170.0	486	283	-203

(1) Includes heavy water user allowance

Table 4.2 – Required Storage Capacity - 72 hour Emergency

Year		Demands (ML/d) (1)		Required Storage - Emergency (Arva Supply Interuption)										
				Emergency - MDD / ADD / ADD (3 days)										
		ADDw	MDD	Emergency Supply Storage (ML)	MOE Balancing Storage (Reduced) (ML)	MOE Fire Storage (ML)	MOE Emergency Storage (ML)	Required Storage (ML)	Well Supply Volume (ML)	Elgin Supply Volume (ML)	Total Supply (ML)	Net Required Storage (ML)	Existing Available Storage (ML)	Storage Surplus (defecit) (ML)
	Existing	133.2	267.3	533.6	49.5	16.3	16.4	615.9	0.0	120.0	120.0	496	312	-184
0	2014	134.4	269.8	538.5	49.9	16.3	16.6	621.3	0.0	160.0	160.0	461	312	-150
5	2019	140.1	281.5	561.7	52.1	16.3	17.1	647.2	0.0	160.0	160.0	487	312	-175
10	2024	145.9	293.3	585.0	54.3	16.3	17.6	673.3	0.0	160.0	160.0	513	283	-230
15	2029	151.6	304.9	608.1	56.4	16.3	18.2	699.0	0.0	255.0	255.0	444	283	-161
20	2034	157.4	316.9	631.7	58.6	16.3	18.7	725.4	0.0	255.0	255.0	470	283	-188
25	2039	163.3	328.9	655.5	60.8	16.3	19.3	752.0	0.0	255.0	255.0	497	283	-214
30	2044	169.4	341.4	680.2	63.2	16.3	19.9	779.6	0.0	255.0	255.0	525	283	-242
35	2049	175.8	354.4	705.9	65.6	16.3	20.5	808.3	0.0	255.0	255.0	553	283	-270
40	2054	182.4	367.8	732.6	68.1	16.3	21.1	838.1	0.0	255.0	255.0	583	283	-300

(1) Includes heavy water user allowance

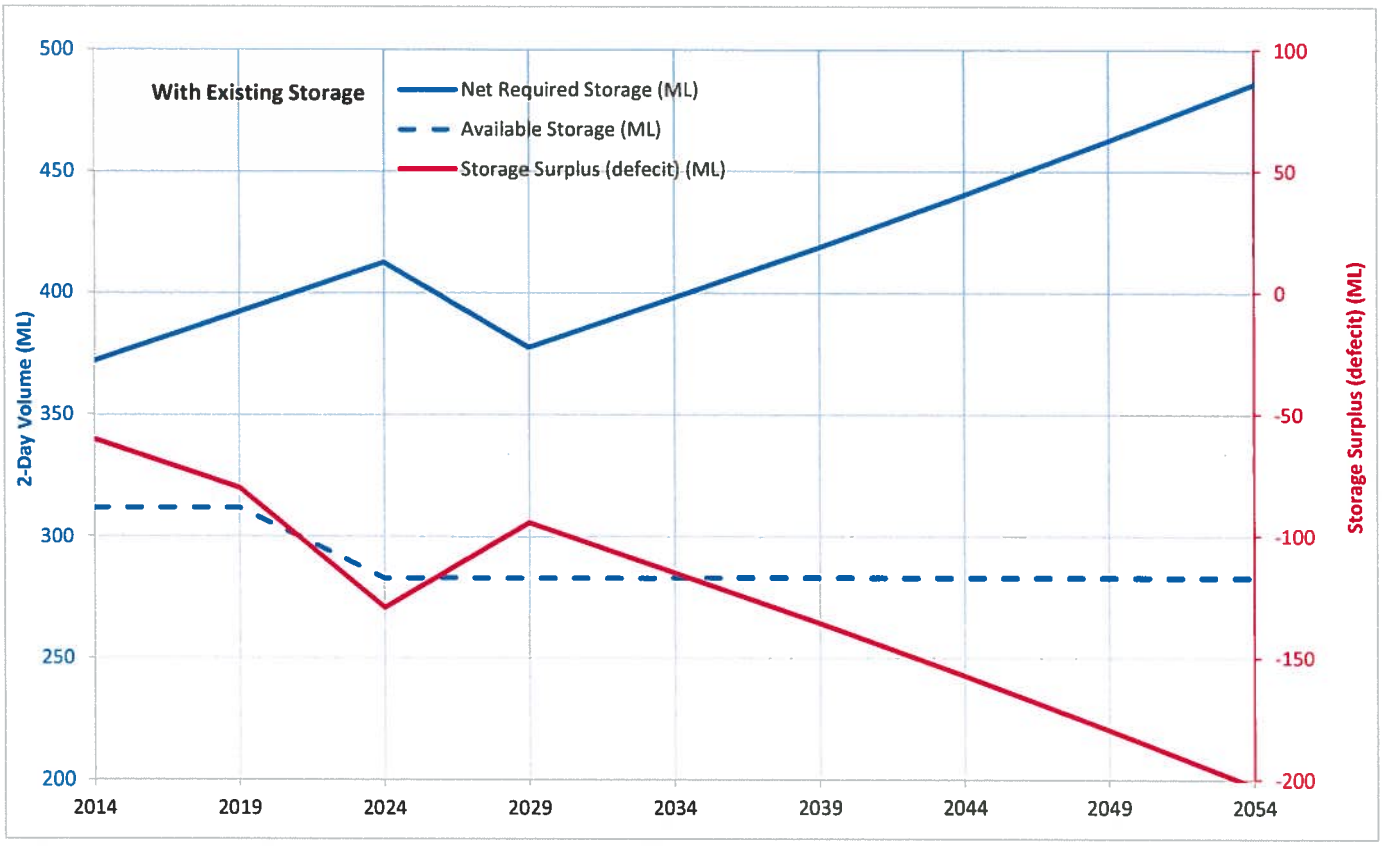


Figure 4.1: Storage Requirements – Existing (48 Hours)

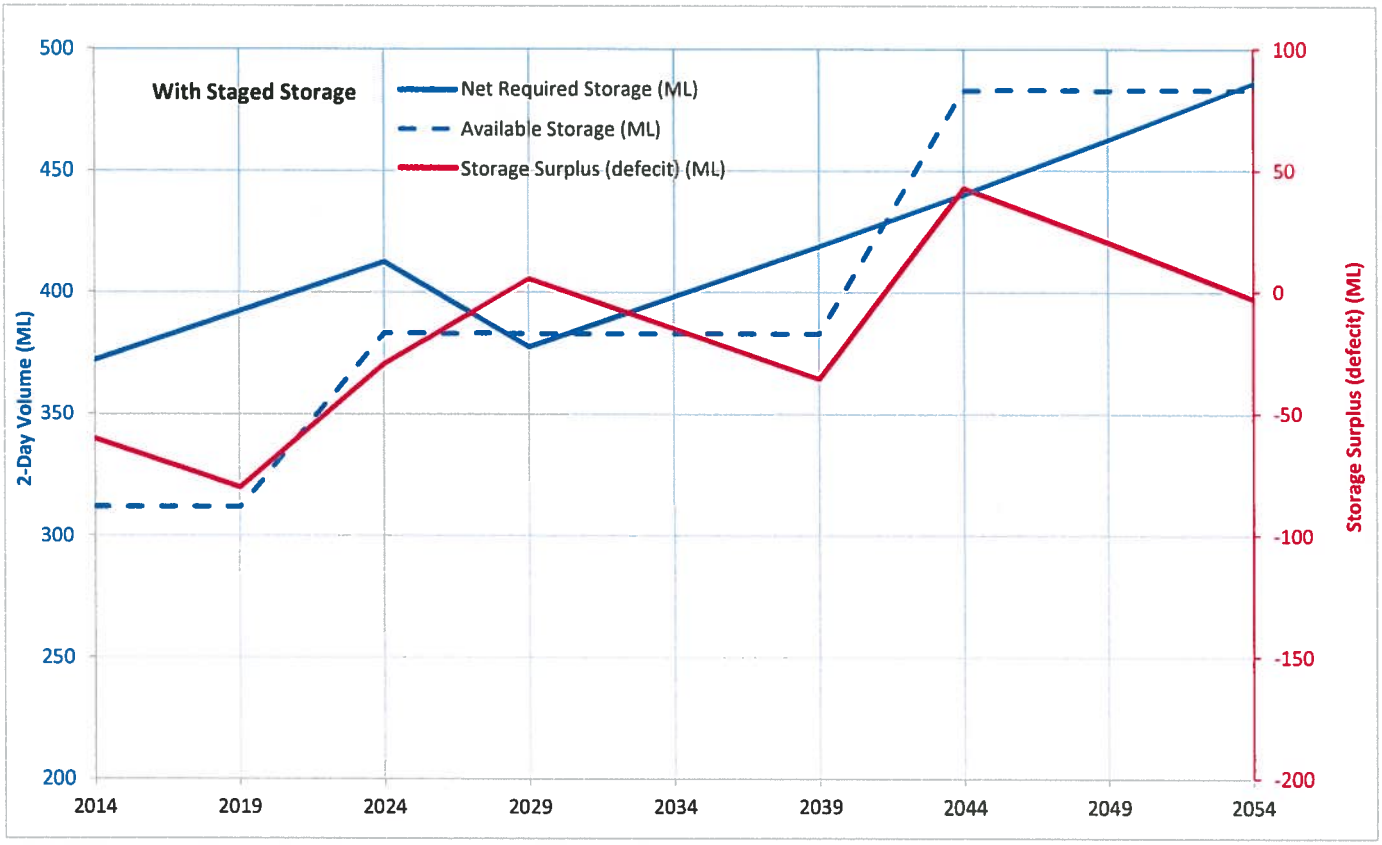


Figure 4.2: Storage Requirements – with Proposed Storage (48 Hours)

5. Potential Storage Locations and Configuration

Only generalized areas of the system were assessed for storage locations. Detailed engineering studies would be required for actual site selection. The model assessment arbitrarily selected model nodes at key network junctions.

5.1 Storage Configuration Alternatives

The following is a description of general storage configuration alternatives.

Elevated storage tank

- This is an elevated tank, which can be included at any ground elevation, provided the tank height is within practical limits.
- This storage 'floats' on the pressure zone.
- This type would supply to the system by gravity and would automatically fill and draw, depending on supply pumping and system demands.
- Elevated tanks are not expandable. Additional tanks would be required to provide additional capacity.
- This type of storage would benefit transients, as it would sustain pressures during a pumping interruption.

The maximum practical size for elevated storage is typically 10 ML, so this type of storage is likely too small based on the required storage for London. Therefore the elevated storage alternative was not considered further.

Elevated ground storage reservoir

- This is a 'floating' storage.
- This type of storage requires a substantial land area, situated at an appropriate elevation to supply the pressure zone with satisfactory pressures.
- This type would supply to the system by gravity and would automatically fill and draw, depending on supply pumping and system demands.
- No or little energy losses are required for filling or drawing the storage, other than any storage supply piping, if required.
- This type of storage is expandable, so storage cells can be staged for future years.
- A floating storage would likely benefit transients, as it would sustain pressures during a pumping interruption.

Floating storage sites should retain the current operating HGL provided for the system by Springbank Reservoirs. It is noted that multiple floating storage facilities within the same pressure zone operating at different hydraulic distances from the supply pumping station can present operational challenges for filling and draining the storage. However, this arrangement has been implemented in other systems (e.g. City of Toronto PD 4, York PD 6 and others). Operation may require throttling of inlet valves to facilitate coordinated filling and draining of the existing and new storage. These are evaluated further in Section 6.

Within the City of London, site opportunities that meet this elevation criterion are generally limited to the area within the vicinity of the existing Springbank Reservoirs and the northeast portion of London. This type of storage is applicable to London and was considered in the evaluation discussed below.

Pumped ground storage

This type of storage consists of a ground reservoir and a re-pumping station, described as follows:

- Filling the storage must be done through the system via a pressure sustaining valve (PSV).
- Water must be re-pumped to the distribution system.
- The filling and pumping operation would result in energy waste.
- This type of storage is expandable, so storage cells can be staged for future years.
- This type of storage is more flexible than floating storage with respect to location, as elevation is not as critical a criterion.
- This type of storage is fairly common in flat pressure zones (e.g. Windsor and Niagara Falls).
- Would likely be detrimental to transients as there is no 'floating' storage that can sustain pressures during a transient and can result in additional transients due to the required pumping station and operation of the reservoir fill valve.

This type of storage configuration would have operational issues with respect to filling and draining a facility within the same pressure zone. This requires coordination during filling or pumping with Arva PS and / or SERPS during supply or filling. This is evaluated further in Section 6. This type of storage is applicable to London and was considered in the evaluation discussed below.

5.2 Storage Location Alternatives

Based on the required storage sizing as discussed in Section 4, potential alternative storage locations and configurations were evaluated for the City of London. Figure 5.1 shows general storage site locations that were considered in the evaluation. Storage type and general locations were assessed as follows:

- Site A – Vicinity of existing Springbank Reservoirs (floating storage):
    - Elevations within this area are favourable for a floating storage facility, similar to the existing reservoirs.
    - This site would have the same issues as Springbank Reservoir in terms of emergency servicing to the entire water system.
    - This site was modelled to provide a baseline comparison with other alternatives, as discussed in Section 6.1.1.
- Site B - Northeast system (floating storage):
    - Elevations within this area are favourable for a floating storage facility, with similar elevations as the existing Springbank Reservoirs.
    - This site was modelled as discussed in Section 6.1.2.
- Site C – Central east system (pumped storage):
    - Elevations within this area are not favourable for a floating storage facility. Therefore a pumped storage facility would be required here.
    - This site was modelled as discussed in Section 6.1.3.
- Site D - Northwest system (pumped storage):

- Elevations within this area are not favourable for a floating storage facility. Therefore a pumped storage facility would be required here.
- This site was not modelled.

- Site E – Central west system (floating storage):
  - Elevations within this area are favourable for a floating storage facility, similar to the existing reservoirs.
  - Essentially within the vicinity of Springbank Reservoirs.
  - May be too far from the main water grid network to adequately turn over water.
  - Would have the same issues as Springbank in terms of emergency servicing to the entire water system.
  - This site was not modelled.
- Site F - Southwest system (pumped storage):
  - Elevations within this area are not favourable for a floating storage facility. Therefore a pumped storage facility would be required here.
  - This site was not modelled.
- Site G – Southeast Reservoir (pumped storage):
  - Existing pumped storage 113 ML via existing pumps.
  - There is space for expanded storage on the site (additional 113 ML).
  - It is noted that an additional 113ML is planned for this site in the future when the Elgin plant expands.
  - Addition of the Southeast Pumping Station and Reservoir will potentially reduce the Arva PS service area to the south (new/ larger to north SE zone) to free up servicing for the northern portion of the Low Pressure Zone. Based on the model runs, it is not likely that increased pumping at this station will benefit pressures within the higher areas within the northeast corner of the water system.
  - This site could be evaluated for implementation of additional storage planned for the Elgin WTP expansion.
  - This site was modelled as discussed in Section 6.1.5.
- Site H – EMPS (pumped storage):
  - The site has two existing cells of 27 ML capacity, of which one of the cells is dedicated to London.
  - The original design had space availability for two (2) new 27 ML cells. This would be too small for the required storage capacity.
  - This site was not modelled.
- Site I – Arva Reservoir (pumped storage):
  - The required storage for 2034 would essentially double the existing capacity, if the existing site can accommodate this.
  - Pumped storage can be achieved using the existing Arva PS pumps – no new pumps required.
  - This site was modelled as discussed in Section 6.1.5.

Of the above sites, several were selected for further evaluation using the hydraulic model were completed as noted above. These sites were evaluated in more detail in Section 6.

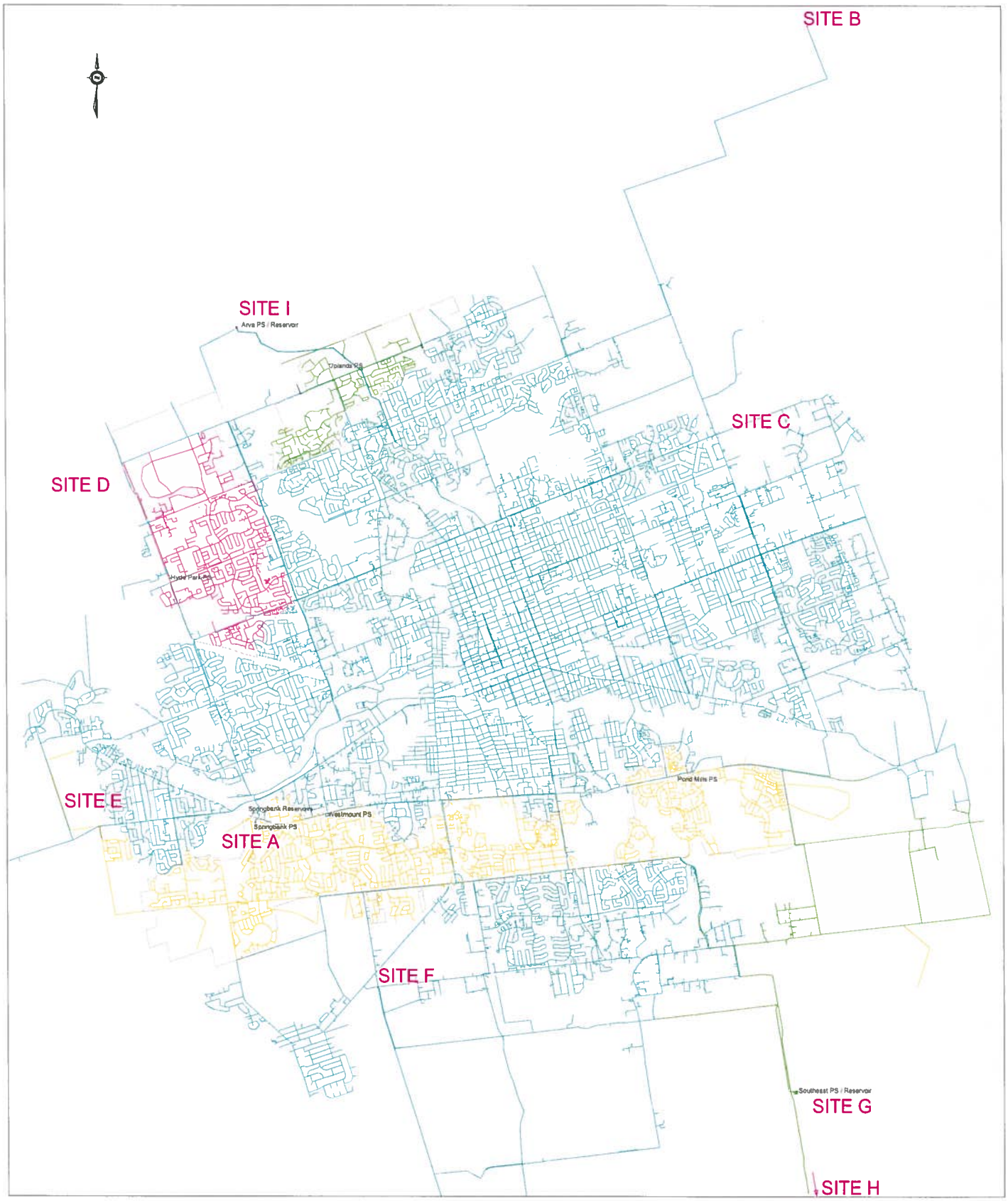


Figure 5.1: General Alternative Storage Locations

6. Alternative Storage Site Hydraulic Evaluation

Three alternative general storage locations were reviewed in more detail based on hydraulics, in addition to expanded storage at the existing Springbank Reservoir site (Site A). This includes Site B (Northeast system), Site C (Central east system), Site G (Southeast Reservoir) and Site I (Arva Reservoir), as discussed in Section 5.2 and as shown on Figure 5.1. The evaluation does not consider constructability, storage land area requirements / availability or evaluation of specific storage sites.

The assessment included hydraulic model evaluation of storage alternative locations and configurations to assess the capability of the storage location to supply the system under an emergency with the existing trunk system. This included alternative configurations for pumped or floating ground storage, depending on the location and elevation. This is described as follows:

- Extended period simulations (EPS) of the system were conducted for the critical emergency condition for each alternative storage location (e.g. one maximum day, followed by one average day). Figure 6.1 shows the modelled demands for the emergency run. The analysis accounted for diurnal demand patterns, which will vary between average and maximum day.
- The modelling was based on the year 2034 demands as well as proposed works based on the 2014 WMP. For this period, the first phase of storage is assumed in place, which is approximately 50% of the 2054 storage shown on Table 4.1.
- The new storage locations were included in the model, including pumps for pumped storage alternatives.
- Arva PS, EMPS and SERPS operations ensured that the reservoirs do not drop below levels discussed in Section 3.4.

The evaluation included the impact on the following for each site:

- Infrastructure requirements for each alternative storage location to adequately supply the storage and the transmission system during the critical emergency.
- Impact on system pressures, including critical customers was evaluated for each alternative storage location for both emergency and normal operation. Critical customers include large water users, critical industrial and institutional users and medical facilities. Table 7.1 shows deficient nodes for pressure as well as minimum pressure at the Clarke / Huron chamber for each alternative.
- Impact on available fire flow was evaluated at all hydrants for each alternative storage location for both emergency and normal operation. Fire flow capacity was tested under emergency conditions for comparison of the following conditions:
    - MDD, assuming one (1) 700 HP pump in operation.
    - ADD, assuming no Arva PS pumps in operation.
    - These were compared with estimated fire flow requirements for each hydrant. Table 7.1 shows deficient nodes for fire flow residual pressure for each alternative.
- A general review of the likely impact on water quality for each site was evaluated.
- A general review of the likely impact on transient considerations for each site was evaluated.
- A qualitative review of the likely impact on pumping energy requirements and cost was reviewed.
- A general review of the likely impact on normal operational requirements was evaluated.

Model setup for the emergency LHPWSS supply off-line scenario was completed as follows:

- LHPWSS supply off-line.
- All reservoirs initially at the 85% full level.
- Arva PS / Reservoir would operate to pump the terminal storage volume to the system. Operations during the emergency would be to run either the Arva PS 700 HP or 900 HP pumps when required based on pressure and /or to maintain system storage levels. It is assumed that the station would have sufficient standby power to operate the pumps under an area-wide electrical power failure condition.
- Elgin Area WTP fixed supply as discussed in Section 3.3 to fill EMPS.
- EMPS was operated with both P4 and P5 continuously, with pump shutoff if the tank level goes below the minimum operating level (normal pump shutoff level).
- SERPS was operated with four pumps (5 pumps during the peak hour condition), with shutoff if the level goes below the minimum operating level (normal pump shutoff level).
- New storage capacity for each alternative location.
- The existing Springbank Cell 2 is assumed to be out of service for the emergency scenarios.

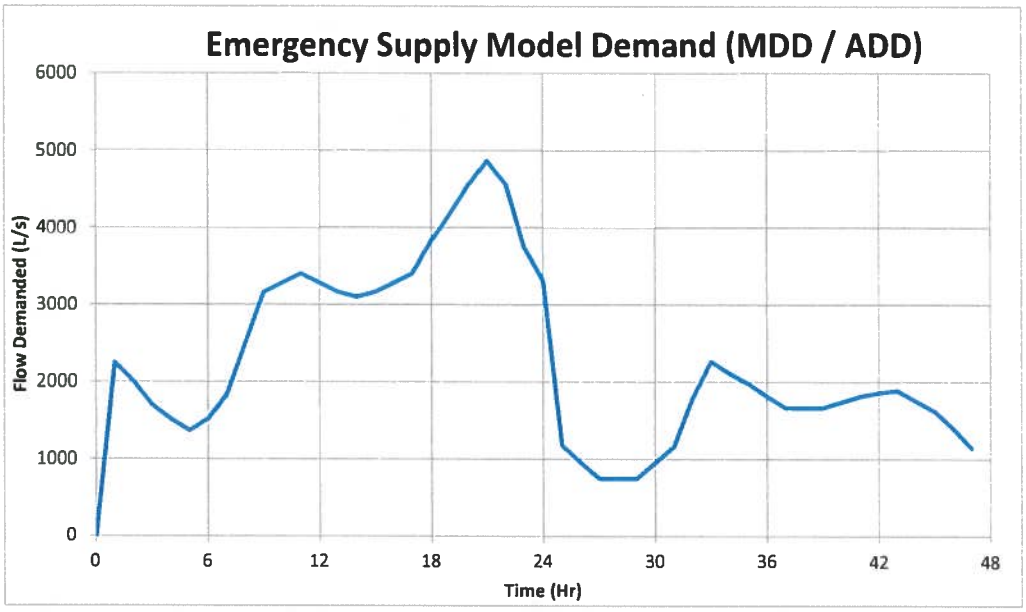


Figure 6.1: Modelled Emergency Demand Pattern (MDD / ADD)

The following discusses and compares various modelling outputs for the current Springbank Reservoir site (Site A) and to the storage site alternatives.

6.1.1 Site A - Vicinity of Existing Springbank Reservoirs

In order to provide a baseline analysis for comparison with alternative storage sites, the emergency condition was evaluated for the additional new storage at the existing Springbank Reservoirs. This assumed that the required storage expansion would be feasible in the vicinity of the existing reservoirs or as a replacement for Cell 2.

- Major infrastructure requirements – A connection main to the transmission system would be required from the new storage cell, with actual length dependant on the actual site used.
- System hydraulics under an emergency condition:
    - Table 7.1 shows the number and percent of model nodes with deficient pressure (below 275 kPa) for the entire system and within the northeast section of the water system:
    - Lower pressures, mainly within the northeast portion of the water system during the peak hour demand condition, even with the 900 HP pump in operation. During maximum day and peak hour demands, there is difficulty providing acceptable pressure to higher elevation areas (>275 m) within the northeast area, even when a pump is operating at the Arva PS.
    - Lower pressures would also occur around Wonderland Road between Sarnia Road and Fanshawe Park Road, which has areas above 275 metres elevation.
    - The Springbank Reservoir location for the new storage would not improve pressures within these areas.
- Figure 6.2 shows pumped flows and reservoir levels for the emergency simulation:
    - The Arva PS pumps would be required to maintain sufficient pressure in these areas, resulting in high utilization of the Arva storage, although only one of either the 700 or 900 HP pumps can be used at a time, otherwise the storage would be depleted leaving insufficient storage for the remainder of the emergency period.
        - Generally, the Arva PS 700 HP pump is on during most of the first day (MDD), with the Arva PS large pump (900 HP) operated during the peak hour demand period to maintain pressure.
        - For the second day (ADD), a 700 HP pump is on as required to maintain pressure, such that the reservoir level stays above the minimum level. During most of the second day of the simulation, no Arva PS pumps are in operation.
    - The SERPS pumps are assumed operating at all times during the emergency. Additional pumping at SERPS would not improve pressures within the high areas of the northeast area.
    - As shown on the figure, Arva and Southeast Reservoirs reach the minimum level at or around the end of the simulation.
    - The storage at Arva Reservoir drops more rapidly than Springbank Reservoir due to the Arva pumping. Springbank Reservoir (including the new reservoir) capacity is not fully utilized.
- Fire flow capacity was tested under emergency conditions for comparison of MDD (1 x 700 HP pumps) and ADD (no Arva PS pumps):
    - Available fire flow was compared with estimated fire flow requirements for each hydrant. This was used as a baseline for comparing available fire flow with other storage alternatives.
    - Table 7.1 shows the number and percent of model nodes with deficient fire flow residual pressure (below 140 kPa) for the entire system and within the northeast section of the system for both conditions.
- Impact on normal system operations:
    - Compared to the other alternative storage sites, this would not have a significant effect on system operations with the new storage at the same location.

- The Springbank site is 'floating' storage, which will be filled using the Arva PS pumps. This would need to ensure adequate recirculation within the larger reservoir volume, requiring changes to Arva PS pumping operations.

- Water quality - A larger storage volume at Springbank would result in longer water residence time. This may be a concern during low water demands. Therefore revised Arva PS operations would be required with the added storage to maintain adequate recirculation time.
- Impact on transients – Transient severity during normal operation such as power failure would not be changed relative to existing conditions by this scenario.
- Impact on pumping energy and cost - This would not increase pumping energy during normal operations, as this storage floats on the system and there is no re-pumping facility. This may benefit energy costs as it will provide more flexibility for operation of the large pumps at the Arva PS and at the Huron WTP during high electrical cost periods, particularly during the 5 critical electricity cost periods in Ontario.

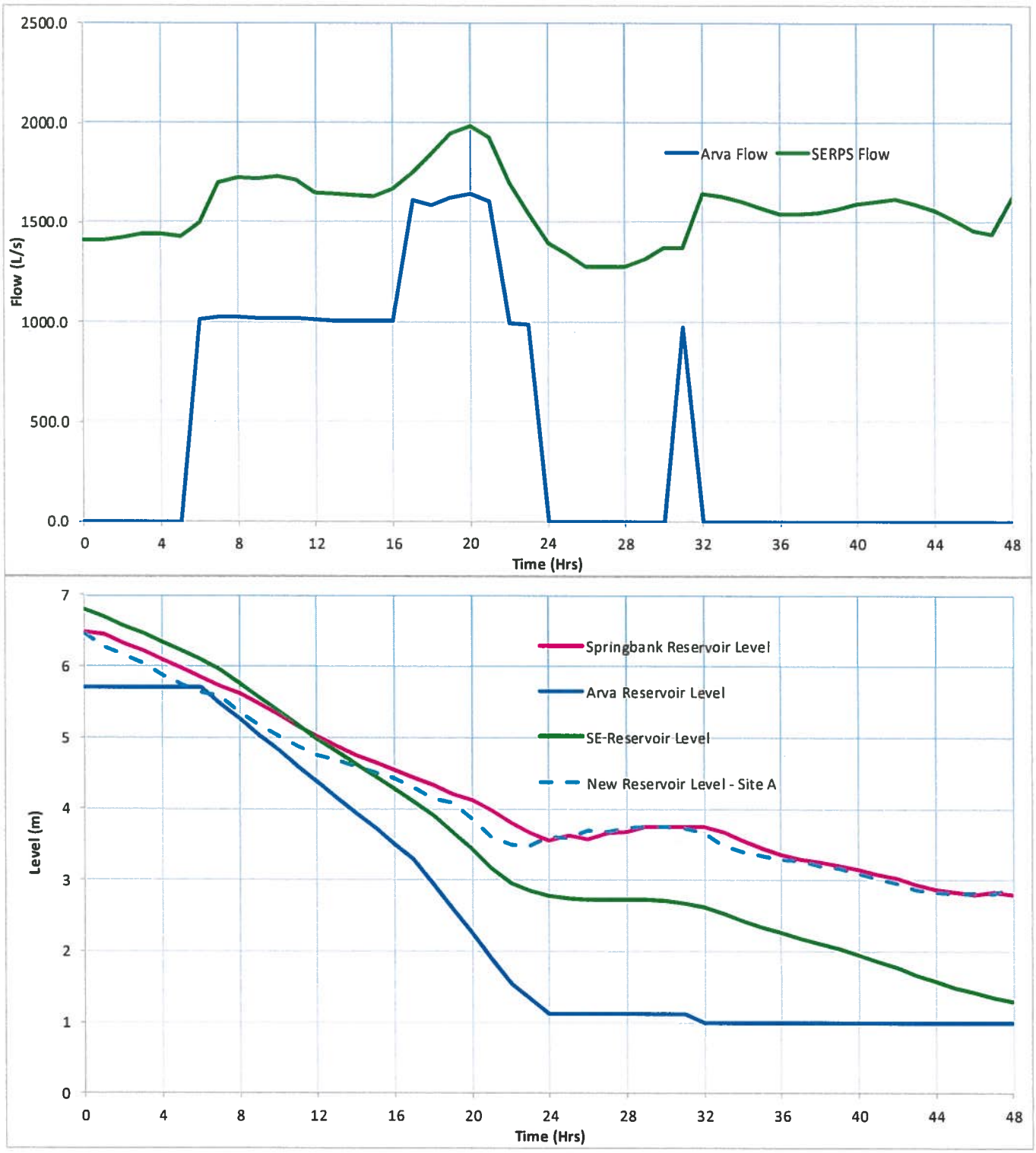


Figure 6.2: Pumping and Storage Levels – Site A (Vicinity of Existing Springbank Reservoirs)

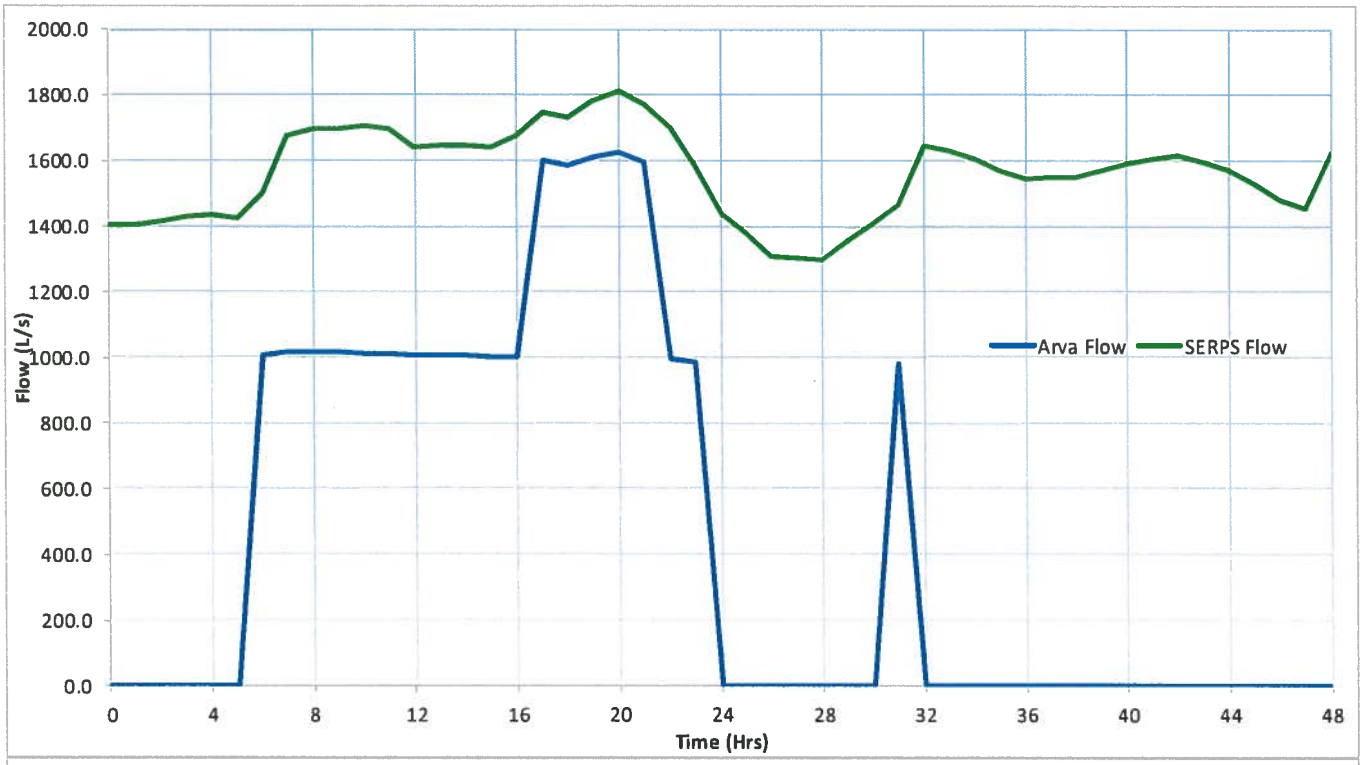
6.1.2 Site B - Northeast system – Floating Storage Facility

There are opportunities for floating storage within the Thorndale area, East of Clark Road, however this is beyond the municipal boundary. A floating storage alternative was modeled north of Thorndale Road between Nissouri Road and Purple Hill Road, which has an approximate 290-300 metre ground elevation.

Other than within the vicinity of Springbank Reservoirs, this is likely the only site opportunity for a floating ground storage for the system in the London area, as it has elevations close to that of the Springbank Reservoirs.

- Major infrastructure requirements:
    - This storage site would be located at least 10 to 13 km from the London water system trunk main (existing 1200 mm Fanshawe Park at Clarke main), requiring a substantial reservoir connection main.
    - This distance would likely require separate reservoir inflow and outflow supply mains to promote circulation within the mains.
- System hydraulics under an emergency condition:
    - Table 7.1 shows the number and percent of model nodes with deficient pressure for the entire system and within the northeast section of the system:
    - As shown on the table, the storage would improve pressures in the northeast portion of the system however they would still be slightly below the criteria. Nodes with deficient pressures would be reduced by about 50% from the Site A results.
- Figure 6.3 shows Arva PS and SERPS pumping as well as reservoir levels for the emergency simulation:
    - Generally, the Arva PS 700 HP pump on during most of the first day (MDD), with the Arva PS large pump (900 HP) operated during the peak hour demand period to maintain pressure.
    - For the second day (ADD), a 700 HP pump is on as required to maintain pressure, such that the reservoir level stays above the minimum level. No Arva PS pumps are in operation for most of the second day.
    - The SERPS pumps are assumed operating at all times during the emergency.
    - As shown, levels in the new reservoir are very sensitive to Arva PS pumping. This would result in unequal operation of both tanks. The reservoir would continue filling as long as Arva PS is pumping, which is all day under normal operation.
    - A control valve would be required to balance operation of the two reservoirs.
    - The Arva and Southeast storage would be fully utilized. As shown on the figure, Arva and Southeast Reservoirs reach the minimum level at or around the end of the simulation.
    - Springbank Reservoir and the new reservoir site capacity would not be fully utilized and would still retain about 34 and 42 percent of the capacity, respectively at the end of the simulation.
    - Storage at the Arva Reservoir drops more rapidly than the Springbank Reservoir due to the Arva pumping.
- Fire flow capacity was tested under emergency conditions for comparison of MDD (1 700 HP pumps) and ADD (no Arva PS pumps):
    - Available fire flow was compared with estimated fire flow requirements for each hydrant.

  - Table 7.1 shows the number and percent of model nodes with deficient fire flow residual pressure for the entire system and within the northeast section of the system.
  - As shown on the table, a reservoir at this location would only marginally improve the number of deficient nodes for fire flow residual pressure.
- Impact on normal system operations:
  - The new storage site is closer to Arva PS, which may result in faster filling than the existing Springbank reservoirs, as shown with the modeling.
  - Supply to multiple storage locations in the same zone, including reservoir turnover and filling may require specialized operations under normal conditions, such as inlet control valve throttling to equalize filling to balance inflow and outflow between Springbank and the new reservoir.
  - Arva PS can adequately fill the Site B reservoir location, however it is difficult to drain the reservoir while Arva PS pumps are operating if located this close to Arva Reservoir.
  - Depending on demands, the reservoir would continue the filling as long as the Arva PS is pumping, which is all day under normal operation.
- Impact on water quality – A larger storage volume would result in longer residence time based on a water age analysis. This may be a concern during low water demands. Therefore revised Arva PS operations would be required. Also, there would be a long residence time and chlorine decay within the long reservoir supply main. Therefore two mains would be required, one for inflow to the reservoir, and one for outflow.
- Impact on transients – Transients, say following a power failure during normal operation should be improved within the northeast section of the water system relative to the other alternatives, due to the effect of the reservoir, which will sustain pressures during transients.
- Impact on pumping energy and cost – This may result in increased pumping energy usage to transfer the water to the storage facility for 10-13 km and then drain back to the system. This may benefit energy costs as it will provide more flexibility for operation of the large pumps at the Arva PS and at the Lake Huron WTP during high electrical cost periods, particularly during the 5 critical electricity cost periods in Ontario.



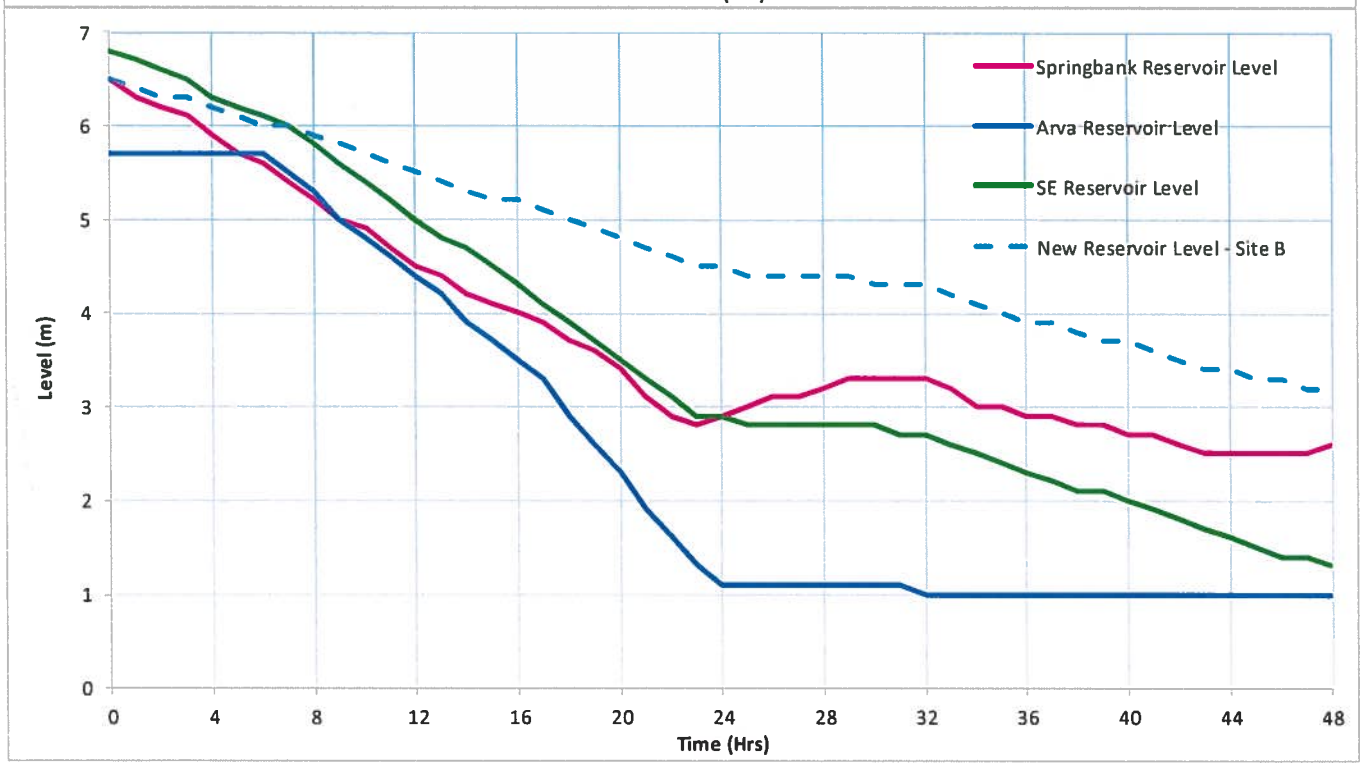


Figure 6.3: Pumping and Storage Levels – Site B (Northeast system – Floating Storage Facility)

6.1.3 Site C - Northeast system – Pumped Storage Facility

A ground storage and re-pumping facility was modelled within the northeast portion of the water system, assumed to be within the vicinity of Clarke Road between Huron Street and Fanshawe Park Road and supplied by the 1200 mm Clark Road main. The run assumed no filling of the storage during the emergency.

- Major infrastructure requirements – the existing Clarke Road main would be sufficient to supply the facility, if it could be built close to this main, so only connection piping to the facility would be required. The station would require a pressure control valve (PSV) to control reservoir filling, while maintaining system pressures.
- System hydraulics under an emergency condition:
    - Table 7.1 shows the number and percent of model nodes with deficient pressure (below 275 kPa) for the entire water system and within the northeast section of the water system.
    - As shown on the table, system pressure would be improved within the northeast portion of the water system during the emergency relative to Site A and B with a pumped storage, however there would still be deficient nodes.
- Figure 6.4 shows Arva PS and SERPS pumping as well as reservoir levels for the emergency simulation:
    - Generally, the Arva PS 700 HP pump is on during most of the first day (MDD), with the Arva PS large pump (900 HP) operated during the peak hour demand period to maintain pressure.
    - For the second day (ADD), a 700 HP pump is on as required to maintain pressure, such that the reservoir level stays above the minimum level. No Arva PS pumps are in operation for most of the second day.
    - The SERPS pumps are assumed operating at all times during the emergency. Additional pumping at SERPS would not improve pressures within the high portions of the northeast area.
    - Pumping from the storage was done for most of the simulation as required to maintain system pressure.
    - The new pumped reservoir capacity at this location would be better utilized compared with Sites A or B due to the controlled pumped outflow.
    - Springbank Reservoir would be underutilized and would still retain about 45 percent of capacity.
    - The Arva Reservoir storage would be fully utilized due to the Arva pumping. As shown on the figure, Arva Reservoir reaches the minimum level after about 32 hours into the simulation.
- Fire flow capacity was tested under emergency conditions for comparison of MDD (1 700 HP pumps) and ADD (no Arva PS pumps):
    - A pump is assumed to operate at the reservoir during the fire flow, which was not assumed for Alternatives A and B.
    - Available fire flow was compared with estimated fire flow requirements for each hydrant.
    - Table 7.1 shows the number and percent of model nodes with deficient fire flow residual pressure for the entire water system and within the northeast section of the water system. This shows that the number of deficient nodes for fire flow residual pressure is only marginally improved over Alternatives A and B.
- Impact on normal system operations:
    - With new storage, two storage facilities would need to be filled from the Arva PS, requiring revised operations at the station.

  - This storage would require filling by means of a pressure sustaining valve. This would likely be done during early hours with Arva PS Pump 5.
  - Re-pumping from the storage would be required, likely during higher demand periods.
  - Pumping from the Arva PS and the new station would have to be coordinated.
- Impact on water quality – A larger storage volume would result in a longer residence time based on a water age analysis. This may be a concern during low water demands. Therefore revised Arva PS operations would be required.
- Impact on transients following a pump trip:
  - Transient potential would likely be worse than existing conditions or with a reservoir at Site A or B due to the operation of the reservoir fill valve and starting and stopping the storage pumps. The addition of new pumps presents increased transient potential during a power failure.
- Impact on pumping energy and cost - This site would have both a higher energy usage and cost due to the following:
  - Energy use would increase as a result of filling through the PSV and re-pumping.
  - Although the reservoir filling would take place during low electrical cost periods, the re-pumping would be required during higher water demand (and likely high electrical cost) periods, resulting in likely no or marginal net cost savings.

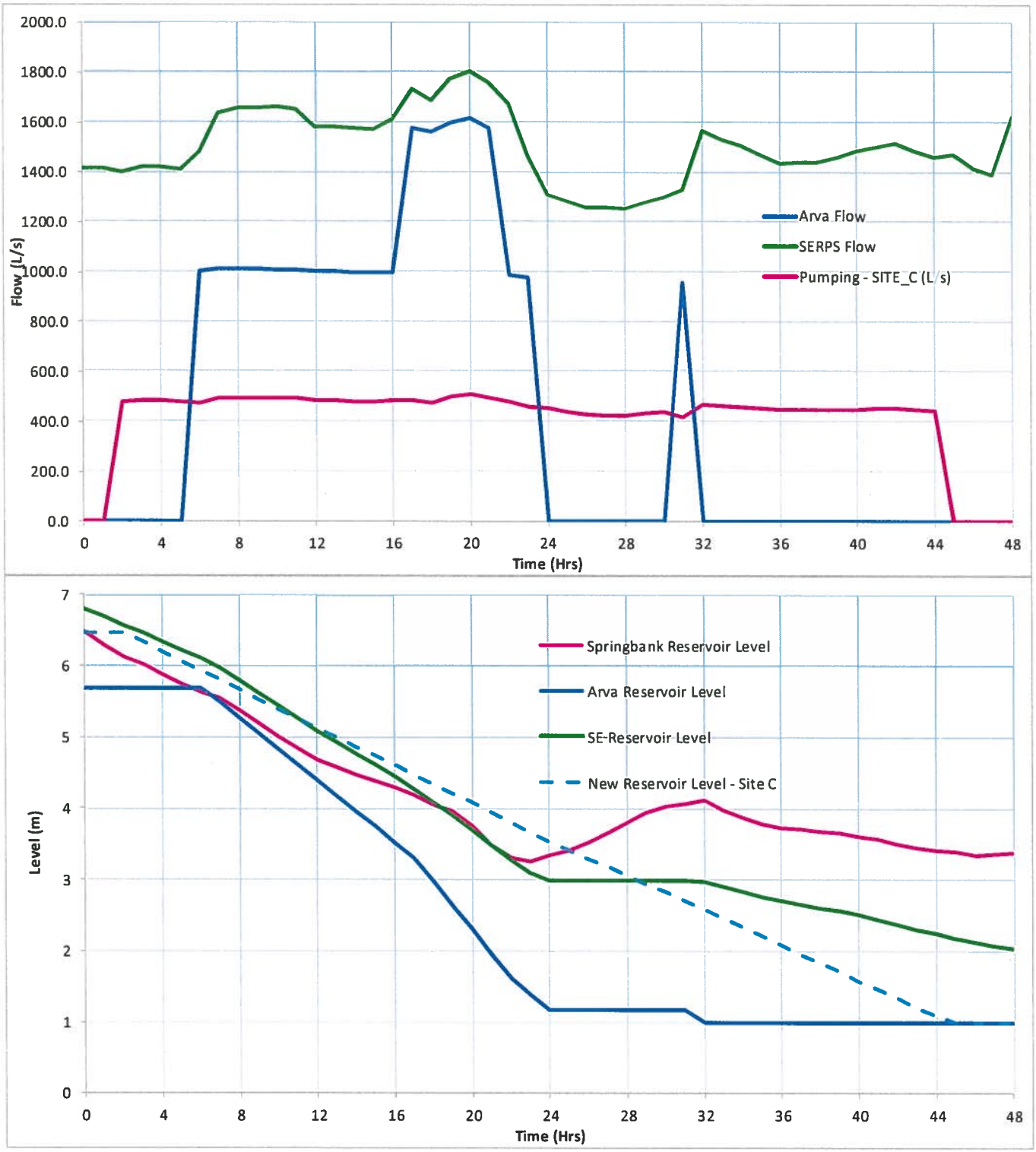


Figure 6.4: Pumping and Storage Levels – Site C (Northeast system – Pumped Storage Facility)

6.1.4 Site G – Southeast Reservoir – Pumped Storage Facility

The additional storage requirement could be constructed at the existing Southeast Reservoir site. Additional future storage is planned based on future expansion of the Elgin WTP. This site has capacity for an additional storage cell. This site is discussed as follows:

- This assumes that the existing site can accommodate the required expanded storage capacity, however this must be further evaluated.
- The site has two (2) existing cells, each with a 56.5 ML capacity, for a total capacity of 113 ML.
- The facility is pumped storage via existing pumps. However in order to utilize the additional storage, additional pumps must be added (not modelled).
- Infrastructure requirements - Pipe and valve connections would be required from the existing reservoir cell to the new reservoir cell and to the existing pumping station. Standby power capacity should be available at the station to operate pumps during an emergency.
- System hydraulics under an emergency condition:
    - Table 7.1 shows the number and percent of model nodes with deficient pressure for the entire system and within the northeast section of the system.
    - As shown on the table, deficient pressures are not improved from those modelled for Site A.
- Figure 6.6 shows Arva PS and SERPS pumping as well as reservoir levels for the emergency simulation:
    - Generally, the Arva PS 700 HP pump is operating during most of the first day (MDD), with the Arva PS large pump (900 HP) operated during the peak hour demand period to maintain pressure.
    - For the second day (ADD), a 700 HP pump is on as required to maintain pressure, such that the reservoir level stays above the minimum level. With the added storage, one 700 HP pump can be operated for most of the second day and still maintain the required storage.
    - As shown on the figure, SERPS levels gradually drop, however the full storage is not utilized as the maximum existing large pumps are used. Additional large pumps would be required to fully utilize the storage.
- Fire flow capacity was tested under emergency conditions for comparison of MDD (1 x 700 HP pumps) and ADD (no Arva PS pumps):
    - Similar results as Site A.
- Impact on normal system operations:
    - Would not impact current operations for the City, would only require additional recirculation to maintain water quality and additional pumping during an emergency to maintain pressures.
- Water quality:
    - New storage capacity will increase system water volume and hence the residence time for water within the reservoir going into London. Rechlorination is already in place at the Southeast PS, so this would likely not be an impact for the London water system.
- Impact on transients – There would be no impact on transients relative to existing conditions.
- Impact on pumping energy and cost - This would not increase pumping energy during normal operations.

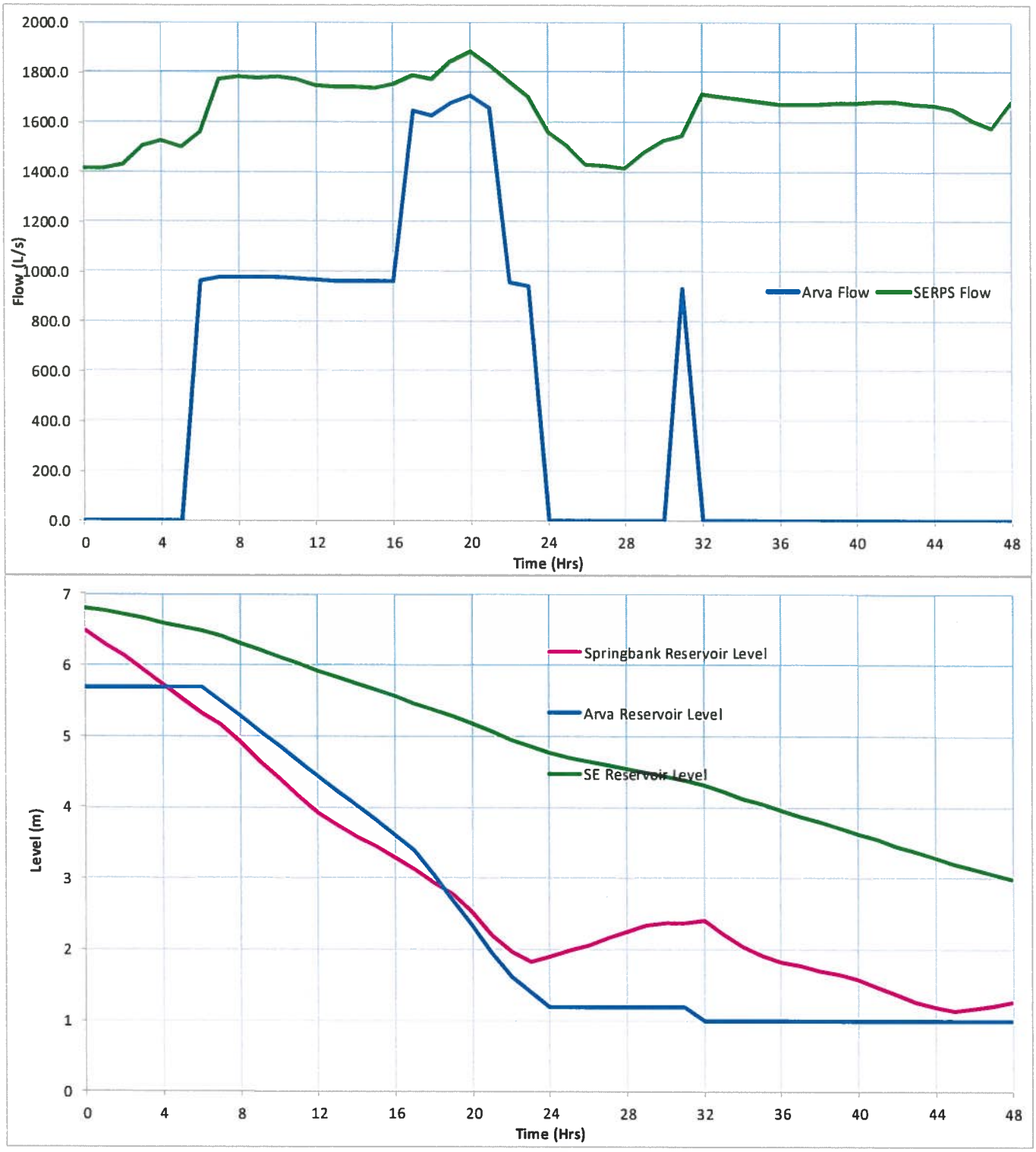


Figure 6.5: Pumping and Storage Levels – Site G (Southeast Reservoir – Pumped Storage Facility)

6.1.5 Site I - Arva Reservoir and Pumping Station

The additional storage requirement could be constructed at the existing Arva Reservoir site, assuming this site can be expanded. This site is outside of the urban boundary:

- This assumes that the existing site can accommodate the required expanded storage capacity, however this must be further evaluated.
- The site has four (4) existing cells, each with a 27.3 ML capacity, for a total capacity of 109.3 ML.
- The facility is pumped storage via existing pumps – No new pumps would be required. Arva PS has six (6) pumps. Typically only one pump (either 700 or 900 HP) is used at a time except during high demand periods, so the station should have sufficient spare pumping capacity available.
- Infrastructure requirements - Pipe and valve connections would be required from the LHPWSS to the new reservoir and to the existing reservoir and the pumping station. Standby power capacity should be available at the station to operate both a 700 and 900 HP pump during an emergency.
- System hydraulics under an emergency condition:
    - Table 7.1 shows the number and percent of model nodes with deficient pressure for the entire system and within the northeast section of the system.
    - As shown on the table, deficient pressures are improved from Site A and are approximately similar as for the pumped storage alternative (Site C).
    - This can benefit the City by allowing additional pumping from Arva PS during an emergency to maintain system pressure.
- Figure 6.6 shows Arva PS and SERPS pumping as well as reservoir levels for the emergency simulation:
    - Generally, the Arva PS 700 HP pump is operating during most of the first day (MDD), with the Arva PS large pump (900 HP) operated during the peak hour demand period to maintain pressure.
    - For the second day (ADD), a 700 HP pump is on as required to maintain pressure, such that the reservoir level stays above the minimum level. With the added storage, one 700 HP pump can be operated for most of the second day and still maintain the required storage.
    - As shown on the figure, the new storage at the Arva PS is more fully utilized than for the other location alternatives, due to the Arva PS pumping.
- Fire flow capacity was tested under emergency conditions for comparison of MDD (1 700 HP pumps) and ADD (no Arva PS pumps):
    - During emergency, one 700 HP pump can run during fire flow due to the added available storage, which was not assumed for Sites A or B.
    - Available fire flow was compared with estimated fire flow requirements for each hydrant.
    - Table 7.1 shows the number and percent of model nodes with deficient fire flow residual pressure for the entire system and within the northeast section of the system. This shows that even with the additional pump this would only provide a marginal benefit for fire flow residual pressure.
- Impact on normal system operations:
    - Would not impact current operations for the City, would only require additional recirculation to maintain water quality and additional pumping during an emergency to maintain pressures.

- Additional storage at Arva PS could benefit the RWS system due to more pumping flexibility for the LHPWSS Huron pumping station.

- Water quality:
  - A new storage capacity will increase system water volume and hence the residence time for water within the reservoir going into London. Rechlorination is already in place at the Arva PS, so this would likely not be an impact for the London water system.
  - This would need to be reviewed for the RWS system.
- Impact on transients – There would be no impact on transients relative to existing conditions.
- Impact on pumping energy and cost:
  - This would not increase pumping energy during normal operations.
  - This may benefit energy costs for both the City of London and the RWS LHPWSS system, as it will provide more flexibility for operation of the large pumps at the Arva PS and at the Lake Huron WTP during high electrical cost periods, particularly during the 5 critical electricity cost periods in Ontario.

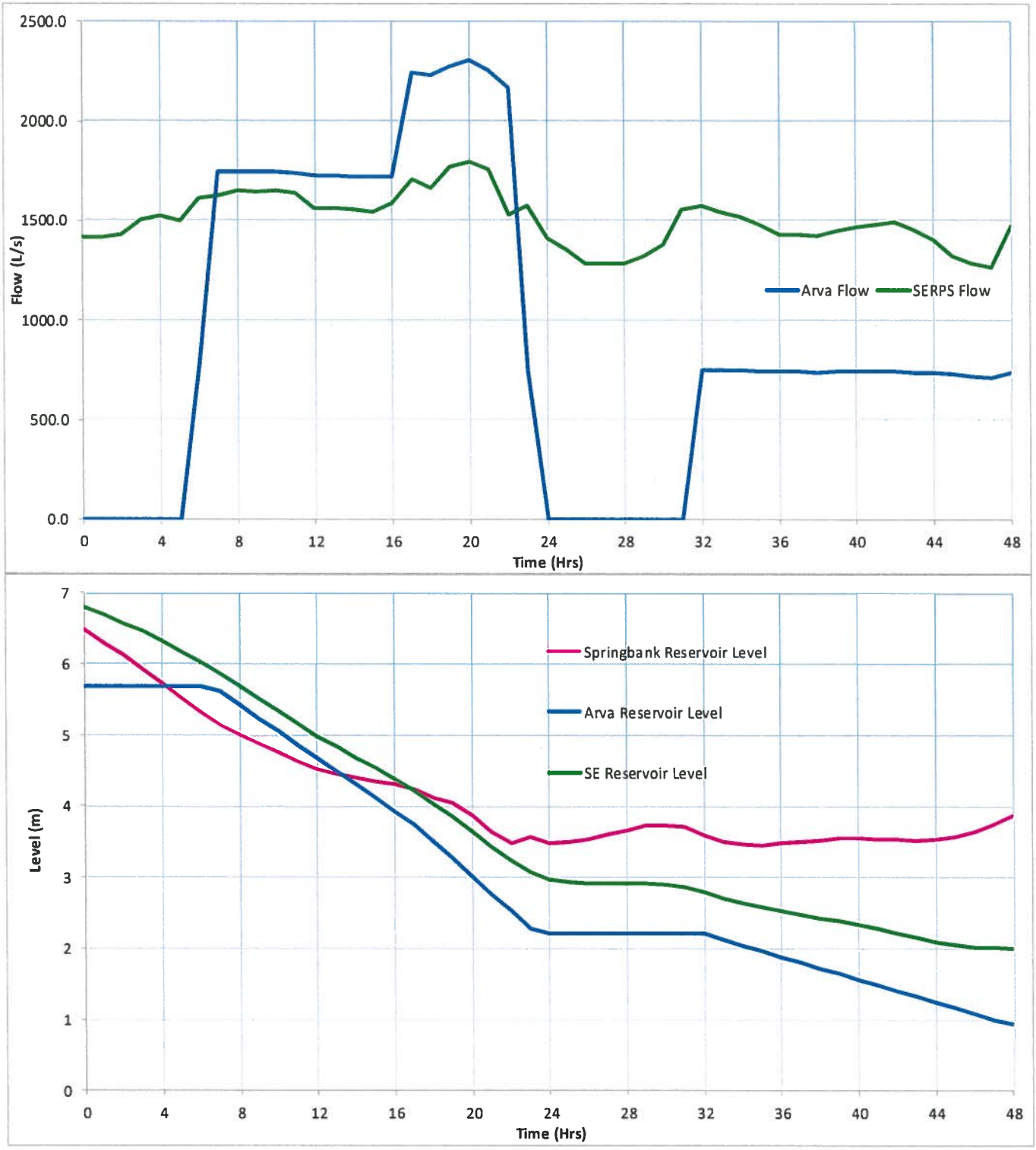


Figure 6.6: Pumping and Storage Levels – Site I (Arva Reservoir)

7. Storage Evaluation Summary

Model results were discussed in the previous Sections 6.1.1, 6.1.2, 6.1.3, 6.1.4. and 6.1.5. Graphics for pumping and storage utilization are shown in Figure 6.2, Figure 6.3, Figure 6.4, Figure 5 and Figure 6.6.

- Table 7.1 shows the number model nodes with deficient operating pressure and fire flow pressure for the entire system and within the northeast section of the system. Results for Site G (SERPS) are similar to site A so are not shown.
- Figure 7.1 shows a comparison of pressures at the Clark-Huron Chamber for each of the storage site alternatives for the emergency runs. This shows the lowest pressure would occur for Site A – Vicinity of existing Springbank Reservoirs (floating storage) and the best pressure for either Site C – Central east system (pumped storage) or Site I – Arva Reservoir (pumped storage). Results for Site G (SERPS) are similar to site A so are not shown.
- Table 7.2 shows a graphical summary of the major criteria discussed in the previous sections for the modelled storage facility location alternatives.

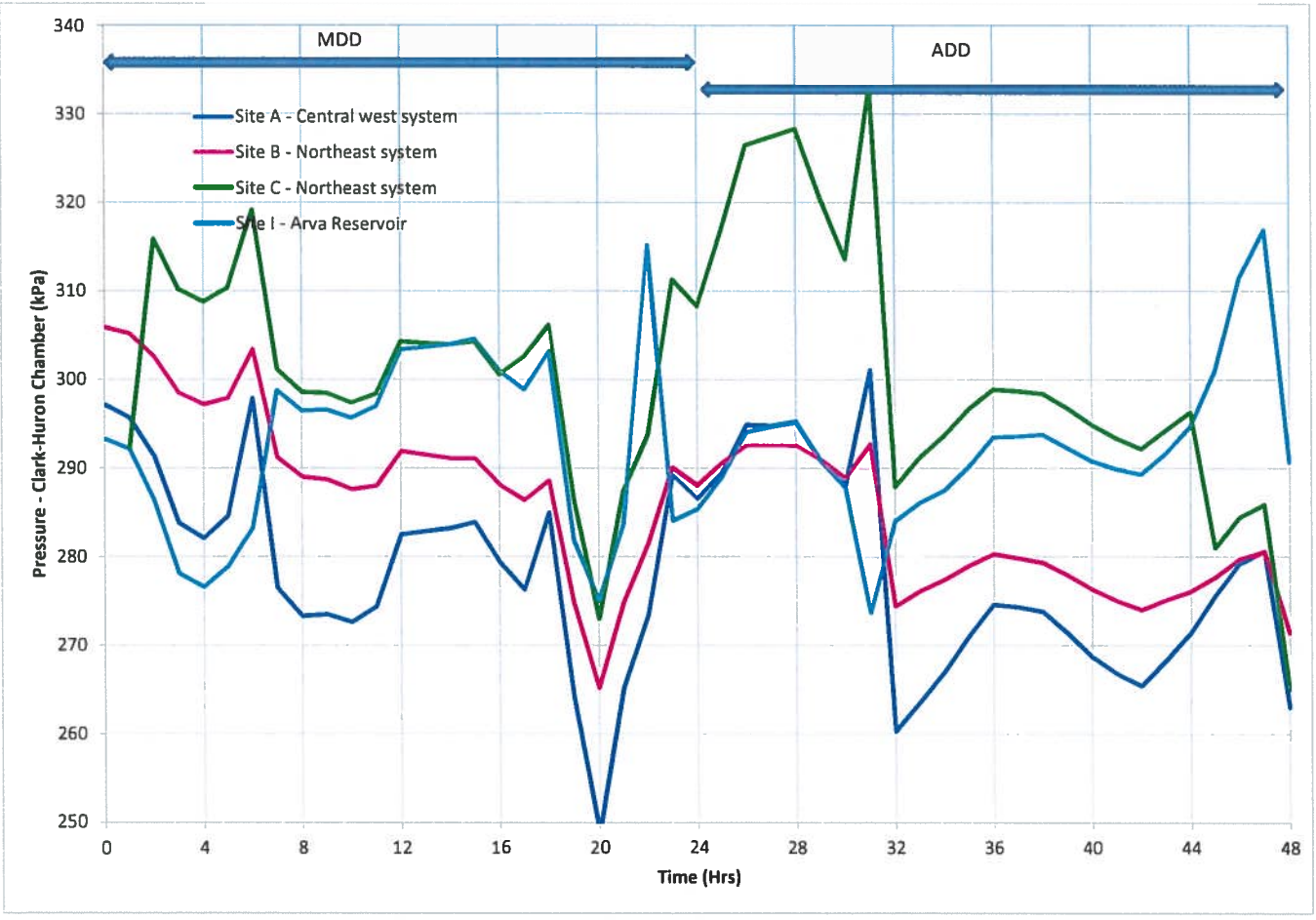


Figure 7.1: Clark – Huron Chamber Pressure Comparison

Table 7.1 – Alternative Storage Site Evaluation Summary

Storage Sites	System Location	Comment	Ground Elevation (m)	Storage Type	No. Nodes Deficient Pressure - Entire System (1)		No. Nodes Deficient Pressure NE Section (1)		Minimum Pressure - NE Section (kPa) (1)	Average Pressure - NE Section (kPa) (1)	No. Nodes Deficient Pressure - Critical Customers (1)	No. Nodes Deficient FF - MDD Entire System (2) (3)		No. Nodes Deficient FF - ADD Entire System (2) (4)		No. Nodes Deficient FF ADD NE Section (2) (4)	
A	Central west system	Vicinity of existing Springbank Reservoir	300.0	Floating on zone	3010	7.9%	1362	14.7%	189	358	5	1808	21.5%	1694	20.2%	562	6.7%
B	Northeast system	Modelled - Thorndale Road between Nissouri Road and Purple Hill Road	300.0	Floating on zone	2451	6.5%	680	7.3%	205	367	4	1793	21.3%	1689	20.1%	557	6.6%
C	Northeast system	Vicinity of Clarke Road between Huron Street and Fanshawe Park Road	274.4	Pumped ground storage - new pumping station	2104	5.6%	426	4.6%	205	373	3	1716	20.4%	1594	19.0%	531	6.3%
G	Southeast Reservoir	Twin existing reservoir	270.8	Pumped storage	3010	7.9%	1362	14.7%	189	358	5	1808	21.5%	1694	20.2%	531	6.3%
I	Arva Reservoir	Expand existing reservoir	282.9	Pumped storage - existing Arva PS	1331	3.5%	165	1.8%	216	390	2	1679	20.0%	1575	18.7%	531	6.3%

Table 7.2 – Alternative Storage Evaluation

Storage Sites	System Location	Comment	Ground Elevation (m)	Storage Type	Hydraulics	Energy	Transients	Operations	Infrastructure Requirements
A	Central west system	Vicinity of existing Springbank Reservoir	300.0	Floating on zone					
B	Northeast system	Modelled - Thorndale Road between Nissouri Road and Purple Hill Road	300.0	Floating on zone					
C	Northeast system	Vicinity of Clarke Road between Huron Street and Fanshawe Park Road	274.4	Pumped ground storage - new pumping station					
G	Southeast Reservoir	Twin existing reservoir	270.8	Pumped storage					(1)
I	Arva Reservoir	Expand existing reservoir	282.9	Pumped storage - existing Arva PS					(2)

No major issues
Minor to moderate issues
Likely significant issues

(1) - New pumps required
(2) - No new pumps required

8. Summary and Recommendations

City of London water storage requirements were estimated to the year 2054 based on an emergency condition of the LHPWSS water supply water off-line for one (1) maximum day followed by one (1) average day, or a duration of 48 hours. This determined that approximately 200 ML of additional storage would be required by the year 2054. This assumes that the existing Springbank Reservoir No. 2 would be decommissioned.

Required storage was assessed using the hydraulic model for the year 2034, for which approximately 50% of the required additional 2054 storage would be required, or 100 ML. Two types of storage was reviewed, namely floating storage and pumped storage.

Feasible sites for floating storage would require operating elevations equivalent to the existing Springbank Reservoirs. There are limited opportunities for floating storage within the system, primarily within the northeast portion of the system, outside of Municipal boundaries. A high level review of nine general storage locations was completed. Five (5) alternative general storage locations were reviewed in additional detail based on hydraulics. Modelled sites included expanded floating storage in the vicinity of the existing Springbank Reservoir site (Site A), floating storage within the Northeast portion of the water system (Site B), pumped storage in the Central east system (Site C), expanded pumped storage at Southeast Reservoir (Site G) and expanded pumped storage at Arva Reservoir (Site I). The evaluation does not consider constructability, storage land area requirements or evaluation of specific storage sites.

A 48-hour simulation was used, consisting of a maximum day demand, followed by an average day demand period for the LHPWSS off-line. The existing system shows pressure deficiencies within the northeast area of the system and around Wonderland Road between Sarnia Road and Fanshawe Park Road under the emergency condition. The objective was to determine the ability of the storage alternatives to supply sufficient pressures to the water system under the emergency condition.

The assessment determined the following:

- Addition of storage within close proximity to the Springbank Reservoir site (Site A), which is the only alternative within the City limits with sufficient elevation, would not provide improvements to pressures within the northeast area of the water system under the emergency condition.
- Floating storage within the northeast portion of the water system (Site B), which has sufficient ground elevations, however is outside of the municipal boundary, would partially improve pressures within the northeast portion of the water system. This site would require extensive transmission infrastructure and may present additional water quality and operational issues.
- Pumped (ground) storage (Site C or Site I) would provide the best pressure within the northeast corner of the system. The provision of new ground storage with re-pumping would substantially improve pressures, however this would present energy management and transient issues for the system, as well as operational issues to fill the new reservoir.
- Additional storage at the existing Southeast Reservoir (Site G) would be feasible, however this would not provide improvements to pressures within the northeast portion of the water system with the LHPWSS off-line and would require the installation of additional pumps. The addition of the additional 100 ML, required for the year 2054, could be evaluated for this site.
- Expansion of additional storage at the Arva PS (Site I), if feasible, would allow added pumping to the system from the existing Arva PS pumps during the emergency condition to improve pressures. This reservoir is under the jurisdiction of the LHPWSS. No new pumping station or new pumps would be required. The feasibility and constructability of added storage at this site must be evaluated. Added storage at this location would also provide energy cost savings opportunities for the LHPWSS by providing the flexibility to operate pumps and reservoir filling, however this must be reviewed in additional detail by both the City of London and RWS.

The following is recommended based on the study:

- Environmental Assessment (EA) evaluation should be conducted to determine the preferred site. As part of the EA evaluation, detailed evaluations of constructability, infrastructure requirements, operations, hydraulics and transients should be carried out.
- Energy optimization opportunities for both the City of London and the LHPWSS using the expanded storage should be evaluated with the preferred storage site.
- Ensure that sufficient standby power is available at the Arva PS to operate at least one 900 HP pump. Based on the record drawings of the station, the system is set up for twin services (London Hydro and Ontario Hydro) however it is not known whether this is currently in service. There is no generator for the pumps.

AECOM

Appendix B.2

Natural Heritage Background Review

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Memorandum

To	Nancy Martin, (AECOM), Emily McNaughton (AECOM)	Page	1
CC	Adam McClelland (AECOM), Gary Epp (AECOM), John Haasen (AECOM)		
Subject	**Water Storage Options Environmental Assessment – Preliminary Natural Heritage Background Review**		
From	Brandon Holden (AECOM)		
Date	January 8, 2019 (revised)	Project Number	60569302

1. Introduction

This preliminary background review was conducted to identify existing natural heritage features, Species at Risk (SAR) and Species of Conservation Concern (SOCC) occurrences within the six candidate sites under investigation as part of the Water Storage Options Environmental Assessment in London, Ontario. The following sources were searched for relevant information:

- Ontario Breeding Bird Atlas (OBBA);
- Ontario Nature Reptile and Amphibian Atlas;
- Ontario Butterfly Atlas;
- Bat Conservation International Species Range Maps;
- Natural Heritage Information Centre (NHIC) Make-A-Map Application;
- Fisheries and Oceans Canada (DFO) Aquatic Species at Risk mapping;
- City of London's The London Plan Natural Heritage System mapping (Map 5); and,
- Middlesex County Official Plan natural heritage mapping.

In addition, the following background reports were reviewed and used to inform site existing conditions:

North Huron Subject Lands Status Report (AECOM 2015)

AECOM completed a Subject Lands Status Report (SLSR) for the North Huron Lands in 2015. Portions of the study area included as part of this study falls within the Site C candidate parcels. Vegetation communities identified within the North Huron SLSR (AECOM 2015) include Mineral Swamp Thicket, Mineral Deciduous Swamp, Deciduous Forest and Mineral Meadow Marsh. These communities form part of the North Huron Significant Woodlands.

The Cameron Award Drain is also present within the study area. Based on previous MNRF correspondence, species known with the Cameron Award Drain include: Brook Stickleback (*Culaea inconstans*), Pumpkinseed (*Lepomis gibbosus*), Northern Redbelly Dace (*Chrosomus eos*), Bluntnose Minnow (*Pimephales notatus*), and Emerald Shiner (*Notropis atherinoides*). These species are all common within Ontario.

Although a preliminary wetland evaluation was completed by AECOM in 2015 as part of the North Huron SLSR, additional surveys would be required to determine wetland significance. These surveys would include bat acoustic monitoring to confirm the presence of SAR bats. One Species of Conservation Concern, Snapping Turtle (*Chelydra serpentina*), was observed within the meadow marsh community on site. Habitat for this species is considered Significant Wildlife Habitat.

Southeast Reservoir Subject Lands Status Report (Earth Tech Canada Inc. 2004)

Earth Tech Canada Inc. completed a Subject Lands Status Report (SLSR) for the Southeast Reservoir lands in 2004. A portion of the study area investigated for this report falls within the Site G candidate parcel. Vegetation communities identified within the parcel include Deciduous Forest, Mineral Deciduous Swamp and Mineral Meadow Marsh. These communities form part of the Significant Woodlands identified in the SLSR.

A provincially rare plant, sweet Joe pyeweed (*Eupatorium purpureum*), which has an NHIC S-rank of S3, was identified within the Mineral Deciduous Swamp community.

Southeast Reservoir & Pumping Station Environmental Impact Study (Earth Tech Canada Inc, 2005).

Earth Tech Canada Inc. completed an Environmental Impact Study (EIS) for the Southeast Reservoir lands in 2015, to follow up the Southeast Reservoir Subject Lands Status Report (2004) mentioned above. No new significant features or species were identified.

The findings for each of the four candidate sites are summarized in **Section 2**, below. The location of these findings relative to the proposed reservoir footprints at each site are described in **Section 3**.

2. Results

2.1 Site A1 – Springbank Pumping Station and Reservoir A

Site A1 is located in west London and is bordered by Springbank Drive, Commissioner's Road West, Crestwood Drive and Longworth Road. The London Plan Natural Heritage System mapping (Map 5) identifies the following natural features within the study area:

- Woodlands.

The Study Area for site A1 can be found on **Attachment A, Figure A1**.

2.1.1 Vegetation Communities and Plants

The woodland overlapping Site A1 is approximately 9.77 hectares in size, and through the completion of aerial photo interpretation, deciduous forest and cultural meadow communities were identified as likely present. Field investigations to confirm these communities should be competed at detailed design. In addition to these natural communities, Site A contains open space parkland dominated by manicured lawn and trees. Also contained within these lands are the existing Springbank Reservoir and Pumping Station.

2.1.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site A1, it was found that habitat for 18 Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B1**.

Table 1. Terrestrial SAR and SOCC with Potential Habitat in Site A

Common Name	Scientific Name	ESA Status
Jefferson Salamander	*Ambystoma jeffersonianum / laterale*	END
American Chestnut	*Castanea dentata*	END
False Hop Sedge	*Carex lupuliformis*	END
Butternut	*Juglans cinerea*	END
Eastern Flowering Dogwood	*Cornus florida*	END
American Badger	*Taxidea taxus*	END
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END
Chimney Swift	*Chaetura pelagica*	THR
Bobolink	*Dolichonyx oryzivorus*	THR
Barn Swallow	*Hirundo rustica*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Eastern-Hog nosed Snake	*Heterodon platirhinos*	THR
Monarch	*Danaus plexippus*	SC
Eastern Wood-Peewee	*Contopus virens*	SC
Wood Thrush	*Hylocichla mustelina*	SC

2.1.3 Aquatic Species

According to DFO aquatic SAR mapping, no aquatic SAR were identified within the vicinity of Site A1. No watercourses are present within the site or immediately adjacent lands. However, the Thames River is located approximately 150 metres north of the study area and is known to contain aquatic SAR.

2.1.4 Summary

As described above, Site A1 contains:

- Deciduous forest and cultural meadow communities; and,
- Potential for 18 Species at Risk & SOCC.

Further field investigations would be required to confirm the presence of suitable habitat for SAR, vegetation communities, wildlife habitat and to confirm absence of watercourses.

2.2 Site A2 – Springbank Pumping Station and Reservoir B

Site A2 is located in west London and is bordered by Springbank Drive, Commissioner's Road West, Crestwood Drive and Longworth Road. The London Plan Natural Heritage System mapping (Map 5) identifies the following natural features within the study area:

- Woodlands.

The Study Area for site A can be found on **Attachment A, Figure A2**.

2.2.1 Vegetation Communities and Plants

The woodland overlapping Site A2 is approximately 9.77 hectares in size, and through the completion of aerial photo interpretation, deciduous forest and cultural meadow communities were identified as likely present. Field investigations to confirm these communities should be competed at detailed design. In addition to these natural communities, Site A2 contains open space parkland dominated by manicured lawn and trees. Also contained within these lands are the existing Springbank Reservoir and Pumping Station.

2.2.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site A2, it was found that habitat for 18 Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B1**.

Table 2. Terrestrial SAR and SOCC with Potential Habitat in Site A

Common Name	Scientific Name	ESA Status
Jefferson Salamander	*Ambystoma jeffersonianum / laterale*	END
American Chestnut	*Castanea dentata*	END
False Hop Sedge	*Carex lupuliformis*	END
Butternut	*Juglans cinerea*	END
Eastern Flowering Dogwood	*Cornus florida*	END
American Badger	*Taxidea taxus*	END
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END
Chimney Swift	*Chaetura pelagica*	THR
Bobolink	*Dolichonyx oryzivorus*	THR
Barn Swallow	*Hirundo rustica*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Eastern-Hog nosed Snake	*Heterodon platirhinos*	THR

Monarch	*Danaus plexippus*	SC
Eastern Wood-Peewee	*Contopus virens*	SC
Wood Thrush	*Hylocichla mustelina*	SC

2.2.3 Aquatic Species

According to DFO aquatic SAR mapping, no aquatic SAR were identified within the vicinity of Site A2. No watercourses are present within the site or immediately adjacent lands. However, the Thames River is located approximately 150 metres north of the study area and is known to contain aquatic SAR.

2.2.4 Summary

As described above, Site A2 contains:

- Deciduous forest and cultural meadow communities; and,
- Potential for 18 Species at Risk & SOCC.

Further field investigations are required to confirm the presence of suitable habitat for SAR, vegetation communities, wildlife habitat and to confirm absence of watercourses.

2.3 Site A3 – Springbank Pumping Station and Reservoir C

Site A3 is located in west London and is bordered by Springbank Drive, Commissioner's Road West, Crestwood Drive and Longworth Road. The London Plan Natural Heritage System mapping (Map 5) identifies the following natural features within the study area:

- Woodlands.

The Study Area for site A can be found on **Attachment A, Figure A3**.

2.3.1 Vegetation Communities and Plants

The woodland overlapping Site A3 is approximately 9.77 hectares in size, and through the completion of aerial photo interpretation, deciduous forest and cultural meadow communities were identified as likely present. Field investigations to confirm these communities should be competed at detailed design. In addition to these natural communities, Site A3 contains open space parkland dominated by manicured lawn and trees. Also contained within these lands are the existing Springbank Reservoir and Pumping Station.

2.3.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site A3, it was found that habitat for 18 Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B1**.

Table 3. Terrestrial SAR and SOCC with Potential Habitat in Site A

Common Name	Scientific Name	ESA Status
Jefferson Salamander	*Ambystoma jeffersonianum / laterale*	END
American Chestnut	*Castanea dentata*	END
False Hop Sedge	*Carex lupuliformis*	END
Butternut	*Juglans cinerea*	END
Eastern Flowering Dogwood	*Cornus florida*	END
American Badger	*Taxidea taxus*	END
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END
Chimney Swift	*Chaetura pelagica*	THR
Bobolink	*Dolichonyx oryzivorus*	THR
Barn Swallow	*Hirundo rustica*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Eastern-Hog nosed Snake	*Heterodon platirhinos*	THR
Monarch	*Danaus plexippus*	SC
Eastern Wood-Peewee	*Contopus virens*	SC
Wood Thrush	*Hylocichla mustelina*	SC

2.3.3 Aquatic Species

According to DFO aquatic SAR mapping, no aquatic SAR were identified within the vicinity of Site A3. No watercourses are present within the site or immediately adjacent lands. However, the Thames River is located approximately 150 metres north of the study area and is known to contain aquatic SAR.

2.3.4 Summary

As described above, Site A3 contains:

- Deciduous forest and cultural meadow communities; and,
- Potential for 18 Species at Risk & SOCC.

Further field investigations are required to confirm the presence of suitable habitat for SAR, vegetation communities, wildlife habitat and to confirm absence of watercourses.

2.4 Site C – Huron Street and Clark Road

Site C is located in northeast London, northeast of the intersection of Huron Street and Clark Road and includes 9 different parcels of land. The site also includes two properties west of Clark Road. The London Plan Natural Heritage System mapping (Map 5) identifies the following natural heritage features within the study area:

- Significant Woodlands;
- Valleylands;
- An Unevaluated Vegetation Patch (which was evaluated by AECOM in 2015);
- Unevaluated wetland patches; and,
- Potential Environmentally Significant Areas.

The study area predominately consists of agricultural land with small portions of natural heritage features as described above. The study area for Site C can be found on **Attachment A, Figure A4**.

AECOM has completed a Subject Lands Status Report (SLSR) for the lands known ad North Huron Industrial Lands which include the six (6) parcels of land situated east of Clarke Road. Information from the SLSR was used to inform the present review.

2.4.1 Vegetation Communities and Plants

Vegetation communities located within Site C as identified within the North Huron SLSR (AECOM, 2015) include Mineral Swamp Thicket, Mineral Deciduous Swamp, Deciduous Forest and Mineral Meadow Marsh. These communities form part of the North Huron Significant Woodlands. The 2015 report also identified a Significant Valleyland, Environmentally Significant Areas (ESAs) and potential ESAs as identified within the study area. The vegetation communities contained within the Site C candidate lot is approximately 8.72 hectares in size. The agricultural lands within the Site C candidate lot cover 96.91 hectares.

2.4.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site C, it was found that habitat for 20 terrestrial Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B2**.

Table 4. Terrestrial SAR and SOCC Records with Potential Habitat in Site C

Common Name	Scientific Name	ESA Status
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END
Drooping Trillium	*Trillium flexipes*	END
Silver Shiner	*Notropis photogenis*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Bank Swallow	*Riparia riparia*	THR
Barn Swallow	*Hirundo rustica*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Chimney Swift	*Chaetura pelagica*	THR

Common Name	Scientific Name	ESA Status
Eastern Wood-pewee	*Contopus virens*	SC
Common Nighthawk	*Chordeiles minor*	SC
Eastern Wood-pewee	*Contopus virens*	SC
Wood Thrush	*Hylocichla mustelina*	SC
Bald Eagle	*Haliaeetus leucocephalus*	SC
Red-headed Woodpecker	*Melanerpes erythrocephalus*	SC
Eastern Ribbonsnake	*Thamnophis sauritus*	SC
Monarch	*Danaus plexippus*	SC
Snapping Turtle	*Chelydra serpentina*	SC

The 2015 SLSR indicated that bat acoustic monitoring to confirm the presence of SAR bats had not been complete and one Species of Conservation Concern, Snapping Turtle (*Chelydra serpentina*), was observed within the meadow marsh community on site. Habitat for this species is considered Significant Wildlife Habitat.

2.4.3 Aquatic

During background review, Silver Shiner (*Notropis photogenis*) (THR) was identified in NHIC records; however, suitable aquatic habitat was not identified during aquatic surveys in 2015 within the Site C study area. The Thames River is located approximately 100 metres north of the study area and contains SAR.

The Cameron Award Drain is present within the study area and provides aquatic habitat. Based on previous MNRF correspondence, species known to occur within the Cameron Award Drain include: Brook Stickleback (*Culaea inconstans),* Pumpkinseed (*Lepomis gibbosus*), Northern Redbelly Dace (*Chrosomus eos*), Bluntnose Minnow (Pimephales notatus), and Emerald Shiner (*Notropis atherinoides*). These species are all common within Ontario.

Depending on which parcel or parcels are selected for a reservoir location, further correspondence with UTRCA may need to be completed as a portion of the study area falls within the regulation limit.

2.4.4 Summary

As described above, Site C contains:

- Significant Woodlands, Significant Valleylands, Environmentally Significant Areas;
- Mineral Swamp Thicket, Mineral Deciduous Swamp, Deciduous Forest and Mineral Meadow Marsh;
- Potential for 20 Species at Risk & SOCC; and,
- Confirmed presence of 1 SAR and 1 SOCC: Barn Swallow and Snapping Turtle.

Further field investigations are required to confirm the presence of suitable habitat for SAR and to confirm vegetation communities.

2.5 Site G – Southeast Pumping Station and Reservoir

Site G is located in southeast London, south of Highway 401. The site is located on the east side of Highbury Avenue South, south of Westminster Drive. The London Plan Natural Heritage System mapping (Map 5) identifies the following natural heritage features within the study area:

- Significant Woodlands; and
- Unevaluated Valleylands.

The study area for Site G can be found on **Attachment A, Figure A5**. Mapping also identifies Unevaluated Wetland and Unevaluated Valleyland patches within the Significant Woodland, however these patches are located outside the Site G study area.

In 2004 and 2005, Earth Tech Canada (now AECOM) completed a Subject Lands Status Report and Environmental Impact Study report, respectively, for the Southeast Pumping Station and Reservoir In lands. Information from these previous studies was used to inform the present review.

2.5.1 Vegetation Communities and Plants

Vegetation communities identified within the SLSR completed in 2004 by Earth Tech identified Deciduous Forest, Mineral Deciduous Swamp and Mineral Meadow Marsh. These communities form part of the Significant Woodland located in the eastern portion of Site G. This Significant Woodland is approximately 14 hectares in size, of which approximately 1.29 hectares falls within the candidate lot boundary. Unevaluated Valleylands and Unevaluated Wetlands were also identified; however, are located outside of the candidate lot.

A provincially rare plant, sweet Joe pye-weed (*Eupatorium purpureum*), a provincially rare species (S3), was identified within the Mineral Deciduous Swamp community located in Site G. Field investigations to confirm the location of this species as well as the wetland community boundary should be completed, as previous work completed for this site was conducted in 2004 and is now considered out of date.

2.5.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site G; habitat for 13 terrestrial Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B3**.

Table 5. Terrestrial SAR and SOCC with Potential Habitat in Site G

Common Name	Scientific Name	ESA Status
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END

Common Name	Scientific Name	ESA Status
Butternut	*Juglans cinerea*	END
Barn Swallow	*Hirundo rustica*	THR
Bobolink	*Dolichonyx oryzivorus*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Red-headed Woodpecker	*Melanerpes erythrocephalus*	SC
Eastern Ribbonsnake	*Thamnophis sauritus*	SC
Golden-winged Warbler	*Vermivora chrysoptera*	SC
Eastern Wood-pewee	*Contopus virens*	SC
Wood Thrush	*Hylocichla mustelina*	SC

2.5.3 Aquatic

According to DFO aquatic SAR mapping, no aquatic SAR were identified within the vicinity of the study area. A small portion of Perl Drain is identified in the southwest corner of the study area and therefore also falls within the UTRCA's Regulation Limit.

2.5.4 Summary

As described above, Site G contains:

- Significant Woodland, Unevaluated Valleylands;
- Potential for 13 Species at Risk & SOCC; and,
- One provincially rare species, sweet Joe pye-weed was identified in the Mineral Deciduous Swamp.

Further field investigations are required to confirm the presence of suitable habitat for SAR, to confirm vegetation community boundaries and the location of the provincially rare sweet Joe-pye weed.

2.6 Site I – Arva Pumping Station and Reservoir

Site I is located on Medway Road east of Wonderland Road North. This site lies just north of the city limits, in Middlesex County. The Middlesex County Official Plan natural heritage mapping identified Significant Woodlands within the study area. This feature is approximately 15 hectares in size of which 1.56 hectares falls within the study area. According to the Middlesex Natural Heritage Study Mapping the boundaries of the patch extends beyond the tree line and includes open field. The woodland boundary should be confirmed through field investigations.

The study area for Site I can be found on **Attachment A, Figure A6**.

2.6.1 Vegetation Communities and Plants

The woodland contained within Site I candidate lot is approximately 1.56 hectares in size. Based on aerial photo interpretation, deciduous forest and open field communities are likely present. Field investigations to confirm communities should be competed at detailed design.

2.6.2 Species at Risk

After a review of background documents and the completion of a preliminary SAR screening of existing conditions within Site I; habitat for 9 terrestrial Species at Risk and Species of Conservation Concern may be present. For a complete SAR screening for species identified through background review please see **Attachment B, Table B4**.

Table 6. Terrestrial SAR and SOCC with Potential Habitat in Site I

Common Name	Scientific Name	ESA Status
Northern Myotis	*Myotis septentrionalis*	END
Little Brown Myotis	*Myotis lucifugus*	END
Tri-coloured Bat	*Perimyotis subflavus*	END
Eastern Small-footed Myotis	*Myotis leibii*	END
Northern Bobwhite	*Colinus virginianus*	END
Barn Swallow	*Hirundo rustica*	THR
Chimney Swift	*Chaetura pelagica*	THR
Bobolink	*Dolichonyx oryzivorus*	THR
Eastern Meadowlark	*Sturnella magna*	THR
Eastern Hog-nosed Snake	*Heterodon platirhinos*	THR
Wood Thrush	*Hylocichla mustelina*	SC
Eastern Wood-pewee	*Contopus virens*	SC
Monarch	*Danaus plexippus*	SC

2.6.3 Aquatic

During the background review, Wavy-rayed Lampmussel (*Lampsilia fasciola*) (THR) was identified in NHIC records; however, aquatic habitat was not identified within the Site I study area. According to DFO aquatic SAR mapping, no aquatic SAR were identified within the vicinity of the study area. Field investigations to confirm absence of watercourses should be completed at Detailed Design.

2.6.4 Summary

As described above, Site I contains:

- Significant Woodland, and
- Potential for 9 Species at Risk & SOCC

Further field investigations are required to confirm the presence of suitable habitat for SAR and to confirm vegetation communities.

3. Overall Summary of Existing Conditions

The following provides a summary of the Natural Heritage Features present within each Candidate Parcel:

Site A1: Springbank Pumping Station and Reservoir A

- Contains Woodlands as per The London Plan which falls within the proposed reservoir footprint; and,
- Potential habitat for 18 SAR/SOCC exists within the proposed reservoir footprint.

Site A2: Springbank Pumping Station and Reservoir B

- Contains Woodlands as per The London Plan which falls within the proposed reservoir footprint; and,
- Potential habitat for 18 SAR/SOCC exists within the proposed reservoir footprint.

Site A3: Springbank Pumping Station and Reservoir C

- Contains Woodlands as per The London Plan which falls within the proposed reservoir footprint; and,
- Potential habitat for 18 SAR/SOCC exists within the proposed reservoir footprint.

Site C: Huron Street and Clarke Road

- Contains Significant Woodlands, Valleylands, Unevaluated Wetland patches and Unevaluated Vegetation patches as per The London Plan (this patch has since been evaluated through the completion of the North Huron Subject Lands Status Report (AECOM, 2015). All features are considered to fall within the proposed reservoir footprint as a proposed location has not yet been determined;
- One SAR (Barn Swallow) and one SOCC (Snapping Turtle) were observed on-site during previous studies. All SAR are considered to fall within the proposed reservoir footprint as the location has not yet been determined;
- Four SAR/SOCC could not be ruled out during previous studies. These species include Little Brown Myotis, Northern Myotis, Small-footed Myotis and Monarch. Additional surveys are needed to confirm the presence of these species; and,
- Potential habitat for 20 SAR/SOCC exists within the proposed reservoir footprint.

Site G: Southeast Reservoir and Pumping Station

- Contains Significant Woodlands which fall outside of the proposed reservoir footprint by approximately 20 m. This distance may or may not meet buffer requirements for Significant Woodlands;
- Unevaluated Valleylands fall outside of the proposed reservoir footprint by approximately 175 m;

- Unevaluated Wetlands fall outside of the proposed reservoir footprint by approximately 200 m, which should be evaluated in the future; and,
- Potential habitat for 13 SAR/SOCC exists within the proposed reservoir footprint.

Site I: Arva Pumping Station and Reservoir

- Significant Woodlands as per the Middlesex County Official Plan fall outside of the proposed reservoir footprint by approximately 30 m. This distance may or may not meet buffer requirements for Significant Woodlands; and,
- Potential habitat for 9 SAR/SOCC exists within the proposed reservoir footprint.

4. Next Steps

Through the Class EA process, Site A1 was selected as the preferred alternative. Works at this site would require an Environmental Impact Study (EIS) as proposed works are within the City of London trigger distance (Significant Woodland) for the completion of an EIS. Surveys for the EIS should include:

- Ecological Land Classification and Floral Inventory
- Breeding Bird Surveys
- Significant Wildlife Habitat assessments
- Surveys for migratory bird nests and other wildlife or wildlife features
- Tree Inventory

Correspondence with the MNRF would be required to determine expectations relating to targeted Species at Risk surveys.

The EIS should use results of the targeted surveys to refine the existing conditions of the Study Area. An assessment of potential impacts to existing natural heritage features should be undertaken when design details are confirmed. The EIS should also include recommendations for the implementation of avoidance, mitigation and compensation measures. Preliminary mitigation recommendations are provided in **Section 5**.

5. Mitigation Measures

The potential impacts and mitigation measures described herein are general in nature and appropriate for an Environmental Assessment. Detailed impact assessment and the provision of detailed recommendations for mitigation and compensation will be provided at the detailed design stage of the proposed works.

Sediment and Erosion Control Fencing

Mitigation measures are recommended to be used for erosion and sediment control to prohibit sediment from entering the identified vegetation communities and watercourses during construction. The primary principles associated with sedimentation and erosion protection measures are to:

1. Minimize the duration of soil exposure;
2. Retain existing vegetation, where feasible;

3. Encourage re-vegetation;
4. Divert runoff away from exposed soils;
5. Keep runoff velocities low; and,
6. Trap sediment as close to the source as possible.

Details of the type and placement of sediment and erosion control to be used will be outlined in an *Erosion and Sediment Control Plan* to de drafted during Detailed Design.

Peripheral Vegetation Protection

During construction adjacent to the identified vegetation communities, heavy equipment could damage peripheral vegetation from contact, excavation and/or soil compaction. Dust coated vegetation can reduce photosynthesis, increase susceptibility to disease and lead to death. It is anticipated that perimeter plants would be most susceptible to such effects. The following recommendations are made to mitigate these potential impacts.

- Prior to heavy machinery working adjacent to the identified vegetation communities, a fence barrier for tree protection should be installed outside the drip-line of tree identified for protection and is in the vicinity of exposure to damage by machinery.

Dust Suppressant Treatment

- Dust suppressants during dry periods should be applied to those areas which generate large amounts of dust.
- Restrict earth movement immediately adjacent to woodlands during periods of high dust generation.

Controlled Construction Vehicle Access

Construction vehicle access should be limited to areas outside of the drip-line of the tree being protected to prevent soil compaction and/or the initiation of soil erosion events. Construction vehicle re-fueling stations should be centralized away from vegetation communities and watercourses. Vehicle washing should be prohibited in areas adjacent to vegetation communities and watercourses. The following recommendations are provided to address these potential sources of impacts.

- Construction vehicle access should be limited to existing roadways and construction paths, away from the identified vegetation communities.
- For areas immediately adjacent to the Thames River, periodic supervision of the construction is recommended.

Construction Vehicle Re-fueling Stations

- Re-fueling stations should be located within a centralized location on-site a minimum of 30 m from vegetation communities, and watercourses.
- Re-fueling stations should be constructed in a manner to prevent soil and/or surface and groundwater contamination from any leaks or spills.
- An emergency response kit should be made available at each re-fueling station in case of a spill.

- All on-site crew members operating construction vehicles should be appropriately trained in handling a potential spill and have WHMIS Training.
- All chemical transfer/maintenance should be conducted within the refueling station areas.

Damage to Rooting Zones during removals

- During grading and construction in areas immediately adjacent to identified vegetation communities and planted trees, roots may be damaged by machinery and soils may be compacted, thereby affecting the trees' ability to grow and absorb nutrients and water. In order to address root damage, it will be necessary to prune roots of adjacent trees during grading and excavation. To avoid compaction of soils, root zones around trees within natural heritage features will need to be fenced. Most areas will be avoided by restricting construction to areas outside the features.

Wildlife Habitat Protection and Mitigation Measures

Construction activities within the study area have the potential to disturb breeding birds and other resident wildlife within the identified vegetation communities. A certain degree of disturbance can be avoided by the proper scheduling of construction periods. The following mitigation measures are recommended to minimize impacts to wildlife.

During the detailed design phase a more detailed wildlife observation protocol will be drafted to ensure that appropriate mitigation measures are followed for encounters with wildlife. The following presents some of the standard steps to be followed.

Breeding Birds, Bat Maternity Roosting and Vegetation Removals

- Removal of vegetation within the study areas can occur between the months of October to April, which is outside of the typical breeding bird period (April 1st to August 31st) and Bat Maternity Roosting Season (April 1st and October 1st) within southern Ontario to avoid contravening the *Migratory Birds Convention Act* and the *ESA*.

Construction Mitigation – Noise Disturbance to Resident Wildlife

- Construction is restricted to periods before and after breeding period (no works April 1st to August 31st and April 1st and October 1st).
- Limit construction activity to a period after 7 am and before 7 pm daily.

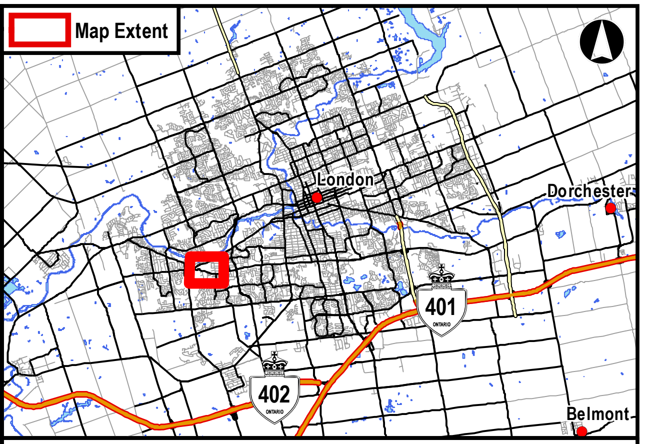
Invasive Species

Consideration should be given to the London Invasive Plant Management Strategy, including the Clean Equipment Protocol during construction activities. An Invasive Species Management Plan should be developed that includes three years of post-construction monitoring and adaptive management for invasive species.

6. Select References

City of London, 2014.
The London Plan. Available online at https://www.london.ca/business/Planning-Development/Official-Plan/Pages/The-London-Plan.aspx

Ontario Ministry of Municipal Affairs and Housing . 2014.
Provincial Policy Statement. Available online at http://www.mah.gov.on.ca/Page215.aspx



Legend

Proposed Design

- 3 to 1 Slope
- Reservoir
- Study Area

Base Layers

- Watercourse
- Waterbody
- Parcel

City Of London Natural Heritage Features

- Significant Woodlands
- Unevaluated Vegetation Patches
- Significant Valley Lands
- Unevaluated Wetlands
- Woodlands

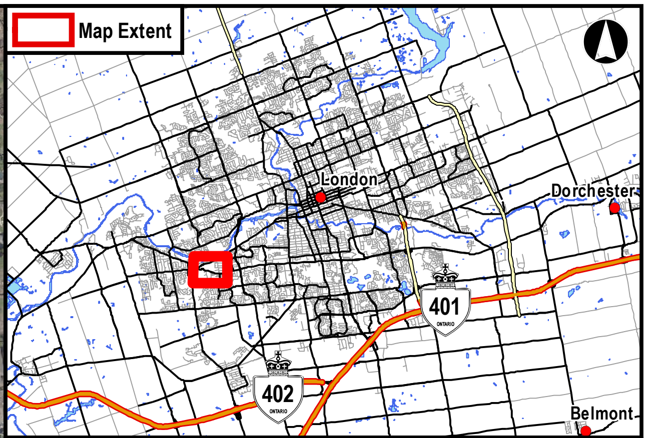
0 100 200
Meters

City of London Water Storage Options
Environmental Assessment

Site A: Option 1 - Reservoir on Reservoir #2
Footprint (Springbank PS and Reservoir)

Jan, 2019	1:5,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302	V#: 002	Figure 1

AECOM



Legend

Proposed Design

- 3 to 1 Slope
- Reservoir
- Study Area

Base Layers

- Watercourse
- Waterbody
- Parcel

City Of London Natural Heritage Features

- Significant Woodlands
- Unevaluated Vegetation Patches
- Significant Valley Lands
- Unevaluated Wetlands
- Woodlands

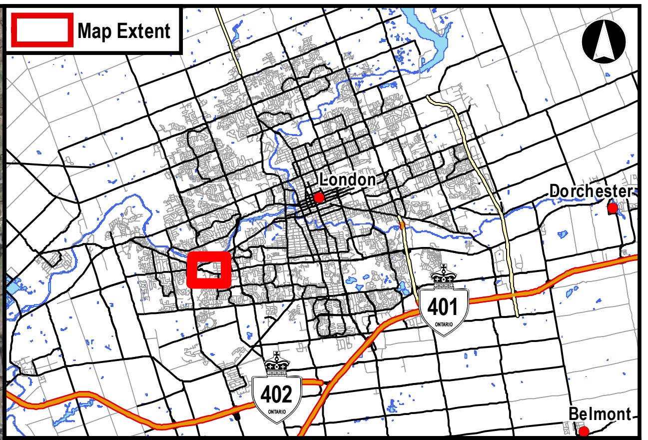
0 100 200
Meters

City of London Water Storage Options
Environmental Assessment

Site A: Option 2 - Reservoir adjacent to Reservoir #2 Footprint (Springbank PS and Reservoir)

Jan, 2019	1:5,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302	V#: 002	Figure 2

AECOM



Legend

Proposed Design

- 3 to 1 Slope
- Reservoir
- Study Area

Base Layers

- Watercourse
- Waterbody
- Parcel

City Of London Natural Heritage Features

- Significant Woodlands
- Unevaluated Vegetation Patches
- Significant Valley Lands
- Unevaluated Wetlands
- Woodlands

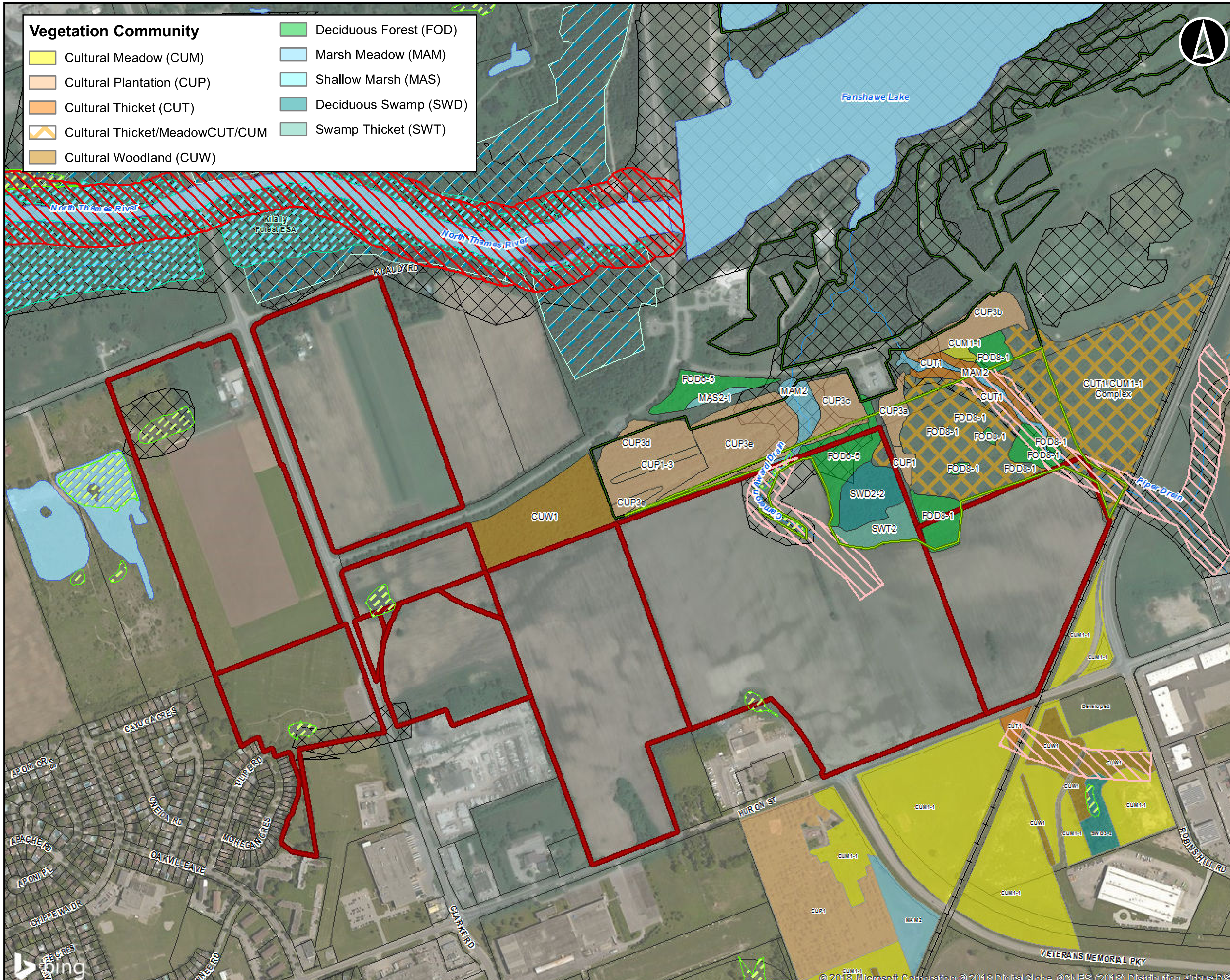
0 100 200
Meters

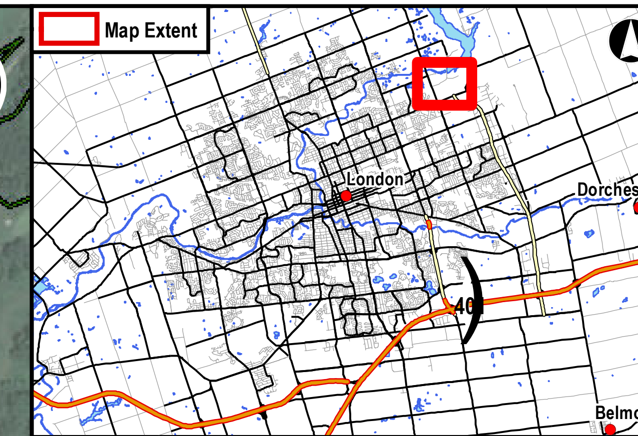
City of London Water Storage Options Environmental Assessment

Site A3 (Springbank PS and Reservoir)

Jan, 2019	1:5,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302	V#: 002	Figure 3

AECOM





Legend

Base Layers

- Watercourse
- Railway
- Waterbody
- Parcel
- UTRCA Regualtion Limits
- Candidate Lot
- Significant Woodlands
- Unevaluated Vegetation Patches
- Significant Valley Lands
- Unevaluated Valley Lands
- Unevaluated Wetlands
- Environmentally Significant Areas
- Potential ESAs

0 100 200
Meters

City of London Water Storage Options Environmental Assessment

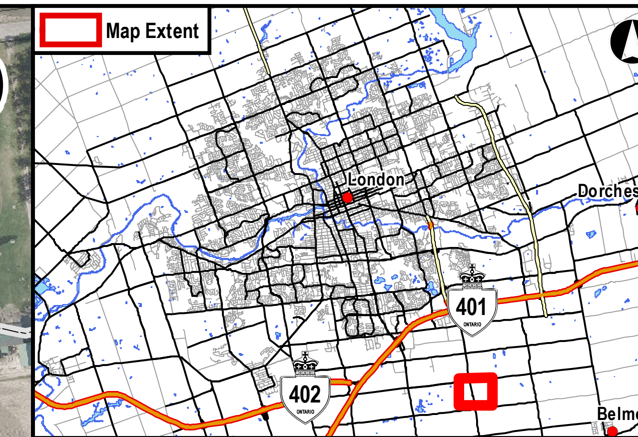
Site C (Huron St and Clarke Rd)

Oct, 2018	1:8,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302		

AECOM

Figure 4

Map location: P:\60569302 CoL Water Storage Options EA\900-CAD_GIS\920-929 (GIS-Graphics)
Date Saved: 10/30/2018 12:43:58 PM User Name: adamsp1



Legend

Proposed Design

- 3 to 1 Slope
- Reservoir
- Study Area

Base Layers

- Watercourse
- Conservation Authority Boundary
- Parcel

City Of London Natural Heritage Features

- Significant Woodlands
- Unevaluated Valley Lands
- Unevaluated Wetlands

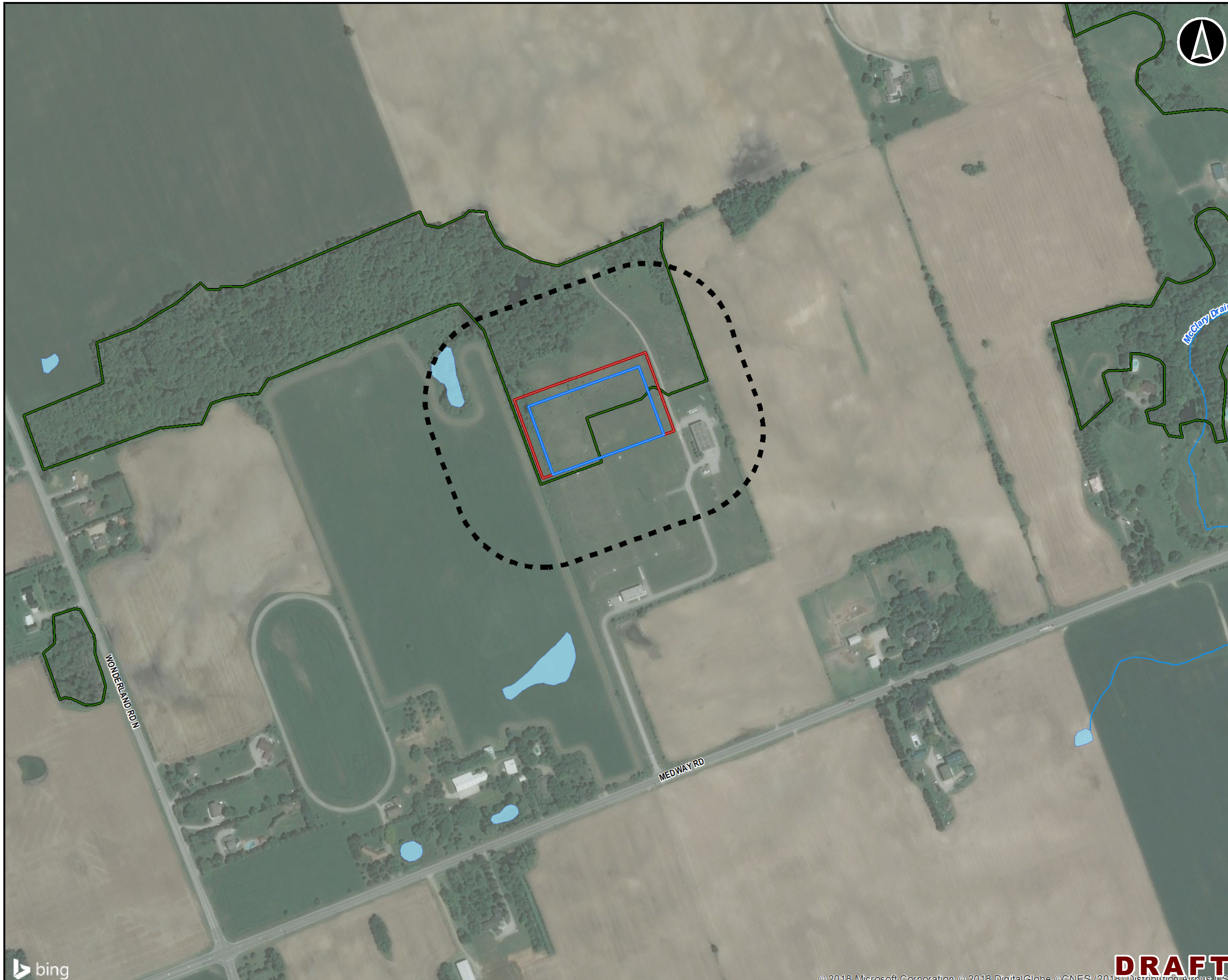
0 100 200
Meters

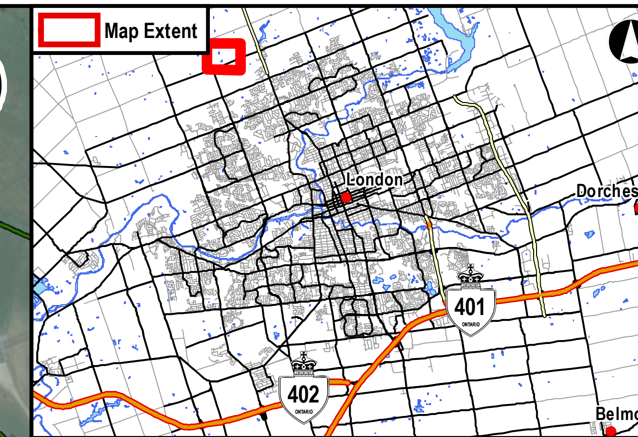
City of London Water Storage Options Environmental Assessment

Site G (Southeast PS and Reservoir)

Jan, 2019	1:5,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302	V#: 002	Figure 5

AECOM





Legend

Proposed Design

- 3 to 1 Slope
- Reservoir
- Study Area

Base Layers

- Watercourse
- Waterbody
- Middlesex Natural Heritage (MNHSS 2014)

0 100 200
Meters

City of London Water Storage Options Environmental Assessment

Site I (Arva PS and Reservoir)

Jan, 2019	1:5,000 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: City of London, MNRF, MMAH, Bing
P#: 60569302	V#: 002	**Figure 6**

AECOM

AECOM

Appendix B-1

Sites A1, A2, A3
Species at Risk
Habitat Screening

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Amphibians	Jefferson Salamander *Ambystoma jeffersonianum*	END	THR Schedule 1	END	Adults live in moist, loose soil, under logs or in leaf litter. Your best chance of spotting a Jefferson salamander is in early spring when they travel to woodland ponds to breed. They lay their eggs in clumps attached to underwater vegetation. By midsummer, the larvae lose their gills and leave the pond and head into the surrounding forest. Once in the forest, Jefferson salamanders spend much of their time underground in rodent burrows, and under rocks and stumps. They feed primarily on insects and worms. This species can be associated with the following ELC code: **FOD** where permanent or temporary ponds or pools are present.	In Canada, it is found only in southern Ontario, mainly along the Niagara Escarpment.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Bank Swallow *Riparia riparia*	THR	No Status	THR	Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs.	The bank swallow is found all across southern Ontario, with sparser populations scattered across northern Ontario. The largest populations are found along the Lake Erie and Lake Ontario shorelines, and the Saugeen River (which flows into Lake Huron).	Ontario Breeding Bird Atlas (Square 17MH75) Natural Heritage Information Centre Make-A-Map Application	**No** Suitable habitat is not known to be present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Barn Swallow *Hirundo rustica*	THR	No Status	THR	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1**; containing or adjacent structures that are suitable for nesting.	The Barn Swallow may be found throughout southern Ontario and can range as far north as Hudson Bay, wherever suitable locations for nests exist.	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Open field within the study area provide suitable foraging habitat. No nesting habitat is known to be present.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Bobolink *Dolichonyx oryzivorus*	THR	No Status	THR	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1** and **MAM2**.	The Bobolink breeds across North America. In Ontario, it is widely distributed throughout most of the province south of the boreal forest, although it may be found in the north where suitable habitat exists.	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Chimney swift *Chaetura pelagica*	THR	THR Schedule 1	THR	Before European settlement Chimney Swifts mainly nested on cave walls and in hollow trees or tree cavities in old growth forests. Today, they are more likely to be found in and around urban settlements where they nest and roost (rest or sleep) in chimneys and other manmade structures. They also tend to stay close to water as this is where the flying insects they eat congregate. Foraging habitat for this species can be associated with the following ELC codes: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1** containing or adjacent structures with suitable nesitng habitat (i.e. chimneys).	The Chimney Swift breeds in eastern North America, possibly as far north as southern Newfoundland. In Ontario, it is most widely distributed in the Carolinian zone in the south and southwest of the province, but has been detected throughout most of the province south of the 49th parallel. It winters in northwestern South America.	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Residential buildings adjacent to the study area may provide suitable nesting habitat.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Common Nighthawk *Chordeiles minor*	SC	THR Schedule 1	THR	Traditional Common Nighthawk habitat consists of open areas with little to no ground vegetation, such as logged or burned-over areas, forest clearings, rock barrens, peat bogs, lakeshores, and mine tailings. Although the species also nests in cultivated fields, orchards, urban parks, mine tailings and along gravel roads and railways, they tend to occupy natural sites. This species can typically be associated with the following ELC communities: **SD, BB, RB, CUM, BO, FOM, FOC and FOD** with openings with little vegetation.	The range of the Common Nighthawk spans most of North and Central America. In Canada, the species is found in all provinces and territories except Nunavut. In Ontario, the Common Nighthawk occurs throughout the province except for the coastal regions of James Bay and Hudson Bay. It winters in South America where it is concentrated in Peru, Ecuador and Brazil.	Ontario Breeding Bird Atlas (Square 17MH75)	**No** No open communities with sparse vegetation are known to be present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Eastern Meadowlark *Sturnella magna*	THR	No Status	THR	Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1**, **CUS,** and **MAM2** with elevated song perches.	In Ontario, the Eastern Meadowlark is primarily found south of the Canadian Shield but it also inhabits the Lake Nipissing, Timiskaming and Lake of the Woods areas.	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Eastern Wood-Pewee *Contopus virens*	SC	No Status	SC	The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. [4] This species can typically be associated with the following ELC communities: **FOC, FOM, FOD, SWD, SWM** and **CUW**.	The Eastern Wood-Pewee Breed throughout central and eastern North America from Saskatchewan to Nova Scotia south along the Atlantic Coast to North Florida and the Gulf Coast. [4]	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Wood Thrush *Hylocichla mustelina*	SC	No Status	THR	The Wood Thrush can typically be found in the interior and along the edges of well-develoepd upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. [3] This species can typically be associated with the following ELC communities: **FOD** and **FOM** that are greater than 1 ha in size.	The Wood Thrush ranges across central and southern Ontario, southern Quebec, New Brunswick and southern Nova Scotia and the majority of the eastern United States. It winters in Central American between southern Mexico and Panama. [3]	Ontario Breeding Bird Atlas (Square 17MH75)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Fish	Lake Sturgeon (Great Lakes-Upper St. Lawrence River population) *Acipenser fulvescens*	THR	No Status	THR	The Lake Sturgeon lives almost exclusively in freshwater lakes and rivers with soft bottoms of mud, sand or gravel. They are usually found at depths of five to 20 metres. They spawn in relatively shallow, fast-flowing water (usually below waterfalls, rapids, or dams) with gravel and boulders at the bottom. However, they will spawn in deeper water where habitat is available. They also are known to spawn on open shoals in large rivers with strong currents. This species can be associated with the following ELC communities: **OAO**. Large lakes/rivers > 20m deep with soft mud, sand or gravel bottoms required.	In Ontario, the Lake Sturgeon is found in the rivers of the Hudson Bay basin, the Great Lakes basin and their major connecting waterways, including the St. Lawrence River. There are three distinct populations in Ontario: Great Lakes - Upper St. Lawrence River, Northwestern Ontario, and Southern Hudson Bay - James Bay.	Natural Heritage Information Centre Make-A-Map Application	**No** No aquatic communities are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Insects	Monarch *Danaus plexippus*	SC	No Status	SC	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico. This species can typically be associated with the following ELC communities: **AI**, **TP** and **CUM** where milkweed plants are present.	The Monarch's range extends from Central America to southern Canada. In Canada, Monarchs are most abundant in southern Ontario and Quebec where milkweed plants and breeding habitat are widespread. During late summer and fall, Monarchs from Ontario migrate to central Mexico where they spend the winter months. During migration, groups of Monarchs numbering in the thousands can be seen along the north shores of Lake Ontario and Lake Erie.	Ontario Butterfly Atlas Square 17MH75	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	American Badger *Taxidea taxus*	END	END Schedule 1	END	In Ontario, badgers are found in a variety of habitats, such as tall grass prairie, sand barrens and farmland. These habitats provide badgers with small prey, including groundhogs, rabbits and small rodents. This speices can typically be associated with the following ELC communiteis: **TPS1, CUM1, CUS, SBO** with dry sandy soil.	In Ontario, the badger is found primarily in the southwestern part of the province, close to Lake Erie in Haldimand-Norfolk County. There are also badgers in northwestern Ontario in the Thunder Bay and Rainy River Districts. Badgers can travel sizeable distances and occupy large home ranges of many square kilometres. There are thought to be fewer than 200 in Ontario.	Natural Heritage Information Centre Make-A-Map Application	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Little Brown Myotis (Bat) *Myotis lucifugus*	END	No Status	END	Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. caviety trees, houses, abandoned buildings, barns, etc.) habitat is available.	The little brown bat is widespread in southern Ontario and found as far north as Moose Factory and Favourable Lake. Outside Ontario, this bat is found across Canada (except in Nunavut) and most of the United States.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Mammals	Eastern Small-footed Myotis *Myotis leibii*	END	No Status	No Status	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	The eastern small-footed bat has been found from south of Georgian Bay to Lake Erie and east to the Pembroke area. There are also records from the Bruce Peninsula, the Espanola area, and Lake Superior Provincial Park. Most documented sightings are of bats in their winter hibernation sites.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Northern (Long-eared) Myotis *(Bat)* *Myotis septentrionalis*	END	No Status	END	Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines. This species can typically be associated with the following ELC communities: **FOC**, **FOM**, **FOD**, **SWC**, **SWM** and **SWD** where suitable roosting (i.e. caviety trees and trees with loose bark) habitat is available.	The northern long-eared bat is found throughout forested areas in southern Ontario, to the north shore of Lake Superior and occasionally as far north as Moosonee, and west to Lake Nipigon. This bat is found in all Canadian provinces as well as the Yukon and Northwest Territories.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Tri-colored Bat *Perimyotis subflavus*	END	END Schedule 1	END	In Ontario, the Tri-colored Bat lives in forested habitats, forming day roosts and maternity colonies in older forest within foliage or in high tree cavities, occasionally also in bars or other structures. This species forages over water and along streams in forests. At the close of the summer season, this species congregate at a location to swarm, usually near caves, mines or underground locations where they will winter; it has a strong fidelity to its winter hibernation sites. This bat overwinters in caves, typically individually instead of as a group.	This bat is found in Southern Ontario and ranging as far north as Espanola, near Sudbury, having a scattered distribution. Its broad range sweeps from eastern North America down to Central America.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Plants	American Chestnut *Castanea dentata*	END	END Schedule 1	END	The American Chestnut prefers dryer upland deciduous forests with sandy, acidic to neutral soils. In Ontario, it is only found in the Carolinian Zone between Lake Erie and Lake Huron. The species grows alongside Red Oak, Black Cherry, Sugar Maple, American Beech and other deciduous tree species. This species can typically be associated with the following ELC communities: **FOD** with dry sandy soil.	The American Chestnut has almost disappeared from eastern North America due to an epidemic caused by a fungal disease called the chestnut blight (Cryphonectria parasitica). In Canada, the American Chestnut is restricted primarily to southwestern Ontario. Based on information available in 2004, it was estimated that there are 120 to 150 mature trees and 1,000 or more small, young trees in the province.	Natural Heritage Information Centre Make-A-Map Application	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Plants	Butternut *Juglans cinerea*	END	END Schedule 1	END	In Ontario, Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges. This species can typically be associated with the following ELC communities: **FOD** and mature hedgerows; Soil: dry rocky or moist (4, 5, 6) to fresh (2, 3).	Butternut can be found throughout central and eastern North America. In Canada, Butternut occurs in Ontario, Quebec and New Brunswick. In Ontario, this species is found throughout the southwest, north to the Bruce Peninsula, and south of the Canadian Shield.	The study area lies within the known range of this species.	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Plants	Eastern Flowering Dogwood *Cornus florida*	END	END Schedule 1	END	Eastern Flowering Dogwood grows under taller trees in mid-age to mature deciduous or mixed forests. It most commonly grows on floodplains, slopes, bluffs and in ravines, and is also sometimes found along roadsides and fencerows. This species can typically be associated with the following ELC communities: **FOD** and **FOM**.	In Canada, it can only be found in southern Ontario in the Carolinian Zone (the small area of Ontario southwest of Toronto to Sarnia down to the shores of Lake Erie).	Natural Heritage Information Centre Make-A-Map Application	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Plants	False Hop Sedge *Carex lupuliformis*	END	END Schedule 1	END	In Canada, this plant most often grows in riverine swamps and marshes, and around temporary forest ponds. It prefers open areas and areas under forest canopy openings, with lots of sunlight. This species can typically be associated with the following ELC communities: **SWD** and **MAS** lots of sunlight.	False Hop Sedge ranges from Florida and Texas north to Quebec and Ontario. In Ontario, seven occurrences are known to persist. In Quebec, there are three persisting populations and three populations that are being restored where False Hop Sedge is believed to have been extirpated. The largest populations occur in southern Ontario.	Natural Heritage Information Centre Make-A-Map Application	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Reptiles	Blanding's Turtle *Emydoidea blandingii*	THR	THR Schedule 1	THR	Blanding's Turtles live in shallow water, usually in large wetlands and shallow lakes with lots of water plants. It is not unusual, though, to find them hundreds of metres from the nearest water body, especially while they are searching for a mate or traveling to a nesting site. Blanding's Turtles hibernate in the mud at the bottom of permanent water bodies from late October until the end of April. This species can typically be associated with the following ELC communities: **SWT2**, **SWT3**, **SWD**, **SWM**, **MAS2**, **SAS1**, **SAM1**, where open water is present.	The Blanding's Turtle is found in and around the Great Lakes Basin, with isolated populations elsewhere in the United States and Canada. In Canada, the Blanding's Turtle is separated into the Great Lakes-St. Lawrence population and the Nova Scotia population. Blanding's Turtles can be found throughout southern, central and eastern Ontario.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Eastern Hog-nosed Snake *Heterodon platirhinos*	THR	THR Schedule 1	THR	The Eastern Hog-nosed Snake specializes in hunting and eating toads, and usually only occurs where toads can be found. Eastern Hog-nosed Snakes prefersandy, well-drained habitats such as beaches and dry forests where they can lay their eggs and hibernate. They use their up-turned snout to dig burrows below the frost line in the sand where eggs are deposited. This species can be associated with the following ELC codes: **BBO** and **FOD**. Sandy soils required.	The Eastern Hog-nosed Snake is only found in eastern North America, with about ten per cent of its range occurring in Canada. The Canadian population is limited to Ontario where it can be found in two areas: The Carolinian Region and Great Lakes-St. Lawrence Region.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Northern Map Turtle *Graptemys geographica*	SC	SC Schedule 1	SC	The Northern Map Turtle inhabits rivers and lakeshores where it basks on emergent rocks and fallen trees throughout the spring and summer. In winter, the turtles hibernate on the bottom of deep, slow-moving sections of river. They require high-quality water that supports the female's mollusc prey. Their habitat must contain suitable basking sites, such as rocks and deadheads, with an unobstructed view from which a turtle can drop immediately into the water if startled. This species can typically be associated with the following ELC communities: **OAO, SA** with emergent rocks and fallen trees suitable habitat for prey.	The Northern Map Turtle's range extends from the Great Lakes region west to Oklahoma and Kansas, south to Louisiana and east to the Adirondack and Appalachian mountain barrier. There are isolated populations in New Jersey and New York states. In Canada, it is found in southwestern Quebec and southern Ontario. In southern Ontario, it lives primarily on the shores of Georgian Bay, Lake St. Clair, Lake Erie and Lake Ontario, and along larger rivers including the Thames, Grand and Ottawa.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Queensnake *Regina septemvittata*	END	END Schedule 1	END	The Queensnake is an aquatic species that is seldom found more than a few metres from the water. It prefers rivers, streams and lakes with clear water, rocky or gravel bottoms, lots of places to hide, and an abundance of crayfish. Queensnakes will often hibernate in groups with other snakes, amphibians and even crayfish. Suitable hibernation sites (called hibernacula) include abutments of old bridges and crevices in bedrock. This species can typically be be associated with the following ELC communities: **OAO** with clear water and rocky or gravel bottoms with lots of places to hide and abundance of crayfish.	In Ontario, the Queensnake is found only in the southwest in Middlesex, Brant, Huron and Essex counties, and on the Bruce Peninsula. There are fewer than 25 sites where it is known to occur in these areas. The extremely specialized habitat requirements of the Queensnake restrict this species to particular areas, with large gaps of unfavourable habitat in between populations. The snake's home range is quite small, making Queensnakes less likely to move into new areas or areas where it was historically found.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**No** No suitable watercourses are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Snapping turtle *Chelydra serpentina*	SC	SC Schedule 1	SC	Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits. This species can typically be associated with the following ELC communities: **OAO, SA** near gravelly or sandy areas.	The Snapping Turtle's range extends from Ecuador to Canada. In Canada this turtle can be found from Saskatchewan to Nova Scotia. It is primarily limited to the southern part of Ontario. The Snapping Turtle's range is contracting.	Ontario Reptile and Amphibian Atlas (Square 17MH75)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

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Appendix B-2

Site C
Species at Risk
Habitat Screening

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Bank Swallow *Riparia riparia*	THR	No Status	THR	Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs.	The bank swallow is found all across southern Ontario, with sparser populations scattered across northern Ontario. The largest populations are found along the Lake Erie and Lake Ontario shorelines, and the Saugeen River (which flows into Lake Huron).	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Exposed human-made banks were observed within the study area.	**Yes** Exposed banks were observed in 2015. **No** This species was not observed during field investigations completed in 2015 / 2016.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Birds	Barn Swallow *Hirundo rustica*	THR	No Status	THR	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1**; containing or adjacent structures that are suitable for nesting.	The Barn Swallow may be found throughout southern Ontario and can range as far north as Hudson Bay, wherever suitable locations for nests exist.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Open agricultural fields present within the study area provide foraging habitat. No nesting habitat was identified within the study area.	**Yes** Cultural meadow communities providing foraging habitat were identified in 2015. **Yes** This species was observed foraging over the study area during field investigations completed in 2015. No nesting habitat was identified.	This species was observed during species-specific surveys (AECOM 2015). Suitable foraging habitat for this species was identified, but no suitable nesting habitat was identified. Protected habitat is centered around nesting sites. No further action is required.
Birds	Bobolink *Dolichonyx oryzivorus*	THR	No Status	THR	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1** and **MAM2**.	The Bobolink breeds across North America. In Ontario, it is widely distributed throughout most of the province south of the boreal forest, although it may be found in the north where suitable habitat exists.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**No** Open agricultural fields were identified within the study area but were high in forb composition and unlikely to provide suitable habitat for this species.	**No** Cultural meadow communities were identified in 2015 but were of unsuitable composition. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.
Birds	Chimney Swift *Chaetura pelagica*	THR	THR Schedule 1	THR	Before European settlement Chimney Swifts mainly nested on cave walls and in hollow trees or tree cavities in old growth forests. Today, they are more likely to be found in and around urban settlements where they nest and roost (rest or sleep) in chimneys and other manmade structures. They also tend to stay close to water as this is where the flying insects they eat congregate. Foraging habitat for this species can be associated with the following ELC codes: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1** containing or adjacent structures with suitable nesitng habitat (i.e. chimneys).	The Chimney Swift breeds in eastern North America, possibly as far north as southern Newfoundland. In Ontario, it is most widely distributed in the Carolinian zone in the south and southwest of the province, but has been detected throughout most of the province south of the 49th parallel. It winters in northwestern South America.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Cultural meadow communities were identified within the study area. No buildings with chimneys are present.	**Yes** Cultural meadow communities identified in 2015 provide suitable foraging habitat. No nesting habitat was identified. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). Suitable foraging habitat for this species was identified, but no suitable nesting habitat was identified. Protected habitat is centered around nesting sites. No further action is required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Common Nighthawk *Chordeiles minor*	SC	THR Schedule 1	THR	Traditional Common Nighthawk habitat consists of open areas with little to no ground vegetation, such as logged or burned-over areas, forest clearings, rock barrens, peat bogs, lakeshores, and mine tailings. Although the species also nests in cultivated fields, orchards, urban parks, mine tailings and along gravel roads and railways, they tend to occupy natural sites. This species can typically be associated with the following ELC communitiesdes: **SD**, **BB**, **RB**, **CUM**, **BO**, **FOM**, **FOC** and **FOD** with openings with little vegetation.	The range of the Common Nighthawk spans most of North and Central America. In Canada, the species is found in all provinces and territories except Nunavut. In Ontario, the Common Nighthawk occurs throughout the province except for the coastal regions of James Bay and Hudson Bay. It winters in South America where it is concentrated in Peru, Ecuador and Brazil.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Cultural meadow communities were identified within the study area.	**Yes** Cultural meadow communities identified in 2015 provide suitable foraging habitat. No nesting habitat was identified. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015), however crepuscular surveys were not completed. Suitable foraging habitat for this species was identified, but no suitable nesting habitat was identified. No further action is required.
Birds	Eastern Meadowlark *Sturnella magna*	THR	No Status	THR	Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1**, **CUS,** and **MAM2** with elevated song perches.	In Ontario, the Eastern Meadowlark is primarily found south of the Canadian Shield but it also inhabits the Lake Nipissing, Timiskaming and Lake of the Woods areas.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Cultural meadow and meadow marsh communities were identified within the study area.	**Yes** Cultural meadow and meadow marsh communities identified in 2015 provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Birds	Eastern Wood-Pewee *Contopus virens*	SC	No Status	SC	The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. [4] This species can typically be associated with the following ELC communities: **FOC**, **FOM**, **FOD**, **SWD**, **SWM** and **CUW**.	The Eastern Wood-Pewee Breed throughout central and eastern North America from Saskatchewan to Nova Scotia south along the Atlantic Coast to North Florida and the Gulf Coast. [4]	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Forest and swamp communities were identified within the study area.	**Yes** Deciduous forest, deciduous swamp and cultural woodland communities identified in 2015 provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Birds	Grasshopper Sparrow *Ammodramus savannarum*	SC	SC Schedule 1	SC	Grasshopper Sparrows inhabit open grassland areas with well-drained, sandy soil. They will also nest in hayfields and pasture, as well as alvars, prairies and occasionally grain crops such as barley. They prefers areas that are sparsely vegetated. Its nests are well-hidden in the field and woven from grasses in a small cup-like shape.	The Grasshopper Sparrow can be found throughout southern Ontario, but only occasionally on the Canadian Shield. It is most common where grasslands, hay or pasture dominate the landscape. The Grasshopper Sparrow is a short-distance migrant and leaves Ontario in the fall to migrate to the southestern United States and Central America for the winter.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**No** No grassland habitat was identified within the study area.	**No** This species was not observed during field investigations completed in 2015. Suitable habitat was not identified.	This species was not observed during species-specific surveys (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Red-headed Woodpecker *Melanerpes erythrocephalus*	SC	THR Schedule 1	THR	The Red-headed Woodpecker lives in open woodland and woodland edges, and is often found in parks, golf courses and cemeteries. These areas typically have many dead trees, which the bird uses for nesting and perching. This woodpecker regularly winters in the United States, moving to locations where it can find sufficient acorns and beechnuts to eat. A few of these birds will stay the winter in woodlands in southern Ontario if there are adequate supplies of nuts. This species can typically be associated with the following ELC communities: **TPS**, **TPW**, **CUW**, **FOD1**, **FOD2**, **FOD4-1**, **FOD6**, **FOD7**, and **FOD9** that are open and have an abundance of dead trees.	The Red-headed Woodpecker is found across southern Ontario, where it is widespread but rare. Outside Ontario, it lives in Alberta, Saskatchewan, Manitoba and Quebec, and is relatively common in the United States.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Cultural woodland and deciduous forest communities were identified within the study area.	**Yes** Cultural woodland and deciduous forest communities identified in 2015 provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Birds	Wood Thrush *Hylocichla mustelina*	SC	No Status	THR	The Wood Thrush can typically be found in the interior and along the edges of well-develoepd upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. [3] This species can typically be associated with the following ELC communities: **FOD** and **FOM** that are greater than 1 ha in size.	The Wood Thrush ranges across central and southern Ontario, southern Quebec, New Brunswick and southern Nova Scotia and the majority of the eastern United States. It winters in Central American between southern Mexico and Panama. [3]	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Breeding Bird Atlas (Square 17MH86)	**Yes** Deciduous forest communities were identified within the sudy area.	**Yes** Deciduous forest communities identified in 2015 provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Fish	Silver Shiner *Notropis photogenis*	THR	SC Schedule 3	THR	Silver Shiners prefer moderate to large size streams with swift currents that are free of weeds and have clean gravel or boulder bottoms. They live in schools and feed on crustaceans and adult flies that fall in the water or fly just above the surface. In June or July, they spawn by scattering their eggs over gravel riffles. This species can typically be associated with the follwoing ELC communities: **OAO** charachterized as moderate to large streams with swift currents, no weeds and gravel or boulder substrates.	The Silver Shiner range includes east-central North America throughout the Ohio and Tennessee River drainage basins. In Ontario, it is found in the Thames and Grand Rivers, and in Bronte Creek and Sixteen Mile Creek, which flow into Lake Ontario.	NHIC Map Tool (Square 17MH8565)	**No** Open aquatic communities are not present within the study area.	**No** This species was not observed during aquatic surveys completed in 2015. **No** Suitable habitat was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No further action is required.
Insects	Monarch *Danaus plexippus*	SC	No Status	SC	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico. This species cany typically be associated with the following ELC communities: **AL**, **TP** and **CUM** where milkweed plants are present.	The Monarch's range extends from Central America to southern Canada. In Canada, Monarchs are most abundant in southern Ontario and Quebec where milkweed plants and breeding habitat are widespread. During late summer and fall, Monarchs from Ontario migrate to central Mexico where they spend the winter months. During migration, groups of Monarchs numbering in the thousands can be seen along the north shores of Lake Ontario and Lake Erie.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Butterfly Atlas (Square 17MH86)	**Yes** Cultural meadow communities were identified within the study area.	**Yes** Cultural meadow communities identified in 2015 contain milkweed and provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). Suitable habitat for this species was identified. Any vegetation removal should be conducted outside of the breeding and larvel period (summer). Vegetation planting following construction should include milkweed to replace lost habitat.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Mammals	Little Brown Myotis (Bat) *Myotis lucifugus*	END	No Status	END	Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. caviety trees, houses, abandoned buildings, barns, etc.) habitat is available.	The little brown bat is widespread in southern Ontario and found as far north as Moose Factory and Favourable Lake. Outside Ontario, this bat is found across Canada (except in Nunavut) and most of the United States.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Bat Conservation International Species Range Maps	**Yes** Deciduous forest and deciduous swamp communities were identified within the study area.	**Candidate** Deciduous forest and deciduous swamp communities provide potential habitat. **No** This species was not observed during field investigations completed in 2015. However, species-specific surveys were not completed.	This species was not observed during field investigations (AECOM 2015). If tree removal is required, a bat habitat assessment is recommended to confirm the presence / absence of suitable habitat.
Mammals	Eastern Small-footed Myotis *Myotis leibii*	END	No Status	No Status	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	The eastern small-footed bat has been found from south of Georgian Bay to Lake Erie and east to the Pembroke area. There are also records from the Bruce Peninsula, the Espanola area, and Lake Superior Provincial Park. Most documented sightings are of bats in their winter hibernation sites.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Bat Conservation International Species Range Maps	**Yes** Deciduous forest and deciduous swamp communities were identified within the study area.	**Candidate** Deciduous forest and deciduous swamp communities provide potential habitat. **No** This species was not observed during field investigations completed in 2015. However, species-specific surveys were not completed.	This species was not observed during field investigations (AECOM 2015). If tree removal is required, a bat habitat assessment is recommended to confirm the presence / absence of suitable habitat.
Mammals	Northern (Long-eared) Myotis *(Bat)* *Myotis septentrionalis*	END	No Status	END	Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines. This species can typically be associated with the following ELC communities: **FOC**, **FOM**, **FOD**, **SWC**, **SWM** and **SWD** where suitable roosting (i.e. caviety trees and trees with loose bark) habitat is available.	The northern long-eared bat is found throughout forested areas in southern Ontario, to the north shore of Lake Superior and occasionally as far north as Moosonee, and west to Lake Nipigon. This bat is found in all Canadian provinces as well as the Yukon and Northwest Territories.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Bat Conservation International Species Range Maps	**Yes** Deciduous forest and deciduous swamp communities were identified within the study area.	**Candidate** Deciduous forest and deciduous swamp communities provide potential habitat. **No** This species was not observed during field investigations completed in 2015. However, species-specific surveys were not completed.	This species was not observed during field investigations (AECOM 2015). If tree removal is required, a bat habitat assessment is recommended to confirm the presence / absence of suitable habitat.
Mammals	Tri-colored Bat *Perimyotis subflavus*	END	END Schedule 1	END	During the summer, the Tri-colored Bat is found in a variety of forested habitats. It forms day roosts and maternity colonies in older forest and occasionally in barns or other structures. They forage over water and along streams in the forest. Tri-colored Bats eat flying insects and spiders gleaned from webs. At the end of the summer they travel to a location where they swarm; it is generally near the cave or underground location where they will overwinter. They overwinter in caves where they typically roost by themselves rather than part of a group.	This bat is found in southern Ontario and as far north as Espanola near Sudbury. Because it is very rare, it has a scattered distribution. It is also found from eastern North America down to Central America.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Bat Conservation International Species Range Maps	**Yes** Deciduous forest and deciduous swamp communities were identified within the study area.	**Candidate** Deciduous forest and deciduous swamp communities provide potential habitat. **No** This species was not observed during field investigations completed in 2015. However, species-specific surveys were not completed.	This species was not observed during field investigations (AECOM 2015). If tree removal is required, a bat habitat assessment is recommended to confirm the presence / absence of suitable habitat.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Plants	Bird's-foot Violet *Viola pedata*	END	END Schedule 1	END	In Ontario, Bird's-foot Violet is found only in black oak savanna, a very rare vegetation type having widely spaced open-grown trees with an understorey of tallgrass prairie herbs. Natural disturbances caused by drought or fire are important for removing trees and shrubs that would otherwise shade out the tiny Bird's-foot Violet. This species can typically be associated with the following ELC communities: **TPS1-1** and **TPW1-1.**	In Canada, Bird's-foot Violet is found only in southern Ontario at a handful of sites. In 2001, the population was estimated to be fewer than 7,000 plants at only five locations.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) NHIC Map Tool (Squares 17MH8563, 17MH8564, 17MH8664)	**No** No tallgrass prairie communities were identified within the study area.	**No** This species was not observed during field investigations completed in 2015. Suitable habitat was not identified.	This species was not observed during floral inventories (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.
Plants	Butternut *Juglans cinerea*	END	END Schedule 1	END	In Ontario, Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges. This species can typically be associated with the following ELC communities: **FOD** and mature hedgerows; Soil: dry rocky or moist (4, 5, 6) to fresh (2, 3).	Butternut can be found throughout central and eastern North America. In Canada, Butternut occurs in Ontario, Quebec and New Brunswick. In Ontario, this species is found throughout the southwest, north to the Bruce Peninsula, and south of the Canadian Shield.	The study area lies within the known range of this species.	**Yes** Deciduous forest communities were identified within the study area.	**Yes** Deciduous forest communities provide suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during floral inventories (AECOM 2015). No further action is required.
Plants	Drooping Trillium *Trillium flexipes*	END	END Schedule 1	END	Drooping Trillium grows on damp sandy soil in mature, deciduous forests that are usually close to a river or stream. It is found in Carolinian forests with Maple, White Ash, Basswood, Hackberry, White Elm, and Blue Ash trees. It shares the forest floor with other native plants including Ostrich Fern, Wild Ginger and Jack-in-the-pulpit. This species can typically be associated with the following ELC communities: **FOD4-2**, **FOD4-3**, **FOD5**, **FOD6** and **FOD7** that are mature and have sandy soils, typically near a river or stream with the associate species listed above.	In Canada, Drooping Trillium only grows in southwestern Ontario in the warmer climate of the Carolinian forest. There were once six known locations in the province, but today there are only two. A total of 1465 flower stems were reported in 2007. Both populations along the Sydenham River in Middlesex County and along the Thames River in Elgin County are believed to be reproducing successfully.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) NHIC Map Tool (Square 17MH8563, 17MH8564, 17MH8664)	**Yes** A deciduous forest (FOD6) community was identified within the study area.	**Yes** A deciduous forest community (FOD6) identified in 2015 provides suitable habitat. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during floral inventories (AECOM 2015). No further action is required.
Reptiles	Eastern Hog-nosed Snake *Heterodon platirhinos*	THR	THR Schedule 1	THR	The Eastern Hog-nosed Snake specializes in hunting and eating toads, and usually only occurs where toads can be found. Eastern Hog-nosed Snakes prefer sandy, well-drained habitats such as beaches and dry forests where they can lay their eggs and hibernate. They use their up-turned snout to dig burrows below the frost line in the sand where eggs are deposited. This species can be associated with the following ELC codes: **BBO** and **FOD**. Sandy soils required.	The Eastern Hog-nosed Snake is only found in eastern North America, with about ten per cent of its range occurring in Canada. The Canadian population is limited to Ontario where it can be found in two areas: The Carolinian Region and Great Lakes-St. Lawrence Region.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Nature Reptile and Amphibian Atlas (Square 17MH86)	**Yes** Deciduous forest communities were identified within the study area.	**No** Forest communities identified in 2015 are too moist to support this species. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). No furtther action is required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Reptiles	Eastern Ribbonsnake *Thamnophis sauritus*	SC	SC Schedule 1	SC	The Eastern Ribbonsnake is usually found close to water, especially in marshes, where it hunts for frogs and small fish. A good swimmer, it will dive in shallow water, especially if it is fleeing from a potential predator. At the onset of cold weather, these snakes congregate in underground burrows or rock crevices to hibernate together. This species can typically be associated with the following ELC communities: **FOC, FOM, FOD, SWC, SWM, SWD, MAM, MAS, OAO, SAS, SAM** and **SAF** containing or near year round standing or flowing water.	The Eastern Ribbonsnake is found from southern Ontario west to Michigan and Wisconsin (isolated pockets), south to Illinois and Ohio, and east to New York State and Nova Scotia, where there is an isolated population. In Ontario, this snake occurs throughout southern and eastern Ontario and is locally common in parts of the Bruce Peninsula, Georgian Bay and eastern Ontario.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) NHIC Map Tool (Squares 17MH8563, 17MH8564, 17MH8664)	**Yes** Deciduous forest, deciduos swamp and meadow marsh communities were identified within the study area.	**Yes** Meadow marsh communities identified in 2015 provide suitable habitat. The swamp and forest communities do not contain standing water required to support this species. **No** This species was not observed during field investigations completed in 2015.	This species was not observed during species-specific surveys (AECOM 2015). Suitable habitat for this species was not identified. No further actions are required.
Reptiles	Northern Map Turtle *Graptemys geographica*	SC	SC Schedule 1	SC	The Northern Map Turtle inhabits rivers and lakeshores where it basks on emergent rocks and fallen trees throughout the spring and summer. In winter, the turtles hibernate on the bottom of deep, slow-moving sections of river. They require high-quality water that supports the female's mollusc prey. Their habitat must contain suitable basking sites, such as rocks and deadheads, with an unobstructed view from which a turtle can drop immediately into the water if startled. This species can typically be associated with the following ELC communities: **OAO**, **SA** with emergent rocks, fallen trees and suitable habitat for prey.	The Northern Map Turtle's range extends from the Great Lakes region west to Oklahoma and Kansas, south to Louisiana and east to the Adirondack and Appalachian mountain barrier. There are isolated populations in New Jersey and New York states. In Canada, it is found in southwestern Quebec and southern Ontario. In southern Ontario, it lives primarily on the shores of Georgian Bay, Lake St. Clair, Lake Erie and Lake Ontario, and along larger rivers including the Thames, Grand and Ottawa.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Nature Reptile and Amphibian Atlas (Square 17MH86)	**No** Suitable habitat was not identified within the study area.	**No** This species was not observed during field investigations completed in 2015. Suitable habitat was not identified.	This species was not observed during field investigations (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.
Reptiles	Queensnake *Regina septemvittata*	END	END Schedule 1	END	The Queensnake is an aquatic species that is seldom found more than a few metres from the water. It prefers rivers, streams and lakes with clear water, rocky or gravel bottoms, lots of places to hide, and an abundance of crayfish. Queensnakes will often hibernate in groups with other snakes, amphibians and even crayfish. Suitable hibernation sites (called hibernacula) include abutments of old bridges and crevices in bedrock. This species can typically be be associated with the following ELC communities: **OAO** with clear water and rocky or gravel bottoms with lots of places to hide and abundance of crayfish.	In Ontario, the Queensnake is found only in the southwest in Middlesex, Brant, Huron and Essex counties, and on the Bruce Peninsula. There are fewer than 25 sites where it is known to occur in these areas. The extremely specialized habitat requirements of the Queensnake restrict this species to particular areas, with large gaps of unfavourable habitat in between populations. The snake's home range is quite small, making Queensnakes less likely to move into new areas or areas where it was historically found.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Nature Reptile and Amphibian Atlas (Square 17MH86)	**No** Suitable habitat was not identified within the study area.	**No** This species was not observed during field investigations completed in 2015. Suitable habitat was not identified.	This species was not observed during species-specific surveys (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.
Reptiles	Snapping Turtle *Chelydra serpentina*	SC	SC Schedule 1	SC	Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits. This species can typically be associated with the following ELC communities: **OAO**, **SA** near gravelly or sandy areas.	The Snapping Turtle's range extends from Ecuador to Canada. In Canada this turtle can be found from Saskatchewan to Nova Scotia. It is primarily limited to the southern part of Ontario. The Snapping Turtle's range is contracting.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) Ontario Nature Reptile and Amphibian Atlas (Square 17MH86)	**Yes** A small pond was identified within the study area.	**Yes** The pond identified in 2015 provides suitable habitat, but is too small to sustain a population of this species. **Yes** This species was observed at the pond during field investigations completed in 2015.	This species was observed during field investigations (AECOM 2015). Suitable habitat for this species was identified. Should proposed works be required adjacent to the pond, exclusionary fencing may be required. Additionally, a relocation plan may be required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Suitable habitat Observed During Field Investigations	Conclusions/ Recommendations
Reptiles	Spiny Softshell *Apalone spinifera*	THR	THR Schedule 1	THR	Spiny Softshells are highly aquatic turtles that rarely travel far from water. They are found primarily in rivers and lakes but also in creeks and even ditches and ponds near rivers. Key habitat requirements are open sand or gravel nesting areas, shallow muddy or sandy areas to bury in, deep pools for hibernation, areas for basking, and suitable habitat for crayfish and other food species. These habitat features may be distributed over an extensive area, as long as the intervening habitat doesn't prevent the turtles from traveling between them. This species can typically be associated with the following ELC communities: **OAO** charaterized as rivers with nearby open sand or gravel nesting areas, shallow muddy or sandy substrates, deep pools, basking areas and suitable habitat for food species.	In Canada, the Spiny Softshell is found only in Quebec and southwestern Ontario in the Lake St. Clair, Lake Erie and western Lake Ontario watersheds. The majority of Spiny Softshells in Ontario are found in the Thames and Sydenham rivers and at two sites in Lake Erie. The size of the home range of this turtle depends on availability of habitat features such as nesting and hibernation sites. Some turtles travel up to 30 kilometres in a year from one part of their home range to another.	North Huron Industrial Lands - Subject Lands Status Report (AECOM 2015) NHIC Map Tool (Square 17MH8564)	**No** Suitable riverine habitat was not identified within the study area.	**No** This species was not observed during field investigations completed in 2015. Suitable habitat was not identified.	This species was not observed during field investigations (AECOM 2015). Suitable habitat for this species was not identified. No further action is required.

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Appendix B-3

Site G
Species at Risk
Habitat Screening

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Bank Swallow *Riparia riparia*	THR	No Status	THR	Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs.	The bank swallow is found all across southern Ontario, with sparser populations scattered across northern Ontario. The largest populations are found along the Lake Erie and Lake Ontario shorelines, and the Saugeen River (which flows into Lake Huron).	Ontario Breeding Bird Atlas (Square 17MH84)	**No** Suitable habitat is not known to be present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Barn Swallow *Hirundo rustica*	THR	No Status	THR	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1**; containing or adjacent structures that are suitable for nesting.	The Barn Swallow may be found throughout southern Ontario and can range as far north as Hudson Bay, wherever suitable locations for nests exist.	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Open field within the study area provide suitable foraging habitat. No nesting habitat is known to be present.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Bobolink *Dolichonyx oryzivorus*	THR	No Status	THR	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1** and **MAM2**.	The Bobolink breeds across North America. In Ontario, it is widely distributed throughout most of the province south of the boreal forest, although it may be found in the north where suitable habitat exists.	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Eastern Meadowlark *Sturnella magna*	THR	No Status	THR	Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1**, **CUS,** and **MAM2** with elevated song perches.	In Ontario, the Eastern Meadowlark is primarily found south of the Canadian Shield but it also inhabits the Lake Nipissing, Timiskaming and Lake of the Woods areas.	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Eastern Wood-Pewee *Contopus virens*	SC	No Status	SC	The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. [4] This species can typically be associated with the following ELC communities: **FOC, FOM, FOD, SWD, SWM** and **CUW**.	The Eastern Wood-Pewee Breed throughout central and eastern North America from Saskatchewan to Nova Scotia south along the Atlantic Coast to North Florida and the Gulf Coast. [4]	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Golden-winged Warbler *Vermivora chrysoptera*	SC	THR Schedule 1	THR	Golden-winged Warblers prefer to nest in areas with young shrubs surrounded by mature forest – locations that have recently been disturbed, such as field edges, hydro or utility right-of-ways, or logged areas.	The Golden-winged Warbler is found in southern Saskatchewan, Manitoba, Ontario, and Quebec, as well as the north-eastern United States. In Ontario, these birds breed in central-eastern Ontario, as far south as Lake Ontario and the St. Lawrence River, and as far north as the northern edge of Georgian Bay. Golden-winged Warblers have also been found in the Lake of the Woods area near the Manitoba border, and around Long Point on Lake Erie. Golden-winged Warblers spend the winter in Central America, some Caribbean islands, and the northern part of South America.	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Deciduous woodlands adjacent to open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Red-headed Woodpecker *Melanerpes erythrocephalus*	SC	THR Schedule 1	THR	The Red-headed Woodpecker lives in open woodland and woodland edges, and is often found in parks, golf courses and cemeteries. These areas typically have many dead trees, which the bird uses for nesting and perching. This woodpecker regularly winters in the United States, moving to locations where it can find sufficient acorns and beechnuts to eat. A few of these birds will stay the winter in woodlands in southern Ontario if there are adequate supplies of nuts. This species can typically be associated with the following ELC communities: TPS, TPW, CUW, FOD1, FOD2, FOD4-	The Red-headed Woodpecker is found across southern Ontario, where it is widespread but rare. Outside Ontario, it lives in Alberta, Saskatchewan, Manitoba and Quebec, and is relatively common in the United States.	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Deciduous woodlands adjacent to open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Wood Thrush *Hylocichla mustelina*	SC	No Status	THR	The Wood Thrush can typically be found in the interior and along the edges of well-develoepd upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. [3] This species can typically be associated with the following ELC communities: **FOD** and **FOM** that are greater than 1 ha in size.	The Wood Thrush ranges across central and southern Ontario, southern Quebec, New Brunswick and southern Nova Scotia and the majority of the eastern United States. It winters in Central American between southern Mexico and Panama. [3]	Ontario Breeding Bird Atlas (Square 17MH84)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Little Brown Myotis (Bat) *Myotis lucifugus*	END	No Status	END	Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. caviety trees, houses, abandoned buildings, barns, etc.) habitat is available.	The little brown bat is widespread in southern Ontario and found as far north as Moose Factory and Favourable Lake. Outside Ontario, this bat is found across Canada (except in Nunavut) and most of the United States.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Eastern Small-footed Myotis *Myotis leibii*	END	No Status	No Status	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	The eastern small-footed bat has been found from south of Georgian Bay to Lake Erie and east to the Pembroke area. There are also records from the Bruce Peninsula, the Espanola area, and Lake Superior Provincial Park. Most documented sightings are of bats in their winter hibernation sites.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Northern (Long-eared) Myotis *(Bat)* *Myotis septentrionalis*	END	No Status	END	Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines. This species can typically be associated with the following ELC communities: **FOC**, **FOM**, **FOD**, **SWC**, **SWM** and **SWD** where suitable roosting (i.e. cavity trees and trees with loose bark) habitat is available.	The northern long-eared bat is found throughout forested areas in southern Ontario, to the north shore of Lake Superior and occasionally as far north as Moosonee, and west to Lake Nipigon. This bat is found in all Canadian provinces as well as the Yukon and Northwest Territories.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Tri-colored Bat *Perimyotis subflavus*	END	END Schedule 1	END	In Ontario, the Tri-colored Bat lives in forested habitats, forming day roosts and maternity colonies in older forest within foliage or in high tree cavities, occasionally also in bars or other structures. This species forages over water and along streams in forests. At the close of the summer season, this species congregate at a location to swarm, usually near caves, mines or underground locations where they will winter; it has a strong fidelity to its winter hibernation sites. This bat overwinters in caves, typically individually instead of as a group.	This bat is found in Southern Ontario and ranging as far north as Espanola, near Sudbury, having a scattered distribution. Its broad range sweeps from eastern North America down to Central America.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Plants	Butternut *Juglans cinerea*	END	END Schedule 1	END	In Ontario, Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges. This species can typically be associated with the following ELC communities: **FOD** and mature hedgerows; Soil: dry rocky or moist (4, 5, 6) to fresh (2, 3).	Butternut can be found throughout central and eastern North America. In Canada, Butternut occurs in Ontario, Quebec and New Brunswick. In Ontario, this species is found throughout the southwest, north to the Bruce Peninsula, and south of the Canadian Shield.	The study area lies within the known range of this species.	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Eastern Ribbonsnake *Thamnophis sauritus*	SC	SC Schedule 1	SC	The Eastern Ribbonsnake is usually found close to water, especially in marshes, where it hunts for frogs and small fish. A good swimmer, it will dive in shallow water, especially if it is fleeing from a potential predator. At the onset of cold weather, these snakes congregate in underground burrows or rock crevices to hibernate together. This species can typically be associated with the following ELC communities: **FOC, FOM, FOD, SWC, SWM, SWD, MAM, MAS, OAO, SAS, SAM** and **SAF** containing or near year round standing or flowing water.	The Eastern Ribbon Snake is found from southern Ontario west to Michigan and Wisconsin (isolated pockets), south to Illinois and Ohio, and east to New York State and Nova Scotia, where there is an isolated population. In Ontario, this snake occurs throughout southern and eastern Ontario and is locally common in parts of the Bruce Peninsula, Georgian Bay and eastern Ontario.	Ontario Reptile and Amphibian Atlas (Square 17MH84)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Snapping turtle *Chelydra serpentina*	SC	SC Schedule 1	SC	Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits. This species can typically be associated with the following ELC communities: **OAO, SA** near gravelly or sandy areas.	The Snapping Turtle's range extends from Ecuador to Canada. In Canada this turtle can be found from Saskatchewan to Nova Scotia. It is primarily limited to the southern part of Ontario. The Snapping Turtle's range is contracting.	Ontario Reptile and Amphibian Atlas (Square 17MH84)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

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Appendix B-4

Site I
Species at Risk
Habitat Screening

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Barn Swallow *Hirundo rustica*	THR	No Status	THR	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1**; containing or adjacent structures that are suitable for nesting.	The Barn Swallow may be found throughout southern Ontario and can range as far north as Hudson Bay, wherever suitable locations for nests exist.	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Open fields within the study area provide suitable foraging habitat. No nesting habitat is known to be present.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Black Tern *Chlidonias niger*	SC	No Status	Not at Risk	Black Terns build floating nests in loose colonies in shallow marshes, especially in cattails. In winter they migrate to the coast of northern South America. Nesting habitat for this species can be associated with the following ELC communities: **MAS2-1** and **OAO**. These two communities must be present immediatly adjacent each other and with sufficient water to provide suitable habitat.	In Ontario, Black Terns are found scattered throughout the province, but breed mainly in the marshes along the edges of the Great Lakes.	Ontario Breeding Bird Atlas (Square 17MH76)	**No** No cattail marshes or aquatic communities are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Bobolink *Dolichonyx oryzivorus*	THR	No Status	THR	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1** and **MAM2**.	The Bobolink breeds across North America. In Ontario, it is widely distributed throughout most of the province south of the boreal forest, although it may be found in the north where suitable habitat exists.	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Chimney swift *Chaetura pelagica*	THR	THR Schedule 1	THR	Before European settlement Chimney Swifts mainly nested on cave walls and in hollow trees or tree cavities in old growth forests. Today, they are more likely to be found in and around urban settlements where they nest and roost (rest or sleep) in chimneys and other manmade structures. They also tend to stay close to water as this is where the flying insects they eat congregate. Foraging habitat for this species can be associated with the following ELC codes: **TPO**, **CUM1**, **MAM**, **MAS**, **OAO**, **SAS1**, **SAM1**, **SAF1** containing or adjacent structures with suitable nesitng habitat (i.e. chimneys).	The Chimney Swift breeds in eastern North America, possibly as far north as southern Newfoundland. In Ontario, it is most widely distributed in the Carolinian zone in the south and southwest of the province, but has been detected throughout most of the province south of the 49th parallel. It winters in northwestern South America.	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Residential buildings adjacent to the study area may provide suitable nesting habitat.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Common Nighthawk *Chordeiles minor*	SC	THR Schedule 1	THR	Traditional Common Nighthawk habitat consists of open areas with little to no ground vegetation, such as logged or burned-over areas, forest clearings, rock barrens, peat bogs, lakeshores, and mine tailings. Although the species also nests in cultivated fields, orchards, urban parks, mine tailings and along gravel roads and railways, they tend to occupy natural sites. This species can typically be associated with the following ELC communities: **SD, BB, RB, CUM, BO, FOM, FOC and FOD** with openings with little vegetation.	The range of the Common Nighthawk spans most of North and Central America. In Canada, the species is found in all provinces and territories except Nunavut. In Ontario, the Common Nighthawk occurs throughout the province except for the coastal regions of James Bay and Hudson Bay. It winters in South America where it is concentrated in Peru, Ecuador and Brazil.	Ontario Breeding Bird Atlas (Square 17MH76)	**No** No open communities with sparse vegetation are known to be present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Eastern Meadowlark *Sturnella magna*	THR	No Status	THR	Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches. This species can typically be associated with the following ELC communities: **TPO**, **TPS**, **CUM1**, **CUS,** and **MAM2** with elevated song perches.	In Ontario, the Eastern Meadowlark is primarily found south of the Canadian Shield but it also inhabits the Lake Nipissing, Timiskaming and Lake of the Woods areas.	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Eastern Wood-Pewee *Contopus virens*	SC	No Status	SC	The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. [4] This species can typically be associated with the following ELC communities: **FOC, FOM, FOD, SWD, SWM** and **CUW**.	The Eastern Wood-Pewee Breed throughout central and eastern North America from Saskatchewan to Nova Scotia south along the Atlantic Coast to North Florida and the Gulf Coast. [4]	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Birds	Northern Bobwhite *Colinus virginianus*	END	END Schedule 1	END	Northern Bobwhites live in savannahs, grasslands, around abandoned farm fields, along brushy fencerows and other similar sites. Grasslands that are occasionally burned are particularly important because the fires help keep the habitat from becoming too forested. In such places, bobwhites can find most of their needs such as food, nesting cover, and places to hide and rest throughout the year. In severe winter conditions bobwhites sometimes need to move into small forest areas to find snow-free areas for foraging. Bobwhites lay up to 16 eggs in a shallow natural depression that they line with plant material and conceal with grasses and vines. This species can typically be associated with the following ELC communities: **TPO, TPS, CUM, CUT, CUS** and **CUW.**	The Northern Bobwhite is near its northern range limit in southern Ontario. This bird benefited greatly when the original forests were cleared and it expanded its range significantly in Ontario. At its peak over a century ago, its range in Ontario extended north to Georgian Bay and east to Kingston. This range has steadily retracted and now includes only the southwest corner of the province, mostly on Walpole Island, and possibly a few scattered locations nearby. Isolated sightings away from this area are usually a result of introductions or birds escaping from captivity.	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Open fields and hedgerows are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Birds	Wood Thrush *Hylocichla mustelina*	SC	No Status	THR	The Wood Thrush can typically be found in the interior and along the edges of well-develoepd upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. [3] This species can typically be associated with the following ELC communities: **FOD** and **FOM** that are greater than 1 ha in size.	The Wood Thrush ranges across central and southern Ontario, southern Quebec, New Brunswick and southern Nova Scotia and the majority of the eastern United States. It winters in Central American between southern Mexico and Panama. [3]	Ontario Breeding Bird Atlas (Square 17MH76)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Insects	Monarch *Danaus plexippus*	SC	No Status	SC	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico. This species can typically be associated with the following ELC communities: **AI**, **TP** and **CUM** where milkweed plants are present.	The Monarch's range extends from Central America to southern Canada. In Canada, Monarchs are most abundant in southern Ontario and Quebec where milkweed plants and breeding habitat are widespread. During late summer and fall, Monarchs from Ontario migrate to central Mexico where they spend the winter months. During migration, groups of Monarchs numbering in the thousands can be seen along the north shores of Lake Ontario and Lake Erie.	Ontario Butterfly Atlas (Square 17MH76)	**Yes** Open fields are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Little Brown Myotis (Bat) *Myotis lucifugus*	END	No Status	END	Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. caviety trees, houses, abandoned buildings, barns, etc.) habitat is available.	The little brown bat is widespread in southern Ontario and found as far north as Moose Factory and Favourable Lake. Outside Ontario, this bat is found across Canada (except in Nunavut) and most of the United States.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Eastern Small-footed Myotis *Myotis leibii*	END	No Status	No Status	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	The eastern small-footed bat has been found from south of Georgian Bay to Lake Erie and east to the Pembroke area. There are also records from the Bruce Peninsula, the Espanola area, and Lake Superior Provincial Park. Most documented sightings are of bats in their winter hibernation sites.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Mammals	Northern (Long-eared) Myotis *(Bat)* *Myotis septentrionalis*	END	No Status	END	Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines. This species can typically be associated with the following ELC communities: **FOC**, **FOM**, **FOD**, **SWC**, **SWM** and **SWD** where suitable roosting (i.e. cavity trees and trees with loose bark) habitat is available.	The northern long-eared bat is found throughout forested areas in southern Ontario, to the north shore of Lake Superior and occasionally as far north as Moosonee, and west to Lake Nipigon. This bat is found in all Canadian provinces as well as the Yukon and Northwest Territories.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Mammals	Tri-colored Bat *Perimyotis subflavus*	END	END Schedule 1	END	In Ontario, the Tri-colored Bat lives in forested habitats, forming day roosts and maternity colonies in older forest within foliage or in high tree cavities, occasionally also in bars or other structures. This species forages over water and along streams in forests. At the close of the summer season, this species congregate at a location to swarm, usually near caves, mines or underground locations where they will winter; it has a strong fidelity to its winter hibernation sites. This bat overwinters in caves, typically individually instead of as a group.	This bat is found in Southern Ontario and ranging as far north as Espanola, near Sudbury, having a scattered distribution. Its broad range sweeps from eastern North America down to Central America.	Bat Conservation International Species Range Maps	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Molluscs	Wavy-rayed Lampmussel *Lampsilis fasciola*	THR	SC Schedule 1	SC	The Wavy-rayed Lampmussel is usually found in small to medium rivers with clear water. It lives in shallow riffle areas with clean gravel or sand bottoms. Like all mussels, this species filters water to find food, such as bacteria and algae. Mussel larvae are parasitic and must attach to a fish host, where they consume nutrients from the fish body until they transform into juvenile mussels and drop off. The Wavy-rayed Lampmussel's fish hosts are the Largemouth Bass and Smallmouth Bass. The presence of fish hosts is one of the key features for an area to support a healthy mussel population. This species can typically be associated with the following ELC communities: **OAO** characterized as small to medium rivers with clean water and riffles with gravel or sand substrates.	In Canada, the Wavy-rayed Lampmussel is found only in Ontario in the Grand, upper Thames, Maitland, and Ausable rivers, and the St. Clair River delta in Lake St. Clair. It has disappeared from Lake Erie, the Detroit River and most of Lake St. Clair, and may also be gone from the Sydenham River.	Natural Heritage Information Centre Make-A-Map Application	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Plants	Butternut *Juglans cinerea*	END	END Schedule 1	END	In Ontario, Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges. This species can typically be associated with the following ELC communities: **FOD** and mature hedgerows; Soil: dry rocky or moist (4, 5, 6) to fresh (2, 3).	Butternut can be found throughout central and eastern North America. In Canada, Butternut occurs in Ontario, Quebec and New Brunswick. In Ontario, this species is found throughout the southwest, north to the Bruce Peninsula, and south of the Canadian Shield.	The study area lies within the known range of this species.	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Blanding's Turtle *Emydoidea blandingii*	THR	THR Schedule 1	THR	Blanding's Turtles live in shallow water, usually in large wetlands and shallow lakes with lots of water plants. It is not unusual, though, to find them hundreds of metres from the nearest water body, especially while they are searching for a mate or traveling to a nesting site. Blanding's Turtles hibernate in the mud at the bottom of permanent water bodies from late October until the end of April. This species can typically be associated with the following ELC communities: **SWT2**, **SWT3**, **SWD**, **SWM**, **MAS2**, **SAS1**, **SAM1**, where open water is present.	The Blanding's Turtle is found in and around the Great Lakes Basin, with isolated populations elsewhere in the United States and Canada. In Canada, the Blanding's Turtle is separated into the Great Lakes-St. Lawrence population and the Nova Scotia population. Blanding's Turtles can be found throughout southern, central and eastern Ontario.	Ontario Reptile and Amphibian Atlas (Square 17MH76)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Eastern Hog-nosed Snake *Heterodon platirhinos*	THR	THR Schedule 1	THR	The Eastern Hog-nosed Snake specializes in hunting and eating toads, and usually only occurs where toads can be found. Eastern Hog-nosed Snakes prefersandy, well-drained habitats such as beaches and dry forests where they can lay their eggs and hibernate. They use their up-turned snout to dig burrows below the frost line in the sand where eggs are deposited. This species can be associated with the following ELC codes: **BBO** and **FOD**. Sandy soils required.	The Eastern Hog-nosed Snake is only found in eastern North America, with about ten per cent of its range occurring in Canada. The Canadian population is limited to Ontario where it can be found in two areas: The Carolinian Region and Great Lakes-St. Lawrence Region.	Ontario Reptile and Amphibian Atlas (Square 17MH76)	**Yes** Deciduous woodlands are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat[1, 2]	Known Species Range[1, 2]	Source Identifying Species Record	Suitable Habitat Identified During Background Review	Species/Habitat Observed During Field Investigations	Conclusions/ Recommendations
Reptiles	Northern Map Turtle *Graptemys geographica*	SC	SC Schedule 1	SC	The Northern Map Turtle inhabits rivers and lakeshores where it basks on emergent rocks and fallen trees throughout the spring and summer. In winter, the turtles hibernate on the bottom of deep, slow-moving sections of river. They require high-quality water that supports the female's mollusc prey. Their habitat must contain suitable basking sites, such as rocks and deadheads, with an unobstructed view from which a turtle can drop immediately into the water if startled. This species can typically be associated with the following ELC communities: **OAO, SA** with emergent rocks and fallen trees suitable habitat for prey.	The Northern Map Turtle's range extends from the Great Lakes region west to Oklahoma and Kansas, south to Louisiana and east to the Adirondack and Appalachian mountain barrier. There are isolated populations in New Jersey and New York states. In Canada, it is found in southwestern Quebec and southern Ontario. In southern Ontario, it lives primarily on the shores of Georgian Bay, Lake St. Clair, Lake Erie and Lake Ontario, and along larger rivers including the Thames, Grand and Ottawa.	Ontario Reptile and Amphibian Atlas (Square 17MH76)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Queensnake *Regina septemvittata*	END	END Schedule 1	END	The Queensnake is an aquatic species that is seldom found more than a few metres from the water. It prefers rivers, streams and lakes with clear water, rocky or gravel bottoms, lots of places to hide, and an abundance of crayfish. Queensnakes will often hibernate in groups with other snakes, amphibians and even crayfish. Suitable hibernation sites (called hibernacula) include abutments of old bridges and crevices in bedrock. This species can typically be be associated with the following ELC communities: **OAO** with clear water and rocky or gravel bottoms with lots of places to hide and abundance of crayfish.	In Ontario, the Queensnake is found only in the southwest in Middlesex, Brant, Huron and Essex counties, and on the Bruce Peninsula. There are fewer than 25 sites where it is known to occur in these areas. The extremely specialized habitat requirements of the Queensnake restrict this species to particular areas, with large gaps of unfavourable habitat in between populations. The snake's home range is quite small, making Queensnakes less likely to move into new areas or areas where it was historically found.	Ontario Reptile and Amphibian Atlas (Square 17MH76)	**No** No suitable watercourses are present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.
Reptiles	Snapping turtle *Chelydra serpentina*	SC	SC Schedule 1	SC	Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits. This species can typically be associated with the following ELC communities: **OAO, SA** near gravelly or sandy areas.	The Snapping Turtle's range extends from Ecuador to Canada. In Canada this turtle can be found from Saskatchewan to Nova Scotia. It is primarily limited to the southern part of Ontario. The Snapping Turtle's range is contracting.	Ontario Reptile and Amphibian Atlas (Square 17MH76)	**No** No suitable aquatic habitat is present within the study area.	**N / A** Field investigations have not been completed to date.	Habitat and species-specific surveys are recommended in order to determine the presence / absence of this species within the study area.

Appendix B.3

Archaeological Assessment

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To: Patricia Lupton, P.Eng., Environmental Service Engineer (City of London)

Date: September 24, 2018

Project #: 60563372

From: Jennifer Morgan, PhD
Bioarchaeology Specialist

cc:

Memorandum

Subject: City of London-Water Storage Options EA- Preliminary Background Review - Archaeology

Methodology

This preliminary background review was conducted to document the archaeological and land use history as well as the existing conditions within the land parcels identified for the four reservoir candidate sites as part of the Class EA for the Long Term Water Storage Solution in the City of London, Ontario. The information obtained during the preliminary desktop review was drawn from the following:

- Recent and historical maps of the Study Area;
- Reports of previous archaeological assessments within 50 m of the Study Area;
- The Ministry of Tourism Culture and Sport's (MTCS) Archaeological Sites Database (ASDB) listing of registered archaeological sites within a 1 km radius of the Study Area;
- Searches of the Ontario Heritage Trust (OHT) Plaques Database and the Canadian Register of Historic Places; and
- The City of London heritage register and archaeological potential mapping.

This information was used to support the preliminary recommendations regarding cultural heritage values or interests as well as archaeological assessment and mitigation strategies.

Findings

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. Criteria commonly used by the MTCS to determine areas of archaeological potential are listed in the *Standards and Guidelines for Consultant Archaeologists* (Ontario Government 2011). Distance to modern or ancient water sources is generally accepted as the most important element for past human settlement patterns and when considered alone may result in a determination of archaeological potential.

Certain features indicate that archaeological potential has been removed, such as land that has been subject to extensive and intensive deep land alterations that have severely damaged the integrity of any archaeological

resources. This includes landscaping that involves grading below the topsoil level, building footprints, quarrying and sewage and infrastructure development.

A review of the historical, environmental, and archaeological context of the land parcels has been provided below as well as a determination regarding the potential for the presence of archaeological resources for both the larger land parcels as well as the proposed reservoir footprints. Details on the features used to determine archaeological potential, as well as the results of the preliminary background review, can be found below.

Site A: Springbank Reservoir (Option 1 and Option 2)

The study area identified for Site A, the Springbank Reservoir, consists of two property parcels located on the north and south sides of Commissioners Road. Reservoir footprints for Site A include two potential options which are located on the property parcel on the north side of the Commissioners Road at the existing Springbank Reservoir; 1) Site A: Reservoir on Reservoir #2 footprint (Option 1), and 2) Site A: Reservoir adjacent to Reservoir #2 footprint (Option 2). The preliminary background review was conducted for the overall study area and determined that portions of both the study area and the potential reservoir options retain archaeological potential based on:

- Proximity to 30 previously identified archaeological sites (i.e. within 1 km) including both pre- and post-contact Indigenous sites as well as 19th century Euro-Canadian sites, one of which was identified within the study area boundaries;

- Proximity to the Thames River, a significant primary water source, to the north of the Site A study area boundaries;

- General topographic variability of the area, soil texture, and drainage suitable for cultivation and agricultural use; and,

- Early Euro- Canadian settlement and industry, significant early transportation routes (i.e. Commissioners Road West).

Two reports documenting previous archaeological work in the vicinity of the Site A study area were identified. These reports included a Stage 1-2 archaeological assessment of the proposed East Staircase in Springbank Park outside of the study area boundaries for Site A, and a Stage 1 archaeological assessment for the Commissioners Road West Realignment EA. The land included within this Stage 1 report also falls outside of the Site A study area.

In addition to previous archaeological assessment reports, a review of the City of London Archaeological Master Plan (AMP) indicates that portions of the Site A study area retain archaeological potential and require further archaeological assessment. Land requiring further work also includes areas within the two potential reservoir footprints.

Based on the current proposed footprint for Option 1, it has been determined that the land within the east half of the footprint retains high potential for the recovery of archaeological resources and must be subject to Stage 2 archaeological assessment. The west half of Option 1 no longer retains archaeological potential due to previous disturbance associated with the construction of the existing Springbank Reservoir and does not require further archaeological assessment; however, the east half falls within an area of high archaeological potential and must

be subject to Stage 2 archaeological assessment. The entirety of the proposed footprint for Option 2 retains high archaeological potential and must be subject to Stage 2 archaeological assessment.

The majority of the land parcel to the south of Commissioners Road West no longer retains archaeological potential. Only a small corridor of manicured lawn extending from Commissioners Road West between existing private properties retains high archaeological potential. A Stage 2 archaeological assessment is required only for the corridor of land included in Site A should this area be subject to land disturbing activities.

Site C: City Northeast (7 potential sites)

The study area identified for Site C, the City Northeast Reservoir, includes seven property parcels along Huron Street as well as Clarke Road. The background review for the Site C study area identified the following features of archaeological potential:

- Proximity to 13 previously identified archaeological sites (i.e. within 1 km) including both pre- and post-contact Indigenous sites as well as 19th century Euro-Canadian sites;
- Proximity to the Thames River, a significant primary water source, to the north of the Site C study area boundaries;
- General topographic variability of the area, soil texture, and drainage suitable for cultivation and agricultural use; and,
- Early Euro- Canadian settlement and industry, significant early transportation routes (i.e. Huron Street and Clarke Road).

Despite the finding that the area has features of archaeological potential, four of the seven potential reservoir sites included in Site C have been cleared of archaeological concerns as a result of multiple previously conducted archaeological assessments. To the best of our knowledge, archaeological work has not yet been conducted for the property parcels on which the remaining three potential sites. The sites that retain archaeological include two sites on the property to the west of Clarke Road and one site on the property at the southeast corner of Clarke Road and Fanshawe Conservation Access Road. A Stage 2 archaeological assessment is required for the land included in Site C that has not yet been subject to archaeological assessment.

Site G: Southeast Reservoir (1 potential site)

The study area for Site G, Southeast Reservoir includes the property parcel along the east side of Highbury Avenue South. The entirety of the study area, including the proposed reservoir footprint, is currently under use as the Southeast Reservoir. The background review for the Site G study area identified the following features of archaeological potential:

- Proximity to two previously identified 19th century Euro-Canadian sites archaeological sites;
- Proximity to Dingman Creek, a significant secondary water source, to the north of the Site G study area boundaries;

- General topographic variability of the area, soil texture, and drainage suitable for cultivation and agricultural use; and,

- Early Euro- Canadian settlement and industry, significant early transportation routes (i.e. Westminster Drive, Highbury Avenue South).

A Stage 1-2 archaeological assessment was previously conducted for the Site G study area as part of the Southeast Terminal Reservoir project. Despite the finding that Site G has features of archaeological potential, based on the results of the archaeological assessment and that the Southeast Terminal Reservoir has since been constructed, archaeological potential has been removed from Site G and a Stage 2 archaeological assessment is not required.

Site I: Arva Reservoir (1 potential site)

The study area for Site I, Arva Reservoir, includes a property parcel to the north of Medway Road and east of Wonderland Road. The study area is comprised of the existing Arva Reservoir and a small woodlot is located in the northwest corner of the study area. The proposed reservoir footprint is located in central portion of the study area within the existing reservoir land. The background review for the Site I study area identified the following features of archaeological potential:

- Proximity to six previously identified archaeological sites including both pre- and post-contact Indigenous sites as well as 19th century Euro-Canadian sites;

- Proximity to Medway Creek, a significant secondary water source, to the south of the Site I study area boundaries;

- General topographic variability of the area, soil texture, and drainage suitable for cultivation and agricultural use; and,

- Early Euro- Canadian settlement and industry, significant early transportation routes (i.e. Westminster Drive, Highbury Avenue South).

No reports for previous archaeological assessments within or in close proximity (i.e. within 50m) to the Site I study area were found in the MTCS' report register. Portions of the study area were determined to retain archaeological potential, specifically the woodlot in the northeast corner of the property. Given the proximity to the existing reservoir, the potential for the presence of archaeological resources within the proposed reservoir footprint is low to moderate; however, a Stage 1 property inspection and, potentially, a Stage 2 archaeological assessment, will be required to determine the extent of ground disturbance within the proposed Site I footprint.

Recommendations

Based on the findings of this background review, it has been determined that archaeological potential has been removed from the entirety of Site G. Portions of the potential sites for Site A, three potential site areas for Site C, and the entirety of Site I were found to retain high potential for the recovery of archaeological resources. In

light of these preliminary findings, a Stage 2 archaeological assessment will be required for all land identified within the candidate sites that retain archaeological potential.

Limitations and Assumptions

This preliminary background review was conducted as part the City of London Water Storage Options EA and includes large land parcels for several candidate reservoir sites. Once the project details preferred site, and areas of impact are determined, only land retaining archaeological potential within the preferred candidate site will be subject to further Stage 2 archaeological assessment, if required. The findings presented herein are limited to the four site options described above. As such, if additional land outside of the current study areas reviewed here be included in this project, additional background research will be required.

This preliminary memorandum has not been reviewed and/or accepted by the MTCS and is not intended to take the place of a full Stage 1 archaeological assessment. As such, the above stated recommendations are to be considered preliminary until accepted by the MTCS. In order to maintain compliance with the MTCS and the *Ontario Heritage Act* (1990), a Stage 1 archaeological assessment, and any subsequent archaeological work where required, must be completed and accepted into the MTCS' register of archaeological reports prior to ground disturbing activities.

Sources

AECOM Canada Ltd.
2016 *Stage 1 Archaeological Assessment, Killaly Road Properties, Part of Lot 4, Concession 3, Geographic Township of London, Now the City of London, Middlesex County, Ontario.*

Bluestone Research Inc.
2017 *Stage 1-2 Archaeological Assessment of 2331 Kilally Road and 1588 Clarke Road, part of Lot 4, Concession 3, City of London, Middlesex County,Ontario.*

Golder Associates Ltd.
2018 *Stage 1 Archaeological Assessment, Commissioners Road West Realignment EA, Part of Lots 39, 40, and 41, Concession 1, Former Township of Westminster, now the City of London, Middlesex County, Ontario.*

Golder Associates Ltd.
2014 *Stage 1 and 2 Archaeological Assessment, 2 Parcels, Part of Lots 3 and 4, Concession 3, Approx. 23.5 Hectares Total, Huron Street and Veteran's Memorial Parkway, City of London, Middlesex County, Ontario.*

Golder Associates Ltd.
2013 *Stage 4 Archaeological Assessment, Location 1 (AgHg-10), Huron Street and Veteran's Memorial Parkway South West Parcel, Lot 3, Concession 2, formerly London Township, now City of London, Middlesex County, Ontario.*

Golder Associates Ltd.
2013 *Stage 4 Archaeological Mitigation, Location 2 (AgHg-11), Huron Street and Veteran's Memorial Parkway, South East Parcel, Lot 3, Concession 2, Formerly London Township, now City of London, Middlesex County, Ontario.*

Golder Associates Ltd.
2012 *Stage 1 and 2 Archaeological Assessment, Concession 3, Part Lot 3, Reg. Plan, 33R12640, and Concession 3, Part Lot 2, Approx. 48.5 Hectares Huron Street and Veterans Memorial Parkway, City of London, Middlesex County, Ontario.*

Golder Associates Ltd.
2012 *2 Parcels, Part of Lot 3, Concession 2, Approx. 21.2 Hectares Total Huron Street and Veterans Memorial Parkway, City of London.*

London Museum of Archaeology
1997 *Fox Hollow Community Plan: Archaeological and Built Heritage Resource Studies.*

M.M. Dillon Ltd.
1994 *Southeast Terminal Reservoir, Archaeological Impact Assessment, Stage 1 and 2.*

Stantec Consultants Ltd.
2017 *Stage 1-2 Archaeological Assessment, Huron Industrial Lands*

Stantec Consultants Ltd.

2015 *Stage 1-2 Archaeological Assessment, 3680 Wonderland Road South, Part of Lot 36, Concession 2, Geographic Township of Westminster, former Middlesex County, now City of London, Ontario.*

Timmins Martellle Heritage Consultants

2017 *Stage 1 & 2 Archaeological Assessment East Staircase Replacement Springbank Park Part of Lots 38 and 39, Concession B Broken Front Geographic Township of Westminster City of London Middlesex County, Ontario.*

Appendix B.4

Cultural Heritage Assessment Report

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Memorandum

To	Patricia Lupton, P.Eng., Environmental Service Engineer (City of London)	Page	1
CC			
Subject	**City of London Water Storage Options EA – Cultural Heritage Checklist**		
From	Michael Greguol, Cultural Heritage Specialist (AECOM)		
Date	September 24, 2018	Project Number	60563372

Environmental Assessment

The City of London is supplied with water from two lake based sources, the Lake Huron Region Water Supply System and the Elgin Area Water Supply Station (Lake Erie). In the event of a disruption or reduction in water supply, and to supply adequate water pressure, the City is connected to these regional reservoirs and benefits from the connection between the municipalities to maintain uninterrupted service. These reservoirs are shown in the attached figure below and include the Arva Reservoir & Pump Station, the Springbank Reservoirs & Pump Station, the Southeast Reservoir & Pump Station, and the Elgin-Middlesex Reservoir.

To address future water storage needs, the City is undertaking a Municipal Class Environmental Assessment (EA) study to determine a preferred site (or sites) for additional water storage to meet future growth and ongoing emergency supply and distribution needs. Additionally, this project will consider the feasibility of retiring the existing Springbank Reservoir #2 and the previously disconnected McCormick Reservoir, as well as options for standby power for the water distribution pumps at the existing Arva Pump Station.

Cultural Heritage Screening

As part of the Municipal Class Environmental Assessment for the Municipal Class EA, AECOM completed the Ministry of Tourism, Culture, and Sport's (MTCS) *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* in order to help determine whether the project has the potential to impact cultural heritage resources. A single checklist was completed for the project and included the properties identified in each short list EA option, as well as consideration of the adjacent properties at each potential project site. In order to complete, the checklist, AECOM reviewed the following registers and databases to screen for recognized and potential cultural heritage resources:

- City of London's *Inventory of Heritage Properties*;
- Ontario Heritage Trust's online inventory of buildings, museum, and easement properties;

- Canadian Register of Historic Places; and
- Directory of Federal Heritage Designations.

Table 1 includes information related to the recognized cultural heritage resources that were identified as part of the desktop review undertaken to complete the checklist. A total of five (5) heritage properties were identified within the vicinity of the Site A, C-1, C-2, C-5, and G. Details related to each property and their respective sites are included below. Details related to the Priority levels included within the City of London's *Inventory of Heritage Resources* are included below for context.

Table 1: Recognized cultural heritage resources located within the EA study area

Municipal Address	Heritage Status	Notes in Register	EA Candidate Site	Anticipated Preliminary Impacts
1040 Flint Lane/1097 Commissioners Road West	Designated under Part IV of *Ontario Heritage Act*	c.1837, Ontario Cottage	Site A	No impacts anticipated. Identified as adjacent property.
1588 Clarke Road	Listed, Priority 2	c.1865, Ontario Farmhouse	Site C-1	Impacts unknown at this time.
1511 Clarke Road	Listed, Priority 2	c.1865, Ontario Farmhouse	Site C-2	Impacts unknown at this time.
2056 Huron Street	Listed, Priority 1	1840, Georgian	Site C-5	No impacts anticipated. Identified as adjacent property.
1889 Westminster Drive	Listed, Priority 2	1880, Queen Anne	Site G	No impacts anticipated. Identified as adjacent property.
5406-5426 Highbury Avenue South	Listed, Priority 1	1870, Ontario Farmhouse	Site G	No impacts anticipated. Identified as adjacent property.

In addition, a municipal plaque is located within Reservoir Park at Site A, noting the Battle of Hungerford Hill, a lesser known battle that took place during the War of 1812.

The City of London's *Inventory of Heritage Properties* includes an inventory of approximately 2,900 buildings inventoried in the City of London for architectural, historical, and contextual reasons. The inventory includes properties that are listed and/or designated under the Ontario Heritage Act. Listed properties are each given a priority level to justify the heritage value of the resource. The following definitions are provided for each category:

Priority 1 buildings are London's most important heritage structures and all merit designation under Part IV of the *Ontario Heritage Act*. They are worthy of protection through whatever incentives may be provided in terms of zoning, bonusing or financial advantage and may be designated without the owner's consent. This group includes not only landmark buildings and buildings in pristine condition, but also lesser well-known structures with major architectural and/or historical significance and important structures that have been obscured by alterations which are reversible.

Priority 2 buildings merit evaluation for designation under Part IV of the *Ontario Heritage Act*. They have significant architectural and/or historical value and may be worthy of protection by whatever incentives may be provided through zoning considerations, bonusing or financial advantages.

Priority 3 buildings may merit designation as part of a group of buildings designated under Part IV of the *Ontario Heritage Act* or as part of a Heritage Conservation District designated under Part V of the Act, even though these buildings are not often worthy of designation individually. They may have some important architectural features or historical associations, be part of a significant streetscape or provide an appropriate context for buildings of a higher priority.

Conclusions and Recommendations

A total of five (5) heritage properties were identified within the vicinity of the Site A, C-1, C-2, C-5, and G. Further cultural heritage reporting requirements are dependent upon the identified alternative or option for this Class EA. If Site A, C-1, C-2, C-5, or G are selected as a preferred alternative further investigation may be required in the form of a Cultural Heritage Evaluation Report (CHER), or a Heritage Impact Assessment (HIA) in order to fully evaluate the cultural heritage value or interest of the identified heritage properties, and to assess the potential impacts that the proposed project may have on the identified heritage value of the properties.

The City of London should continue to consider potential impacts to cultural heritage resources as part of this Class EA.

AECOM

Appendix B.5

Geotechnical and Hydrogeological Summary

AECOM Imagine it. Delivered.

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CC:
John Haasen; Nancy Martin

Project name:
60569302

Project ref:
Water Storage Options EA

From:
Yu Guo, Taesang Ahn, Miln Havrvy

Date:
September 09 2018

Memo

Subject: Geotechnical and Hydrogeological Data Summary Of Previous Investigations for Site A, Site C, Site G and Site I, City of London Water Storage Facility, London, ON

1. Introduction

Four (4) sites, i.e., Site A, Site C, Site G and Site I, are subjected to an Environment Assessment (EA) level of evaluation for the City of London Water Storage Facility. Within these four sites, Site A contains two (2) candidate areas (Area A1 and A2). Site C consists of seven (7) candidate areas (Area C1 to C7). This memorandum summarizes the historical geotechnical and hydrogeological data obtained during various field investigations completed by a number of other consultants at or near the candidate site areas to determine their relevance and suitability for use in the EA level of evaluation for the City of London Water Storage Facility.

2. Site A – Springbank PS and Reservoir

2.1 Background

This section of the memorandum provides a summary of the geotechnical factual data for Site A. Site A is located adjacent to 869 Commissioners Road W, London, ON. Site A is divided into two areas by Commissioners Road, i.e., A1 and A2, as shown in Figure 1. The geotechnical information referenced in this section was obtained from the following geotechnical reports:

1. **Geotechnical Investigation - Springbank Reservoir No. 2** dated June 2012, prepared by exp Services Inc.
2. **Preliminary Geotechnical Assessment- Commissioners Road West Realignment Environmental Assessment London, Ontario** dated August 2016, prepared by Golder Associates
3. **Geotechnical Investigation for Commissioner Road West Realignment, Springbank Drive to Crestwood Drive (Snake Hill), London, Ontario** dated August 31, 2005, prepared by Atkinson, Davies Inc.

2.2 Previous Geotechnical Investigations

- Borehole (Golder Report 811-3508)
- Borehole (Golder Report 961-3153)
- Borehole (Atkinson Davies Investigation No. 1-3608)
- Borehole (exp Services Inc. Geotechnical Investigation - Springbank Reservoir No. 2)

Figure 1 Borehole locations in and near Site A

A total of eight (8) boreholes, i.e. BH1 to BH8, were located inside Area A1 and one (1) borehole (BH-4*) was drilled close to the western boundary of Area A1. There were two (2) boreholes at Area A2, i.e., BH-7 and BH-7a. BH-7 (Golder Associates) was drilled inside the Area A2 and BH-7a (exp Services) was located near the southeast boundary of Area A2.

2.2.1 Area A1

2.2.1.1 Subsurface Conditions

Eight (8) boreholes were advanced in Area 1. BH-1 to BH-4 were drilled outside the reservoir slopes. A 50 to 100 mm thick layer of topsoil was encountered at the surface of the boreholes. Below the topsoil, a 4.5 to 6.1 m thick layer of loose to compact sand/silty sand/sand and gravel fill was encountered at the depth of 0.1 metres below ground surface (mbgs) and extended to depths of 4.6 to 6.2 mbgs. Below the sand fill, a 0.8 to 1.4 m thick layer of stiff clayey silt fill was encountered at depths of 4.6 to 6.2 mbgs and this extended to depths of 6.4 to 7.6 mbgs. Below the sand fill or the clayey silt fill, a layer of loose to dense sand was encountered at depths of 5.3 to 7.6 mbgs and this extended to the borehole termination depths. The details of the subsurface soil conditions beneath the outside reservoir slopes are summarized in Table 1.

BH-5 to BH-8 were drilled on the base of the reservoir. A 200 to 240 mm thick layer of concrete was encountered at the surface of the boreholes. Below the concrete, a 0.6 to 1.3 m thick layer of loose sand fill was encountered at a depth of 0.2 mbgs and this extended to depths of 0.8 to 1.5 mbgs. Below the sand fill or concrete, a 1.3 to 3.2 m thick layer of compact sand was encountered at depths of 0.2 to 1.5 mbgs and this extended to depths of 1.5 to 3.4 mbgs or to the termination depths. Below the sand, a layer of compact sand and gravel was encountered at a depth of 1.5 mbgs and this extended to the borehole termination depth in BH-7. Also below the sand, a layer of compact sandy silt was encountered at a depth of 3.4 mbgs and extended to the borehole termination depth in BH-5. The details are summarized in Table 2.

Atkinson Davies drilled BH-4* on Commissioners Road W. The borehole encountered a 115mm asphalt concrete layer underlain by 135 mm of granular fill. A 1.2 m thick compact fine sand layer was encountered under the granular fill with a Standard Penetration Test (SPT) N of 18 indicating compact relative density. This was in turn underlain by a 0.7m thick compact sandy silt layer. The sandy silt layer had SPT N of 35 indicating a dense condition. A very dense sand layer was under the sandy silt layer extending to the borehole termination depth.

Table 1: Subsurface Soils Conditions - Site A - Outside Reservoir Slopes (BH-1 to 4)

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.1	-
Fill (Sand, Silty Sand, Sand and Gravel)	4.5 to 6.1	Loose to compact (SPT N= 4~20)
Fill (Clayey Silt)	0.8 to 1.4	Stiff (SPT N= 12~22)
Sand	-	Loose to dense (SPT N= 6~50)

Table 2: Subsurface Soils Conditions - Site A - Base of the Reservoir (BH-5 to BH-8)

Soil Type	Thickness (m)	Consistency/ Compactness
Concrete	0.2	-
Fill (Sand)	0.6 to 1.3	Loose (SPT N= 5~8)
Sand	1.3 to 3.2	Compact (SPT N=17~32)
Sand and Gravel	0.2 (terminated)	Compact (SPT N= 17~21)
Sandy Silt	0.2 (terminated)	Compact (No N-Value available)

2.2.1.2 Groundwater

The groundwater generally flows to the north, toward the Thames River through the extensive granular deposit. The groundwater observations for boreholes located in Area A1 are summarized in Table 3. The measured groundwater level was 7.6 mbgs on May 14, 2012 in BH-1, which is a monitoring well. The groundwater level in BH-2 was measured at 4.9 mbgs in

the open hole upon completion of drilling. However, BH-3 to BH-8 were dry upon completion of drilling. Seasonal fluctuations in groundwater levels may be expected.

Table 3: Groundwater conditions in Area A1

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH-1	7.6	Monitoring Well
BH-2	4.9	Open hole (on completion of drilling)
BH-3 to BH-8	Dry	Open hole (on completion of drilling)

2.2.2 Area A2

2.2.2.1 Subsurface Conditions

Two (2) boreholes were advanced in Area A2. BH-7 was drilled inside Area 2 on the reservoir floor slab by means of a hand auger. The depth of the borehole was 3.5m, and the soils encountered in BH-7 were compact sand. The detailed subsurface conditions in BH-7a are summarized in Table 4.

Table 4: Subsurface Soils Conditions – BH-7a

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.46	
Clayey Silt (Till)	1.90	Brown stiff to very stiff (SPT N=14~16)
Sand	5.24	Compact to dense brown fine to medium (SPT N=16~33)
Clayey Silt	0.3	Hard brown with silt seams
Sand	0.46	Dense brown fine to medium (SPT N=45)
Silt	0.76	Very dense, brown (SPT N=80)
Sand	0.31	Compact brown fine to medium
Sand and Gravel	-	Grey

2.2.2.2 Groundwater

No groundwater information is available for the boreholes drilled in Area A2.

2.2.3 Site A - Hydrogeological Overview

The subsurface conditions at Site A generally consist of a unit of sand and gravel. The hydraulic conductivity of the sand and gravel is estimated to range from 1×10^{-4} – 1×10^{-3} m/s based on Figure 2 (Freeze and Cherry, 1979), which is considered to be relatively high. The only stabilized groundwater elevation was measured in BH-2 at 7.6 mbgs. Ground surface elevation at the site is approximately 300 metres Above Sea Level (mASL), and thus the water table is at approximately 292 mASL. Historically, the groundwater elevation in the Byron Gravel Pit (to the west of the site) was approximately 240 mASL, and the North Thames River has a surface water elevation of approximately 228 mASL. Thus, the groundwater flow direction is toward the north and west of the site. No groundwater samples were collected for water quality analysis.

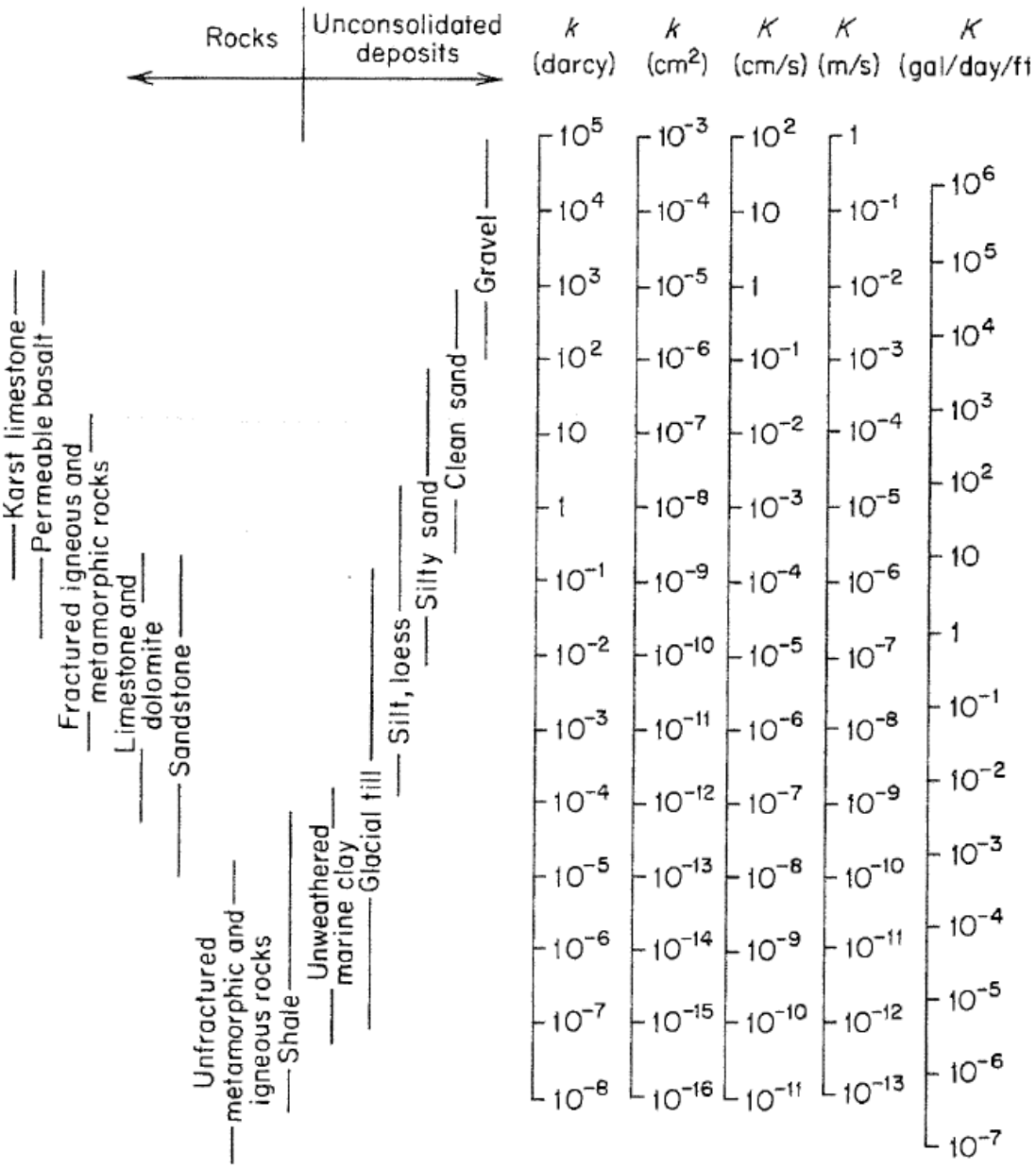


Figure 2 Range of Values of Hydraulic Conductivity and Permeability

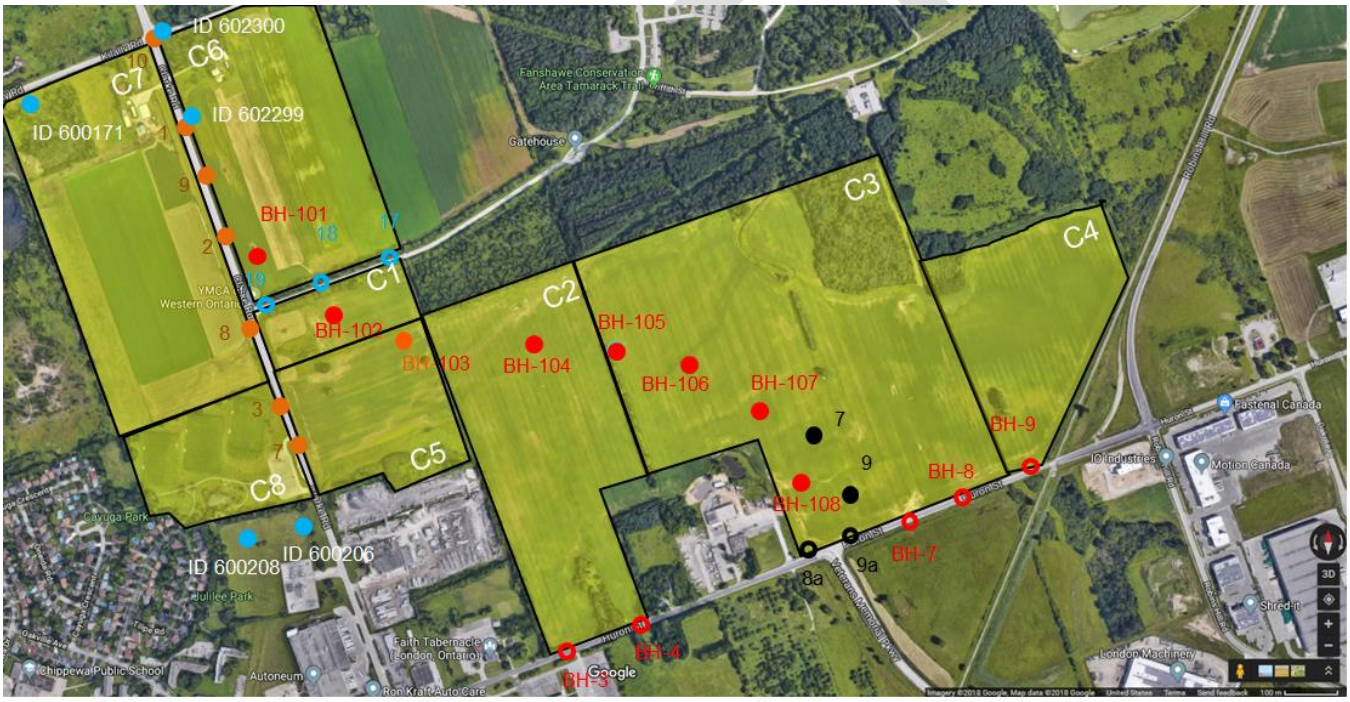
Ref: Freeze, A and J. Cherry (1979) Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.

3. Site C – Huron Street and Clarke Road

3.1 Background

This section provides a summary of the geotechnical factual information for Site C. The Site C is located between Clarke Road and Robison Hill Rd, and on either side of Huron Street, London, ON as shown in Figure 3. Site C is divided into seven (7) areas (C1 to C7). The geotechnical information in this section was obtained from the following geotechnical reports:

1. **Geotechnical Investigation – Veterans Memorial Parkway Extension Huron Street to Clarke Road London Ontario** dated June 2016, prepared by Golder Associates Ltd.
2. **Geotechnical Investigation Proposed Watermain Huron-Crumlin-Oxford London, Ontario** dated August 1988, prepared by Trow Ontario Ltd.



- Borehole (Golder Investigation 021-3132)
- Borehole (Golder Investigation 041-130270-3)
- Borehole (Golder Investigation 1540637-1000-R01 Veterans Memorial Parkway Extension Huron Street to Clarke Rd London, Ontario)
- Borehole (Golder Investigation 11-1132-004-R01)
- Borehole (Golder Investigation 961-3045)
- Borehole (Trow Geotechnical Report Proposed Water Main Huron-Crumlin-Oxford)
- Borehole (Ontario Geological Survey)

Figure 3 Borehole locations in and near Site C

3.2 Previous Geotechnical Investigations

3.2.1 Area C1

3.2.1.1 Subsurface Conditions

Five (5) boreholes were advanced in Area C1. BH-102 was drilled in the middle of Area C1. BH-17 to BH-19 were drilled to depths of 3.5 to 4.0m respectively at the north boundary. BH-8 was drilled to a depth of 1.5m on the Clarke Rd at west boundary.

A 0.2 to 0.3 m of topsoil layer was encountered in BH-17 to BH-19, and this was underlain by a 0.9 to 2.0 m of compact to dense sand layer. A layer of very dense silt till/clayey silt till was found under the sand layer at BHs 17 and 19 while a very stiff clayey silt layer was encountered under the sand layer in BH 18.

A layer of 0.13m asphalt was found in BH-8, and this was underlain by 0.17m granular base and 0.5m granular subbase. A layer of silty sand was found below the granular subbase, and it extended to the borehole termination depth.

The subsurface conditions in BH-102 are summarized in Table 5. The subsurface conditions in BH-17 to BH-19 are summarized in Table 6.

Table 5: Subsurface Soils Conditions – BH-102 (Inside Area C1)

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.52	
Clayey Silt (Till)	1.61	Brown stiff to very stiff (SPT N = 11~17)
Sandy Silt (Till)	1.53	Grey dense to very dense (SPT N = 45~60)
Clayey Silt (Till)	-	Grey hard (SPT N=34~58)

Table 6: Subsurface Soils Conditions – BH-17 to 19 (North boundary at Area C1)

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.21-0.3	
Sand/silty sand	0.92-2.14	Brown compact to dense (SPT N = 19~36)
Clayey silt/ Clay silt (Till)/ Silt (Till)	-	Grey dense to very dense (SPT N = 46~120)

3.2.1.2 Groundwater

In this area, the groundwater levels were measured at 0.75 mbgs in BH-8 (this may be a perched water table level), and at 2.0 mbgs in BH-19, as shown in Table 7.

Table 7: Subsurface Soils Conditions – BH-17 to 19

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH-8	0.75	Open hole (on completion of drilling)
BH-19	2.0	Monitoring well
Other boreholes	Dry	

3.2.2 Area C2

3.2.2.1 Subsurface Conditions

Three (3) boreholes were advanced in Area C. BH-104 was drilled at north part of Area C2 and BH-3 and BH-4 were drilled at the south boundary of Area C2. The subsurface conditions of Area C2 are summarized in Tables 8 and 9.

Table 8: Subsurface Soils Conditions – BH-104

Soil Type	Thickness (m)	Consistency/ Compactness
Top Soil	0.4	
Sandy Silt (Till)	2.5	Brown compact to dense (SPT N = 18~31)
Sandy Silt (Till)	3.65 (terminated)	Grey dense to very dense (SPT N= 41~101)

Table 9: Subsurface Soils Conditions – BH-3 and BH-4

Soil Type	Thickness (m)	Consistency/ Compactness
Asphaltic concrete	0.05	
Fill	0.8~0.9	Granular intermixed with clayey silt(SPT N = 8~20)
Silt (Till)	2.05~2.15 (terminated)	Clayey silt till, very stiff, becoming sandy, gravelly and very dense with depth (SPT N= 20~120)

3.2.2.2 Groundwater

In this area, no groundwater was encountered in the depths of boreholes drilled.

3.2.3 Area C3

3.2.3.1 Subsurface Conditions

Eleven (11) boreholes were advanced in Area C3. BH-105 to BH-108, and BHs 7 and 9 (black dots) were drilled in Area C3. BHs 8a, 9a, 7,and 8 were drilled on Huron Street. The soil conditions in Area C3 are summarized in Table 10.

At the south boundary of Area C3, BH-8a and BH-9a were drilled to a 2 m depth and BH-7 was drilled to 3 m. A 0.5 to 0.8 m granular fill layer was encounterred below the ground surface. Below the fill layer, a 0.6 to 1.0 m topsoil or sandy silt layer underlained by a layer of sandy silt/silt till was encounterred.

Table 10: Subsurface Soils Conditions – BH-105 to 108; BHs 7 and 9

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.15~0.98m	
Sandy Silt (Till)	-	Very dense; Brown closed to the surface and turning to grey with depth 0.39-0.46m clayey silt was found in some area overlain the sandy silt (Till) layer in some area 0.5-1.5m silty sand was found to separate the brown sandy silt (Till) and grey sandy silt (Till) in some area.

3.2.3.2 Groundwater

Groundwater was encounterred at the ground surface in BH 9. The groundwater level was initially encounted at 3.38 mbgs after completion of the drilling (March 15, 2011) but it later rose to 0.61 mbgs (April 8, 2011). At the south boundary of this area, the groundwater table was measured from 0.6 to 2.0mbgs.

Table 11: Groundwater conditions in Area C3

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH 9	0	Open hole
BH 7	3.38	During drilling (March 15, 2011)
	1.27	Monitoring well (March 19, 2011)
	0.61	Monitoring well (April 8, 2011)
Others	Dry	

3.2.4 Area C4

3.2.4.1 Subsurface Conditions

One (1) borehole is availabe at the south boudary of Area C4. BH-9 was drilled at the southwest corner of Area C4 to the depth of 5 m. A 1.4 m fill layer underlain by 1.0 sand layer was found in BH-9. The sandy silt till was found under the sand layer unitl the end of borehole. The subsurface conditions are summarized in Table 12.

Table 12: Subsurface Soils Conditions – BH-9

Soil Type	Thickness (m)	Consistency/ Compactness
Fill	1.4	Granular, organic stained, brown moist
Sand	1.0	Trace to some silt, fine to medium grained, compact (SPT N=22)
Sandy Silt (Till)	-	Grey very dense with depth (SPT N=16~52)

3.2.4.2 Groundwater

The groundwater table was encountered at 1.8 mbgs in BH-9.

Table 13: Groundwater conditions in Area C4

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH-9	1.8	Open hole

3.2.5 Area C5

3.2.5.1 Subsurface condtions

One (1) borehole (BH-103) was drilled to a depth of 6.55 m inside of Area C5 near the northeastern corner. Two (2) boreholes (BH3 and BH7), which are shallow boreholes drilled on Clarke Road, closed to the west boundary of Area C5. A 0.55 m thick of topsoil layer underlain by a 0.43 m sand layer was encounterred in BH-103. A 3.44 m thick of dense sandy silt till layer was encountered under the sand layer followed by a clayey silt till layer with a 0.61m silty sand seam. The subsurface conditions based on BH-103 are summarized in Table 14.

Table 14: Subsurface Soils Conditions – BH-103

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.55	Black silty sand
Sand	0.43	Brown, compact (SPT N=15)
Sandy silt (Till)	3.44	Brown turning grey at 2.1mbgs, dense to very dense, trace to some gravel, trace clay (SPT N=14~50/125mm)
Clayey silt (Till)	0.76	Grey, hard, trace gravel and sand (SPT N=62)
Silty sand	0.61	Grey, very dense, with clayey silt seams (SPT N=77)
Clayey silt (Till)	-	Grey, hard, trace gravel and sand (SPT N=50)

3.2.5.2 Groundwater

The groundwater table was encountered at 0.75 mbgs in BH-7 on completion of drilling (this may be a perched water table level).

Table 15: Groundwater conditions in Area C5

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH-7	0.75	Open hole (on completion of drilling)
Others	Dry	

3.2.6 Area C6

3.2.6.1 Subsurface condtions

One (1) boreholes, BH-101, were advanced to the depth of 6.37 m in Area C6. Four (4) shallow borholes, BH 1, 2, 9 and ID 602299 were drilled to a depth about 1.5m on Clarke Road at the west boundary of Area C6. BH 10 and ID602300 were advanced at the northwestern corner of Area C6 to depths of 1.52 m and 4.4 m, respectively.

According to BH-101 and ID 602300, a 0.3m thick of topsoil was encountered underlain by layers of silt to silty sand to sand (i.e., cohesionless layers). The thickness of the silt to sand layer increased from south to north. A very stiff clayey silt layer was found under the cohesionless layers underlain by a layer of dense to very dens sandy silt till. The subsurface conditions are summarized in Table 16.

Table 16: Subsurface Soils Conditions based on BH-101 and ID602300

Borehole ID	Soil Type	Thickness (m)	Consistency/ Compactness
BH-101	Topsoil	0.37	Black silty
	Silty sand	0.33	Brown
	Clayey silt	1.43	Brown very stiff, with some sand and trace gravel (SPT N=18~22)
	Sandy silt till	-	Grey, dense to very dense, trace to some gravel, trace to some clay (SPT N=42~50/75mm)
ID 602300	Topsoil	0.3	
	Silt	0.9	Brown, with clay and gravel
	Sand	3.2	Brown, with gravel and silt, dense

3.2.6.2 Groundwater

No groundwater was encountered in the depths of boreholes drilled.

3.2.7 Area C7

3.2.7.1 Subsurface condtions

One (1) boreholes, ID 600171, were found in Area C7. Five (5) shallow BHs 1, 2, 8, 9 and ID 602299 were drilled to a depth of 1.5m on Clarke Road at the east boundary of Area C7. The subsurface conditions according to borehole ID 600171 are summarized in Table 17. According to borehole ID 600171, top 1.5 m below the ground surface contained gravel mixed with sand and silt underlain by a 22.3m thick of clay layer. A 6.7m thick of gravel layer containing clay, sand and silt was encountered under the clay layer. A lower layer of clay was found under the gravel layer, likely extended to the bedrock surface at a depth of approximately 31 mbgs.

Table 17: Subsurface Soils Conditions based on ID600171

Borehole ID	Soil Type	Thickness (m)	Consistency/ Compactness
ID 602300	Gravel with sand and silt	1.5	
	Clay	22.3	With sand, gravel and boulders
	Gravel	1.2	With clay
	Gravel	5.5	With sand and silt
	Clay	-	With gravel

3.2.7.2 Groundwater

No groundwater information was founded in this area.

3.2.8 Area C8

3.2.8.1 Subsurface condtions

No borehole was found in Area C8. Two (2) shallow borholes, BH-3 and BH-7 were drilled to a depth of 1.5m on Clarke Road at the east boundary of Area C8. Two (2) boreholes, ID 600208 and ID600206 at the adjacent land that is about 30m south from the southern boundary of Area C8 were advanced to depths of 6.3 m and 6.2 m, respectively,

According to these two boreholes, a 0.5 m thick of layer black topsoil was encountered at this area underlain by a compact to dense silt layer. The subsurface conditions according to boreholes ID 600206 and 600208 are summarized in Table 18.

Table 18: Subsurface Soils Conditions based on ID 600206 and ID600208

Borehole ID	Soil Type	Thickness (m)	Consistency/ Compactness
ID 600208	Topsoil	0.5	Black with organic materials
	Silt	-	Brown at top, dense, with sand, gravel and clay
ID 600206	Topsoil	0.5	Black with organic materials
	Silt	-	Brown to grey, compact to dense, with sand and clay, more clayey with depth

3.2.8.2 Groundwater

The groundwater table was encountered at 0.75 mbgs in BH-7 on completion of drilling (this may be a perched water table level).

Table 19: Groundwater conditions in Area C5

Borehole ID	Groundwater Level (mbgs)	GW measured from
BH-7	0.75	Open hole (on completion of drilling)
Others	Dry	

3.2.9 Site C – Hydrogeological Overview

The subsurface at Site C consists, in general, of sandy silt till to clayey silt till. The hydraulic conductivity of silty clayey till is in the range of 1×10^{-8} – 1×10^{-7} m/s (Freeze and Cherry, 1979), which is considered to be relatively low. The stabilized groundwater elevation, as measured in monitoring wells, is in the range of 0.61 – 2.0 mbgs. The North Thames River is located to the north of the Site C, and the surface water elevation is approximately 250 mASL. Thus, the groundwater flow direction is northward toward the North Thames River, and the water table will occur deeper below ground surface in the table lands as you move northward toward Kilally Road. No groundwater samples were collected for water quality analysis.

4. Site G – Southeast PS and Reservoir

4.1 Background

This section provides a summary of the geotechnical factual data at Site G. The geotechnical information in this section was obtained from the following geotechnical report:

1. **Geotechnical Investigation, Proposed Southeast Terminal Reservoir and Pumping Station** dated January 10, 2005, prepared by Golder Associates Ltd.

4.2 Previous Geotechnical Investigations

Eleven (11) boreholes in total were investigated at the proposed Southeast Terminal Reservoir and Pumping Station. Table 20 presents the borehole information. The borehole locations are shown in Figure 4. The existing

Figure 4 Borehole locations in Site G

Table 20: Existing Borehole Data - Site G

Borehole ID	Borehole Depth (mbgs)	Location Description
2005-BH1	15.7	North Property Line
2005-BH2	15.7	North Property Line
2005-BH3	15.7	North Property Line
2005-BH4	15.7	North Property Line
2005-BH5	14.2	East of Proposed Reservoir Area
2005-BH6	14.2	Proposed Reservoir Area
2005-BH7	14.2	Proposed Reservoir Area
2005-BH8	13.4	Pumping Station Location
2005-BH9	13.4	Pumping Station Location
1994-BH1	11.1	Proposed Reservoir Area
1994-BH2	11.9	Ease of Proposed Reservoir Area

4.2.1 Subsurface Conditions

2005-BH1 to 2005-BH9 and 1994-BH1 and 1994-BH2 were advanced near the proposed reservoir location. A 0.3 to 0.4 m thick layer of topsoil was encountered in the boreholes at the surface. Below the topsoil, a 0.2 to 0.8 m thick layer of loose sandy silt/sand was encountered at a depth of 0.3 mbgs and this extended to depths of 0.5 to 1.1 mbgs. Below the silty sand/sand or topsoil, a 14.8 m thick layer of stiff to hard clayey silt till was encountered at depths of 0.3 to 1.1 mbgs and this extended to a depth of 15.1 mbgs or to the borehole termination depths. Below the clayey silt till, a layer of silty sand till was encountered at a depth of 15.1 mbgs and this extended to the borehole termination depths. The subsurface soil conditions outside the reservoir slopes are summarized in Table 21.

Table 21: Subsurface Soils Conditions - Outside Reservoir Slopes

Soil Type	Thickness (m)	Consistency/ Compactness
Topsoil	0.3 to 0.4	-
Sandy Silt, Sand	0.2 to 0.8	Loose
Silty Clay Till	14.8	Stiff to hard
Silty Sand Till	-	

4.2.2 Groundwater

The groundwater level ranged from 3.66 to 7.00 mbgs (270.92 to 267.58 masl) between May 12, 1994 and May 27, 1994 in the 1994-BH1 and 1994-BH2, respectively. During the drilling the open boreholes 2005-BH1 to 2005-BH9 were found to be dry upon completion of drilling. No piezometers were installed in these boreholes.

Table 22: Groundwater conditions in Site G

Borehole ID	Groundwater Level (mbgs)	Date of Measurement
2005-BH1	3.66	Monitoring well (May 12, 1994)
	7.0	Monitoring well (May 27, 1994)
2005 BH2	4.72	Monitoring well (May 12, 1994)
	3.95	Monitoring well (May 27, 1994)
Others	Dry/no piezometers	

4.2.3 Site G – Hydrogeological Overview

The subsurface at Site G consists, in general, of silty clay till. The hydraulic conductivity of silty clayey till is in the range of 1 x 10^{-9} – 1 x 10^{-8} m/s (Freeze and Cherry, 1979), which is considered to be relatively low. The stabilized groundwater elevation, as measured in Monitoring Wells, is in the range of 3.66 – 7.0 mbgs. From previous geotechnical investigations on the southern portion of the site, groundwater levels are near the existing ground surface at 0.0 – 3.9 mbgs. The site is located in the headwaters of Kettle Creek, which flows in a southerly direction toward Lake Erie. Thus, the groundwater flow direction is likely southward toward the Kettle Creek. No groundwater samples were collected for water quality analysis.

5. Site I – Arva PS and Reservoir

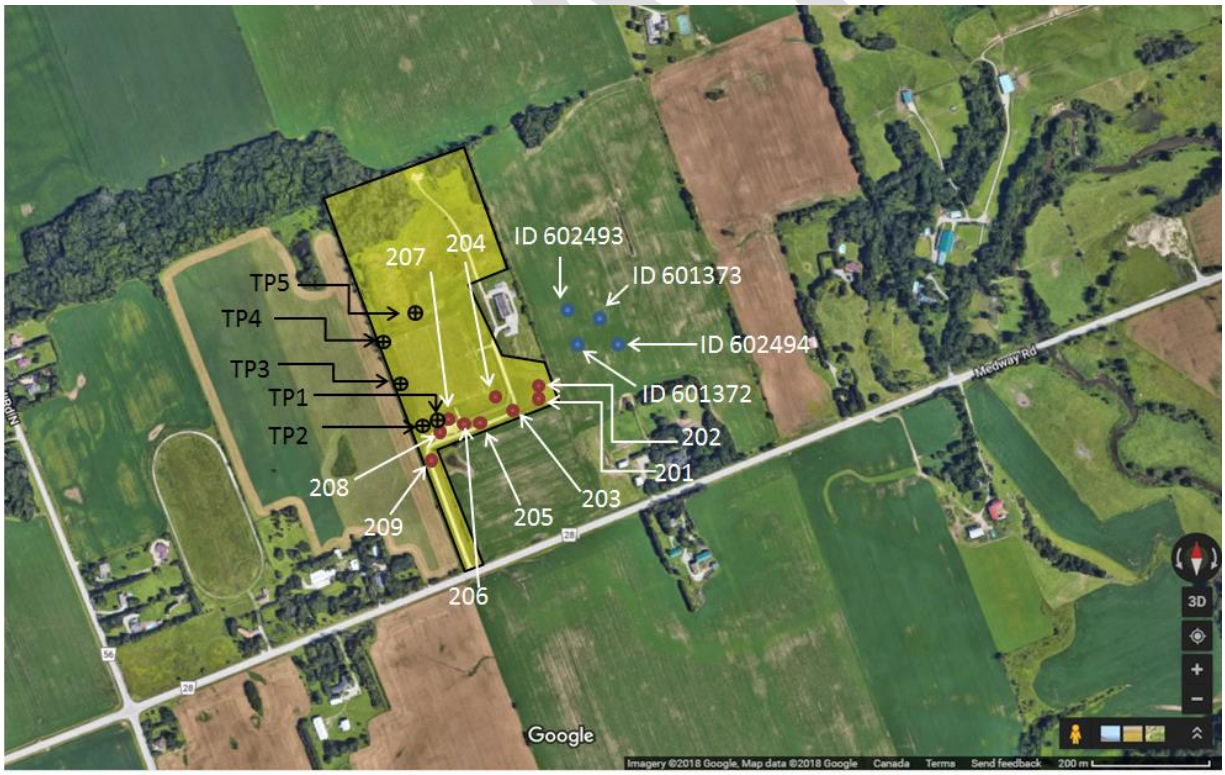
5.1 Background

This section provides a summary of the geotechnical factual data for Site I. The geotechnical information in this section was obtained from the Ontario Geological Survey (OGS) and the following geotechnical reports:

1. **Soil Investigation Proposed Arva to London Waterline Arva Reservoir to Huron Street** dated November 1965 prepared by Golder Associates.
2. **Geotechnical Investigation Proposed Arva Reservoir Expansion Lake Huron Water Supply System Ministry of The Environment Project No. 5-0001-06 Arva, Ontario** dated May, 1990 prepared by Golder Associates.
3. **Geotechnical Investigation - Proposed Arva Booster Pumping Station, Kilworth-Mount Brydges Transmission Main, Lake Huron Primary Water Supply System, and Municipality of Middlesex Centre, Ontario** dated April 29, 2009, prepared by Golder Associates.

5.2 Previous Geotechnical Investigations

There are thirteen (13) boreholes and five (5) test pits that were investigated at or near the Site I land as shown in Figure 5. The borehole and test pit information is summarized in Table 23Table 23.



Borehole from Ontario Geological Survey

Borehole from Golder report 2009 (Geotechnical Investigation- Proposed Arva Booster Pumping Station, Kilworth-Mount Brydges Transmission Main, Lake Huron Primary Water Supply System, Municipality of Middlesex Centre, Ontario)

Test pit from Golder report 1990 (Geotechnical Investigation Proposed Arva Reservoir Expansion Lake Huron Water Supply System Ministry of The Environment Project No. 5-0001-06 Arva, Ontario)

Figure 5 Borehole locations near Site I

Table 23: Borehole and test pit information for Site I

Borehole ID	Borehole Depth (mbgs)	Completion year	Ground Surface Elevation (m)
602493	6.1	1966	279.3
601373	6.1	1966	276.7
601372	6.6	1966	279
602494	6.2	1964	276.7
TP1	4.3	1990	284.6
TP2	4.4	1990	284.3
TP3	4.4	1990	285.3
TP4	4.4	1990	285.9
TP5	5.7	1990	287.3
201	5.0	2009	278.9
202	3.5	2009	278.6
203	1.5	2009	282.9
204	3.5	2009	283.0
205	1.5	2009	283.6
206	1.5	2009	283.6
207	5.0	2009	283.8
208	5.0	2009	283.9
209	3.5	2009	284.1

5.2.1 Subsurface Conditions

This site generally consists of sand or silt soils below the fill layer. The top 2.4m soil varied from a loose to dense condition. The soils below 2.4 mbgs are generally compact to dense or hard. The detailed soil profiles are shown in Table 24.

Table 24: Subsurface Soils Conditions

Borehole ID	Depth	Soil Types	Descriptions
602493	0~0.6m	fill	sand, gravel
	0.6~2m	sand	with silt, clay, gravel brown, dense, medium grained
	2~6.1m	silt	with sand, clay, brown, dense, medium grained
601373	0~0.6	fill	Sand
	0.6~2.4 m	fill	with sand, silt, clay, brown, compact
	2.4~3.7 m	silt	with gravel, clay, organic, brown, compact
	3.7~6.1 m	sand	with gravel, silt, brown, dense, coarse grained
601372	0~2.4m	silt	organic material, brown, firm
	2.4~4.6m	sand	with silt, organic, grey, compact, medium grained
	4.6~5m	sand	with silt, gravel, grey, compact, medium grain
	5~6.6m	silt	with clay, grey, hard
602494	0~2.4 m	silt	with clay, brown, loose
	2.4~6.2 m	silt	with sand, clay, gravel, brown, dense, coarse grained
TP1	0~0.4	fill	brown clayey silt with some topsoil
	0.4~1.4	silty sand	brown, gravel and cobbles
	1.4~4.3	clayey silt till	brown becoming grey at 3.5 m, with sand, gravel, cobbles and boulders
TP2	0~0.3	topsoil	brown, silty
	0.3~0.6	clayey silt	brown, with topsoil pockets
	0.6~4.4	clayey silt till	brown becoming grey at 3.5 m, with trace sand, gravel, cobbles and boulders
TP3	0~0.2	clayey silt fill	brown, with some topsoil, wood fragments
	0.2~4.4	clayey silt till	brown becoming grey at 0.8 m, with gravel, cobbles and boulders

Borehole ID	Depth	Soil Types	Descriptions
TP4	0~0.2	clayey silt fill	brown, with some topsoil, numerous rootlets
	0.2~4.4	clayey silt till	brown becoming grey at 2 m, with gravel, cobbles and boulders
TP5	0~0.1	topsoil	brown, silty
	0.1~5.7	clayey silt till	brown becoming grey at 3.5 m, with gravel, cobbles and boulders
201	0~0.4m	topsoil	brown
	0.4~5.0m	clayey silt till	with sand, gravel, brown to grey, very stiff to hard
202	0~0.4m	topsoil	brown
	0.4~3.5m	clayey silt till	with sand, gravel, brown to grey, stiff to hard
203	0~0.1m	topsoil	brown
	0.1~0.4m	fill	clayey silt with sand, gravel, brown
	0.4~1.5m	clayey silt till	with sand, gravel, brown
204	0~0.1m	topsoil	brown
	0.1~0.4m	fill	sand and gravel, brown
	0.4~2.1m	fill	clayey silt with sand, gravel, grey, firm to stiff
	2.1~3.5m	clayey silt till	with sand, gravel, brown, very stiff to hard
205	0~0.1m	topsoil	brown
	0.1~1.5m	clayey silt till	with sand, gravel, brown
206	0~0.2m	topsoil	brown
	0.2~0.3m	fill	sand and gravel, brown
	0.4~2.1m	fill	clayey silt with sand, gravel, brown and grey
207	0~0.2m	topsoil	brown
	0.2~0.3m	fill	sand and gravel, brown
	0.3~1.4m	fill	sandy silt with clay, gravel, brown, loose
	1.4~4.3m	clayey silt till	with sand, gravel, brown to grey, very stiff to hard
	4.3~4.4m	sand	with silt, grey
	4.4~5.0m	clayey silt till	with sand, gravel, grey, very stiff
208	0~0.1m	topsoil	brown
	0.1~0.3m	fill	sand and gravel with silt, brown
	0.3~5.0m	clayey silt till	with sand, gravel, brown to grey, very stiff
209	0~0.1m	asphalt	asphalt pavement
	0.1~0.6m	fill	sand and gravel with silt, brown.
	0.6~1.4m	fill	clayey silt with sand, gravel, grey, very stiff
	1.4~2.1m	clayey silt	with sand, gravel, grey, very stiff
	2.1~2.5m	clayey silt	with sand, grey, stiff
	2.5~3.5m	clayey silt till	With sand, gravel, brown, very stiff to hard

According to the Golder report dated November 1965, three (3) boreholes, i.e., BH-24 to BH-26 were drilled in the high area near Arva Reservoir. However, the location of these boreholes was not clearly reported. The subsurface soils consist of stratified silts and silty fine sands extending either to the borehole termination depth in BH-25 or overlaying stiff to hard till in BH-24 and BH-26. The soil conditions are summarized in Table 25.

Table 25: Subsurface Soils Conditions – BH-24 to BH-26

Soil Type	Depth (m)	Description
Sand and Gravel fill	0~0.15	
Sandy silt/ silt	2.1~2.4	Brown, loose to compact (SPT N= 5~17)
Sand/ Silt fine Sand (BH-25)	3.8 (terminated)	Brown, compact to very dense (SPT N=28~81)
Sandy silt till/clayey silt till (BH-24 and BH-26)	2.1~3.1(terminated)	Brown to grey, compact to dense or hard (SPT N=24~81)

5.2.2 Groundwater

In this area, no groundwater monitoring wells were installed in boreholes shown in Figure 5 adjacent to Site I. However, the unstabilized groundwater was measured during drilling to range from 279.6 to 281.6 masl in boreholes 207 to 209 in January, 2009. Boreholes 201 to 206 were found to be dry during drilling operatoins.Based on the 1965 Golder report, the groundwater levels were measured in the sandy silt deposit in BH-24 and BH-25 at depths of 1.7 m and 3.4 m respectively in early Decmeber 1964 while BH-26 was dry. According to 1990 Golder Report, the groundwater was encountered at 284 masl (0.6mbgs) in TP1, while TP2 to TP5 were dry. Grain size analysis that was completed on soil samples from three (3) boreholes (BH-201, BH-204, BH-207) and one (1) test pit indicates that the hydraulic conductivity of the clayey silt till is in the range of $6 \times 10^{-8} – 3 \times 10^{-7}$ m/s.

5.2.3 Site I – Hydrogeological Overview

The subsurface condition at Site I generally consists of clayey silt till / clayey silt / silt. The hydraulic conductivity of clayey silt till is in the range of $6 \times 10^{-8} – 3 \times 10^{-7}$ m/s, based on grain size analysis, which is considered to be relatively low. Groundwater elevations, as measured in open boreholes nearby this site, are in the range of 2.5 m to 4.2 mbgs (281.6 to 279.6 mASL), and based on change in soil color and water content profile in the boreholes, the long-term groundwater elevation is estimated to be at approximately 281 mASL. The site is located to the northwest of Medway Creek. Ground surface topography slope southeastward toward Medway Creek, and thus, the groundwater flow direction is expected to be southeasterly toward Medway Creek, as well. No groundwater samples were collected for water quality analysis.

6. Summary and Future Works

The geotechnical recommendations for the design and construction of foundations are related to the compactness and consistency of the native soils, and the seasonal groundwater table. Based on the results of this desktop review of the available data for new Water Storage facility the following is a summary of the available information:

1. It is noted that there is sufficient geotechnical information for Site A-Area A1, Site C-Area C3, and Site G;
2. The subsurface conditions at Site A –Area 1 are mainly sand or sandy silt soils. The compactness of the sandy soils was loose to very dense, which is suitable for the foundation of the proposed structure. The groundwater table was observed to range from 4.9 mbgs to 7.6 mbgs from two boreholes. The groundwater generally flows to the north, toward the Thames River through an extensive granular deposit. However, an additional investigation at this site is required to understand the seasonal groundwater fluctuations;
3. The subsurface conditions at Site C-Area C3 are uniform with dense to very dense sandy silt till, which is suitable for the foundation of the proposed storage facilities. However, further investigation is required at this site to understand the groundwater conditions for the preliminary and final designs.; and
4. Site G contains hard to stiff silty clay till, which is also suitable for the proposed storage facilities. The groundwater level elevation at site G was observed to range from 3.67 mbgs to 7.0 mbgs from two boreholes. Supplementary investigation/assessment is required at this site to understand the seasonal groundwater fluctuations.

From a hydrogeological perspective, there are a number of issues that will affect the design and construction of a water storage reservoir:

1. Construction dewatering: Hydrogeological conditions will impact the rate and quality of groundwater flow into the construction area.
    a. Groundwater flow is generally related to the hydraulic conductivity of the soil material and the elevation of the water table in the construction area.
    b. No hydraulic conductivity test results are available for the Sites A, C, G and I.
2. Long-term maintenance: Groundwater elevations may impact the long-term effectiveness of the chosen storage reservoir design.
    a. Groundwater table elevations: a high groundwater table may impact the material used to construct the reservoir (e.g. concrete). Site C has a high groundwater table. Sites A and G have relatively lower groundwater levels. However, seasonal monitoring is required to understand the groundwater table fluctuations for all the Areas.
    b. Groundwater quality: there are soluble constituents in groundwater that can attack the material used to construct the reservoir and shorten its design life. Further groundwater sampling and testing is required for all Areas.

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Appendix C
Design Details

C.1 Preliminary Design Report

C.2 Preliminary Cost Estimate

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Appendix C.1

Preliminary Design Report

AECOM

Appendix C.2

Preliminary Cost Estimate