Municipality of North Grenville

Water Pollution Control Plant and Sanitary Pump Station Optimization and Expansion

Environmental Study Report Addendum

Volume 1 of 3

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Prepared for:

MUNICIPALITY OF NORTH GRENVILLE
285 County Road 44
PO Box 130
Kemptville, ON
K0G 1J0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
864 Lady Ellen Place
Ottawa, ON
K1Z 5M2
Tel: 613-728-3571
Fax: 613-728-6012

JLR No.: 27292

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

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List of Abbreviations

ADF	Average Daily Flow
BOD_5	5-Day Biochemical Oxygen Demand
$cBOD_5$	5-Day Carbonaceous Biochemical Oxygen Demand
C of A	Certificate of Approval
CAS	Conventional Activated Sludge
EA	Environmental Assessment
ECA	Environmental Compliance Approval
ESR	Environmental Study Report
F/Mv	Food to Microorganism Ratio
HRT	Hydraulic Retention Time
I&I	Inflow and Infiltration
JLR	J.L. Richards & Associates Limited
MBBR	Moving Bed Biofilm Reactor
MEA	Municipal Engineers Association
MECP	Ministry of the Environment, Conservation and Parks, formerly MOECC
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
MNRF	Ministry of National Resources and Forestry
MOECC	Ministry of Environmental and Climate Change
OLR	Organics Loading Rate
PDF	Peak Day Flow
PHF	Peak Hourly Flow
PIC	Public Information Centre
PIF	Peak Instantaneous Flow
PS	Pumping Station
RAS	Return Activated Sludge

RVA	R.V. Anderson Associates Limited
RVCA	Rideau Valley Conservation Authority
SLR	Sludge Loading Rate
SOR	Surface Overflow Rate
SPP	Source Protection Plan
SRT	Sludge Retention Time
TAN	Total Ammonia Nitrogen
TDH	Total Dynamic Head
TKN	Total Kjeldhal Nitrogen
TM	Technical Memorandum
TP	Total Phosphorous
TS	Total Solids
TPAD	Temperature-Phased Anaerobic Digestion
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VS	Volatile Solids
WAS	Waste Activated Sludge
WPCP	Water Pollution Control Plant
XCG	XCG Consultants Ltd.

ES-1: Introduction and Background

In 2010, the Municipality of North Grenville (Municipality) completed an Environmental Study Report (ESR) to develop the preferred alternative(s) and design concepts for the optimization and expansion of the Kemptville Water Pollution Control Plant (WPCP). The Class Environmental Assessment (EA) was conducted in accordance with Phases 1 to 4 of the Class EA process.

Phase 5 of the Class EA was also initiated by the Municipality, consisting of consulting with the Rideau Valley Conservation Authority (RVCA) on the development of a phosphorous offsetting program. Due to financial constraints and planning updates which were predicted to impact the outcome of the 2010 Class EA, implementation of the phosphorous offsetting program as well as proposed WPCP upgrades identified within the 2010 ESR were deferred. Since that time, advancements have been made in wastewater treatment technologies, regulatory requirements have changed, and the Municipality is now faced with different infrastructure demands. Projected growth for the Municipality was reviewed by Watson & Associates Economists Ltd. and a Long-Term Population, Housing and Employment Forecast Report (Watson, 2017) was prepared. The Forecast Report identified lower population projections for the next 20-year period than previously used within the 2010 Class EA. In addition, reduced average day flows were identified within the Master Plan Update (Stantec, 2015).

For the above reasons, the Municipality decided to amend the 2010 Class EA ESR through and ESR Addendum. The ESR Addendum re-evaluated the WPCP upgrades and/or expansion requirements as to ensure that any future modifications best meet their needs.

The WPCP is located at 2899 County Road 43, adjacent to Kemptville Creek. The study area for this project consists of the areas within and adjacent to the existing Kemptville WPCP site, as well as the Bridge Street Pump Station (PS), located at the intersection of Currie Street and Bridge Street.

The WPCP consists of a conventional activated sludge tertiary treatment process, with a rated average and maximum day capacity of 4,510 m^3/d and 11,370 m^3/d, respectively. The Bridge Street PS consists of two dry pit centrifugal pumps and an extended shaft, end suction pump (one duty and two standby pump configuration) with a rated capacity of 8,640 m^3/d.

ES-2: Public and Agency Consultation Activities

A consultation plan was developed for the project. The project notification was published in a local newspaper and on the Municipality website in November 2016, and project initiation notification letters were issued to potential project stakeholders at that time. A Project Liaison Committee (PLC) was also formed to review key issues relating to the project and includes representatives from the Municipality, JLR, and other stakeholders. Two Public Information Centres (PICs) were held for this project; the first on December 14, 2017 and the second on March 7, 2019.

At each phase of the project, a Public Consultation Summary was updated with public and stakeholder comments as well as information as to how the comments were addressed. Refer to the ESR for further details.

ES-3: Phase 2 - Review and Update 2010 ESR

The 2010 Class EA represented a significant undertaking by the Municipality. Previous work completed during the 2010 Class EA process still holds significant value, which was carried forward as part of the ESR Addendum.

The following Problem and Opportunity Statements were identified as a basis for the WPCP ESR Addendum:

- **Problem Statement:** *"North Grenville is currently experiencing high growth and development pressures and is undertaking an Environmental Study Report (ESR) Addendum to address their need for additional wastewater treatment capacity to service community growth. A review of the Kemptville Water Pollution Control Plant (WPCP) suggests that there are hydraulic constraints limiting the treatment capacity of the WPCP, specifically its ability to provide tertiary treatment of high peak flows. The WPCP requires additional wastewater treatment capacity and/or equalization storage to accommodate these current peak demands as well to meet projected growth and sewage flow demands associated with future developments.*

- **Opportunity Statement:** *"The Municipal Class Environmental Assessment planning process provides an opportunity to evaluate existing systems and infrastructure at the Kemptville Water Pollution Control Plant (WPCP) in the context of meeting or exceeding current treatment standards, projected demands and long-term reliability and sustainability."*

Previous Studies

As the proposed study area is generally unchanged from the 2010 Class EA, previous archaeological, geotechnical, natural environment, and assimilative capacity studies undertaken as part of the 2010 Class EA process were referenced for this assignment. In addition, other studies that were completed for the WPCP and Bridge Street PS following the filing of the 2010 ESR were also considered in the preparation of the ESR Addendum. The below list summarizes key studies in which relevant findings are considered in this ESR Addendum:

- Outfall Capacity Review (XCG, 2010 Class EA)
- Assimilative Capacity Assessment of the Rideau River (2010 Class EA)
- Flow Equalization Preliminary Assessment (2010 Class EA)
- Archeological Assessment Report (Golder, 2010 Class EA)
- Geotechnical Overview Report (Golder, 2010 Class EA)
- Natural Environment (2010 Class EA and 2015 Master Plan Update)
- BioMag^{TM} Process Pilot Demonstration at the Kemptville WPCP (XCG, 2014)
- Assimilative Capacity Assessment of the Rideau River (2015 Master Plan Update)
- Updated Flood Mapping (RVCA, 2017)
- Long-Term Population, Housing and Employment Forecast Report (Watson, 2017)

<u>Updated Studies</u>

As part of the ESR Addendum, certain studies/reviews were also updated. These studies include:

- Technical Memorandum No. 1 – Projected Raw Wastewater and Quality Update

  This Memorandum provides an update to the 20-year projected raw wastewater flows and quality for the Municipality of North Grenville WPCP. Population projections to 2038 are based on the growth identified in the Alternative Residential Growth Scenario as presented in the Long-Term Population, Housing and Employment Forecast Report (Watson, 2017). Projected raw wastewater quality and loadings were updated based on updated flow projections, updated raw water quality and estimated septage daily volumes and loadings as presented in the 2010 Class EA. The updated review identified the following projections:

  - Population projection of 9,453 persons in 2038;
  - Projected WPCP average day flow, maximum day flow and peak instantaneous flow of 4,660 m^3/d, 13,980 m^3/d and 31,072 m^3/d, respectively.

- Process Capacity Assessment (2019 ESR Addendum)

  An update to the desktop process capacity assessment completed as part of the 2010 Class EA was undertaken. A meeting with operations staff was held in 2017 to identify additional operational/maintenance constraints at the WPCP.

- Source Water Protection Review (2019 ESR Addendum)

  The Mississippi – Rideau Source Protection Plan (SPP) (January 2015) was reviewed to determine whether the Kemptville WPCP or Bridge Street PS is located within an area in which these facilities would be considered as a significant drinking water threat. Based on SPP mapping, the Kemptville WPCP and Bridge Street PS are located in an area identified as WHPA-B which has been assigned a vulnerability score of 6 in the Draft Official Plan (North Grenville, 2017). In addition, it is noted that almost all of North Grenville has been designated as a highly vulnerable aquifer and has also been assigned a vulnerability score of 6 based on the SPP. These facilities are not considered as significant drinking water threats based on the SPP. A notice is required to be submitted to the Risk Management Official prior to approval for Planning Act or Building Code Act applications.

- Land Use and Property Constraints (2019 ESR Addendum)

  A portion of the WPCP property is within the 1:100 year floodplain and that the property limits are entirely within the 120 metre adjacent lands of a Provincially Significant Wetland. A large portion of the lands adjacent to the WPCP are owned by the Municipality and leased to the Ferguson Forestry Centre. The existing WPCP is located approximately 150 metres from the closest sensitive user (animal hospital) located south of the WPCP. Recommended separation distances from sensitive land uses are considered in the preferred solution.

<u>Alternative Solutions</u>

The alternative solutions that were identified as part of the 2010 Class EA were updated accounting for the following items:

- The updated projected 20-year flows remains below an ADF of 6,800 m^3/d, and therefore, enhanced tertiary treatment and/or phosphorous offsetting is not required to meet the approved loading of 1.35 kg/d.

- The 20-year projected ADF for the ESR Addendum (4,660 m^3/d) is below the Stage 1 expansion (6,800 m^3/d) identified for this alternative; therefore, staged expansion is not being considered further for the ESR Addendum.

The following two alternatives were evaluated as part of the ESR Addendum process:

1. WPCP expansion <u>without</u> influent equalization storage; and
2. WPCP expansion <u>with</u> influent equalization storage.

Using an evaluation methodology to score the two alternatives, it was determined that expanding the WPCP <u>with</u> influent equalization storage provided the highest overall net benefit to the Municipality. The updated preferred solution also involves increasing the rated capacity of the Bridge Street SPS to 11,370 m^3/d by replacing one of the existing pumps. The preferred solution was further refined during Phase 3.

The updated preferred solution is summarized in Table ES-1 below:

Table ES-1: Summary of Updated Preferred Solution

Parameter/Component	Comments (2)
WPCP Design Flows	ADF – 5,000 m^3/d, PDF – 15,000 m^3/d, PIF – attenuated to PDF
Effluent Requirements	TP: 0.27 mg/L, $cBOD_5$: 10 mg/L, TSS : 10 mg/L
Equalization Storage	New Equalization Storage Facility
Septage Receiving(1)	New Septage Receiving Facility
WPCP Expansion	Based on the above design flows, conceptually the following expansion to the WPCP would be required for an expansion with equalization ahead of the plant: • Headwork upgrades (screens, grit chambers, odour control) • An additional primary clarifier • An additional aeration tank • An additional secondary clarifier • An additional tertiary filter • Upgrade UV Disinfection
Biosolids	Additional primary digestion required Additional secondary digestion biosolids storage required

Parameter/Component	Comments (2)
Effluent Pumping System	Upgrades as required to increase pumping capacity
Outfall Infrastructure Requirements(3)	No forcemain or effluent gravity sewer infrastructure piping upgrades; all 16 ports at the outfall are to be opened for maximum flow conditions.

Notes:
1. For this evaluation, it is assumed that septage would be treated by the same processes as the WPCP (i.e., not a separate treatment train).
2. Upgrade requirements were further reviewed as part of Phase 3.
3. Effluent gravity sewer reviewed based on surcharge conditions in the transition chamber; no modifications required based on maximum pumped flow of 15,000 m^3/d. Converting transition chamber to a pressurized Air Release/Vacuum relief chamber by capping the open connection is to be further reviewed as part of preliminary design and pump upgrades.

ES-4: Phase 3 – Evaluation of Design Alternatives

Bridge Street Sewage Pumping Station

A review of the Bridge Street Sewage Pumping Station (SPS) was undertaken during Phase 3. The existing rated capacity of the Bridge Street SPS is 100 L/s. The existing rated capacity of the SPS is currently limited by the rated capacity of the Kemptville WPCP and its ability to handle peak flows. The Municipality plans to complete a second phase of upgrades to the Bridge Street SPS. Upgrades include replacing the existing Raw Sewage Pump No. 1 with a dry pit submersible pump and VFD motor combination to match that of existing Raw Sewage Pumps No. 2 and 3. The pump replacement will include the removal and replacement of the reinforced concrete pump and piping supports, replacement of the existing starter with a new VFD, new power feed and instrumentation cabling to the new motor, and modification of the control narrative to maintain consistency with the Raw Sewage Pumps No. 2 and 3 installations. The pumps will continue to operate as a one duty, two stand-by arrangement until upgrades to the Kemptville WPCP increase its ability to handle higher peak flows. Following upgrades at the WPCP, the Bridge Street SPS is anticipated to be rerated to a flow of 11,370 m^3/d.

Technical Memorandum – WPCP Liquid Treatment Train

Alternative design concepts for the liquid treatment train were reviewed and an updated preferred design concept was presented. Furthermore, based on a review of the historical daily influent flows to the WPCP, an updated equalization storage volume was identified. Table ES-2 provides a summary of the updated liquid treatment preferred design concept. Refer to the full TM – WPCP Liquid Treatment Train for further details.

Table ES-2: Updated Liquid Treatment Preferred Design Concept

Process Description	Summary
Equalization Storage	• Two new equalization storage tanks (total 10,000 m^3)
Headworks	• New septage receiving truck unloading enclosure and pumping system • New headworks building complete with odour control • Two new mechanical bar screens

Process Description	Summary
	• One new manual bar screen • Two new vortex grit chambers • Equalization control provisions
Primary Treatment	• One new primary clarifier • Two existing primary clarifiers • Co-thickening of WAS in the primary clarifiers
Secondary Treatment	Conventional activated sludge process • One new aeration tank • Two existing aeration tanks • One new secondary clarifier • Two existing secondary clarifiers
Tertiary Treatment	• One new tertiary filter • Two existing tertiary filters
Phosphorous Removal	• Upgrades to flash mix tank • Multi-point dosing of alum (upgrade existing system)
Disinfection	• Upgrade UV disinfection system
Effluent Pumping	• Upgrades to increase firm capacity
Outfall Piping System(1)	No forcemain or effluent gravity sewer infrastructure piping upgrades; all 16 ports at the outfall are to be opened for maximum flow conditions.
Notes: 1. Converting transition chamber to a pressurized Air Release/Vacuum relief chamber by capping the open connection is to be further reviewed as part of preliminary design and pump upgrades.	

Design parameters for the preferred design concept were also presented in this TM and are identified in the tables below.

Table ES-3: Proposed Design Raw Wastewater Flows

Parameter	Existing	Proposed Design (2038)	WPCP ECA Rated Capacity
Average Day Flow (m^3/d)	2,562(1)	5,000	4,510
Maximum Day Flow (m^3/d)	12,514(1)	15,000(2)	11,370
Peak Instantaneous Flow (m^3/d) (L/s)	14,235 165	31,072(3) 360	-
Notes: 1. Average day flow and maximum day flow based on data from 2012 to 2017. 2. Maximum day flow calculated based on a peaking factor of 3.0. 3. Peak flows above the maximum day flow are to be attenuated by influent equalization storage to 15,000 m^3/d.			

Table ES-4: Proposed Design Raw Sewage Quality and Quantity (2038)

	BOD_5	TSS	TP	TKN	TAN
Average Concentration (mg/L)	165	262	4.7	34	20
Average Loading (kg/d)	825	1310	24	170	100
Maximum Monthly Concentration (mg/L)	212	338	6.8	44	30
Maximum Monthly Loading (kg/d)	1060	1690	34	220	150
BOD_5: 5-day Biological Oxygen Demand; TSS: Total Suspended Solids; TP: Total Phosphorous; TKN: Total Kjeldahl Nitrogen; TAN: Total Ammonia Nitrogen					

Table ES-5: Proposed Future Effluent Requirements

Parameter	Objectives	Limits	
		Concentration	Loading
5-Day Biological Oxygen Demand(1)	5.0mg/L	13.5mg/L	67.7kg/d
Total Suspended Solids(1)	5.0mg/L	13.5mg/L	67.7kg/d
Total Phosphorous(1)	0.2mg/L	0.27 mg/L	1.35kg/d
Total Ammonia Nitrogen(1)	1.0 mg/L (May 1 to Nov 30) (2) 4.0 mg/L (Dec 1 to Apr 30)(2)	2.0 mg/L (May 1 to Nov 30) 7.0 mg/L (Dec 1 to Apr 30)	10.0 kg/d 35.0 kg/d
E. Coli(3)	150 cts/100mL	200 cts/100mL	-
Toxicity Testing for Damphia and Rainbow Trout	Pass	Pass	

Notes:
1. Monthly average concentration and loading. Based on maintaining existing ECA loading.
2. Objective timelines for TAN have been updated to match existing ECA dates for effluent limits; no change proposed for TAN concentrations.
3. Monthly geometric mean.

<u>Technical Memorandum – WPCP Solid Treatment Train</u>

Alternative design concepts for the solid treatment train were reviewed and an updated preferred design concept was presented. Table ES-6 provides a summary of the updated solid treatment preferred design concept. Refer to the full TM – WPCP Solid Treatment Train for further details.

Table ES-6: Updated Solids Treatment Preferred Design Concept

Process Description	Summary
Sludge Pumping	• Upgrades to sludge pumping system as required to meet additional sludge production
Thickening	• Maintain co-thickening of primary and secondary sludge
Stabilization	• Existing mesophilic anaerobic primary digester • Modify existing digested sludge piping from primary digester as needed to the new digester and/or the secondary digester

Process Description	Summary
	• One new mesophilic anaerobic primary digester with future provisions considered to operate in Temperature-Phased Anaerobic Digestion (TPAD) mode
Biosolids Management/Storage	• Existing Secondary Digester • New Geotube® Dewatering Facility

ES-5: Environmental and Construction Impacts and Mitigation Monitoring

Potential effects on the environment, caused by the proposed project, have been identified. Various mitigation measures are recommended to reduce net effects to acceptable levels. Some of the suggestions include implementation of erosion and sediment control, re-vegetation of affected areas, butternut tree assessment, a Stage 2 archaeological assessment of the areas impacted by construction, including a Cultural Heritage Evaluation Report (CHER), restrictions to work within specific times during the year to protect breeding birds and fish, relocation of public walking trails, etc.

Potential effects and proposed mitigation measures are summarized in Section 8 of the ESR Addendum. Mitigation measures and associated monitoring are to be further developed and detailed during the design and construction phases.

ES-6: Project Costs

A Class ‘D’ Cost Estimate (Order of Magnitude) of the conceptual upgrades was prepared as part of this project and presented in the ESR Addendum. The construction and engineering estimate to expand the existing plant to accommodate the 20-year projected growth is estimated at $31 Million, excluding HST, expressed in 2018 dollars. For further information regarding the estimated cost refer to Section 7.6 of the ESR Addendum.

ES-7: Completion of Class Environmental Assessment

The filing of this Environmental Study Report (ESR) Addendum represents the conclusion of Phase 4 of the Class EA Addendum process, including public and agency consultation. The ESR Addendum will be placed on the public record by issuing a Notice of Completion and interested individuals will have 30 days to provide comments. If comments arise that cannot be resolved or mitigated in discussions with the Municipality of North Grenville within the 30 day period, a person/party may request the Minister of the Environment, Conservation and Parks to issue a Part II Order for an individual EA. The request must be made in writing and directed to the Minister of the Environment, Conservation and Parks and the Director of Environmental Assessment and Permissions Branch with a copy to the proponent.

1.0 Introduction and Background

1.1 Introduction

The Kemptville Water Pollution Control Plant (WPCP) was commissioned in 1993 to provide wastewater servicing for the Municipality of North Grenville (the Municipality). A Class Environmental Assessment (Class EA) was completed by XCG Consultants Ltd. (XCG) in association with J.L. Richards & Associates Limited (JLR) in 2010 in accordance with Phases 1 to 4 of the Class EA process. Phase 5 was also initiated by the Municipality, consisting of consulting with the Rideau Valley Conservation Authority (RVCA) on the development of a phosphorous offsetting program. Due to financial constraints and planning updates which were predicted to impact the outcome of the 2010 Class EA, implementation of the phosphorous offsetting program as well as proposed WPCP upgrades identified within the Environmental Study Report (ESR) were deferred.

Since that time, advancements have been made in wastewater treatment technologies, regulatory requirements have changed, and the Municipality is now faced with different infrastructure demands. Furthermore, a Long-Term Population, Housing and Employment Forecast Report prepared by Watson & Associates Economists Ltd. (Watson, 2017) was recently completed which updated the service area populations previously considered in the 2010 Class EA. Due to the reduction in ADFs per capita since the 2010 Class EA as identified within the Master Plan Update (Stantec, 2015) and new population projections established by Watson, the Municipality has decided to amend the 2010 Class EA ESR through re-evaluation of the WPCP upgrades and/or expansion requirements as to ensure that any future modifications best meet their needs. As such, the municipality has retained JLR to assist in the preparation of the ESR Addendum.

1.2 Background and Study Area

1.2.1 Background

The WPCP is located at 2899 County Road 43, adjacent to Kemptville Creek. Refer to Figure 1 and Figure 2 for a location plan and an aerial view of the plant. The plant consists of a conventional activated sludge tertiary treatment process, with a rated average and maximum day capacity of 4,510 m^3/d and 11,370 m^3/d, respectively.

The WPCP is currently operated in accordance with Environmental Compliance Approval (ECA) Number 9628-9Q4LRN, dated December 9, 2014. Table 1 provides a summary of key ECA compliance requirements for treated effluent quality. Refer to Appendix B for a copy of the ECA.

Table 1: WPCP ECA Compliance Requirements

Parameter	Objectives	Limits	
		Concentration	Loading
5-Day Biological Oxygen Demand(1)	5.0 mg/L	15.0 mg/L	67.7 kg/d
Total Suspended Solids(1)	5.0 mg/L	15.0 mg/L	67.7 kg/d
Total Phosphorous(1)	0.2 mg/L	0.3 mg/L	1.35 kg/d
Total Ammonia Nitrogen(1)	1.0 mg/L (Jun 1 to Aug 31) 4.0 mg/L (Sep 1 to May 31)	2.0 mg/L (May 1 to Nov 30) 7.0 mg/L (Dec 1 to Apr 30)	9.0 31.5
E. Coli(2)	150cts/100mL	200cts/100mL	-
pH	6.5 – 8.5	6.0 – 9.5	

Notes:
1. Monthly average concentration and loading.
2. Monthly geometric mean.

In order to meet the above criteria, the plant provides treatment of wastewater through a conventional activated sludge tertiary treatment process that includes the following liquid train components:

- *(Preliminary treatment)*
    - One mechanical screen and grinder and one standby manually cleaned bar screen;
    - Two horizontal flow grit channels;
- *(Primary treatment systems)*
    - Two rectangular primary clarifiers;
- *(Secondary treatment)*
    - Two rectangular aeration tanks with fine bubble diffusion;
    - Two rectangular secondary clarifiers;
- *(Tertiary treatment)*
    - One flash mix tank for coagulation prior to filtration;
    - Two flocculation tanks;
    - Two tertiary filters with automatic backwashing;
- *(Disinfection)*
    - Two ultraviolet banks for disinfection;
- *(Effluent System)*
    - Two effluent holding tanks;
    - Three centrifugal pumps (one standby) each equipped with variable frequency drive (VFD);
    - Effluent forcemain approximately 700 m long;
    - Effluent gravity sewer approximately 3,100 m long;
    - Outfall approximately 125 m long with a 33 m long diffuser with 16 discharge ports, discharging to the Rideau River.

Waste activated sludge is co-thickened in the primary clarifiers. Solids are removed from the primary treatment tanks, stabilized in a primary anaerobic digester and stored in a secondary digester prior to being hauled off-site for seasonal land application. A process flow schematic of the treatment system updated from the 2010 Class EA is presented in Figure 3 and a conceptual site plan is presented in Figure 4.

As noted previously, the Municipality has decided to amend the 2010 Class EA ESR due to changes in the project environment, notably projected population growth and reduction in ADF flows per capita. New projected 20-year flows have been determined as part of this ESR Addendum. The revised population projections determined by Watson in 2017 have been used to determine the updated flow rates and design basis for the WPCP upgrades.

Future sanitary pumping station flows were also used to update the design basis. Planned expansion to the Kemptville sewage collection system will ultimately consist of four sub-area pumping stations discharging to the Kemptville WPCP. In order to accommodate future growth, the Bridge Street SPS has been reviewed to determine the potential to re-rate the SPS based on its existing pumping system. The Municipality plans to upgrade the SPS by replacing the existing Raw Sewage Pump No. 1 with a dry pit submersible pump and VFD motor combination to match that of existing Raw Sewage Pumps No. 2 and 3. The pumps will continue to operate as a one duty, two stand-by arrangement until upgrades to the Kemptville WPCP increase its ability to handle higher peak flows. Following upgrades at the WPCP, the Bridge Street SPS is anticipated to be rerated to a flow of 11,370 m^3/d. This increased flow has been considered in this ESR Addendum.

1.2.2 Study Area

The study area for this ESR Addendum consists of the areas within and adjacent to the existing Kemptville WPCP site, as well as the Bridge Street PS located at the intersection of Currie Street and Bridge Street. The WPCP is located in Lot 28, Concession II and Lot 29 Concession I in the former Township of Oxford-on-Rideau. A large portion of the lands adjacent to the WPCP are owned by the Municipality and leased to the Ferguson Forestry Centre. Refer to Figure 5 for the overview of the study area.

2.0 Class Environmental Assessment and Amendment Process

2.1 Environmental Assessment Act and Class Environmental Assessments

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

The Municipal Class EA process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. It involves detailed site-specific information gathering and studies, as well as consultation with the public and stakeholder agencies. In 1987, the first Class EA document prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities was approved under the Act. Updates and amendments were subsequently made in 1993, 2000, 2007, 2011 and 2015.

The Class EA framework (refer to Figure 6) defines the process for each type of project. There are three categories of projects (Schedule A/A+, B and C) which require increasing levels of activity within the Class EA framework. The Class EA completed in 2010 was carried out in accordance to the requirements for Schedule C projects. For Schedule C projects, the completion of the following Phases of the Class EA process are required:

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

2.2 Environmental Study Report Addendum

The 2010 Class EA was completed in accordance with Phases 1 to 4 of the Class EA process. Phase 5 was also initiated by the Municipality, consisting of consulting with the RVCA on the development of a phosphorus offsetting program. However, due to financial constraints, implementation of the phosphorous offsetting program as well as proposed WPCP upgrades identified within the ESR were deferred. The scope of proposed upgrades from the 2010 Class EA included the following short term (Stage 1A) and long term (Stage 1B and 2) upgrades:

Stage 1A: Construction of an influent equalization storage facility and expansion of existing biosolids storage capacity, or implementation of improved solids management protocols for the existing anaerobic digesters facility.

Stage 1B: Construction of a septage receiving facility and expansion of all major WPCP unit processes to accommodate an average day flow of 9,020 m^3/d, including headworks modifications, new primary clarifier(s), a new aeration basin, two new secondary clarifiers, three new tertiary filter cells, one new primary digester, additional biosolids storage, expansion of the UV disinfection system and expansion of the treated effluent pumping system, including construction of a second forcemain and conversion of the existing gravity sewer portion to a pressure sewer.

Stage 2: Expansion of major WPCP unit processes identified in Stage 1B to accommodate an average day flow of 11,800 m^3/d.

In accordance with the MEA Class EA planning process, an ESR may require an Addendum for two reasons:

1. <u>Lapse of Time</u>: The planning process must be reviewed if the proposed commencement of construction exceeds 10 years after filing the Notice of Completion of the original ESR. This is necessary to ensure the proposed works and mitigation measures are still valid given the current context.

2. Change in the Project Environment: Any significant modification to the project or change in the environmental setting, which occurs after filing of the ESR, must be reviewed and an amendment to the document must be prepared through an Addendum.

For the Kemptville WPCP and Bridge Street PS, an Addendum is required due to a change in the Project Environment. There have been a number of significant changes that needed to be considered, including the following:

- **Changes to Flows** associated with the 2010 Class EA design period: A Long-Term Population, Housing and Employment Forecast Report (Watson, 2017) was recently completed which identified new population projections. These new projections are used to determine updated design flow rates for the ESR Addendum.

- **Innovative Technology:** Wastewater treatment and pumping technology continues to evolve. Innovative and leading-edge secondary treatment and biosolids storage technologies (e.g., biological activated filters, moving bed bioreactors, membrane bioreactors, Geotubes®) offer the potential for improved effluent quality and reduced carbon footprint requirements.

- **Energy Efficiency:** Technological advancements in the design of energy intensive treatment equipment (e.g., pumps, blowers, etc.) have resulted in significant improvements in energy efficiency.

- **Changing Receiving Stream Quality:** Potential new effluent requirements to achieve a non-toxic discharge and different removal efficiencies (e.g., phosphorous) were reviewed and confirmed.

- **Biosolids Management:** The Municipality is faced with the need to increase biosolids storage capabilities. The preferred solution was considered in conjunction with the Municipality's current solid waste management initiatives (i.e., land application).

- **Project Costs:** The 2010 Class EA proposed an approximate total project cost of $37.5M (2009 dollars) to implement the aforementioned scope of WPCP upgrades (Stage 1A, 1B and 2) and the phosphorous offsetting program. The 2015 Master Plan Update recommended only Stage 1A and 1B WPCP upgrades be implemented, with an associated total project cost of $18.8M (2014) and an additional $7.6M (2014) for equalization storage. Project costs have been updated based on the WPCP upgrades identified as part of the ESR Addendum process.

- The 2015 Master Plan Update recommended that the 2010 Class EA be updated to address new treatment technologies and timing of implementation of an equalization storage facility.

The revision and addenda process requires that an ESR Addendum be completed, which documents the process followed in determining modifications to the original project, or change in the environmental setting for the project.

Once the ESR Addendum is completed, the Class EA process requires that it be placed on Public Record for 30 calendar days for review by the public, stakeholder agencies and other interested parties. A Notice of Filing of Addendum indicating completion of the ESR Addendum and its filing on Public Record must be issued to the public and all interested parties that have previously been contacted and that have indicated a desire to stay involved in the planning of the undertaking, as well as those who were notified in the preparation of the 2010 Class EA ESR. The review period is intended to resolve any outstanding concerns regarding the project between the Municipality and the party expressing the concern.

If issues cannot be resolved with the Municipality, a party may request that the Minister of the Environment, Conservation and Parks order the proponent to comply with Part II of the EA Act, which addresses individual Environmental Assessments. Information regarding the Part II order process will be provided in the Notice of Filing of Addendum. If no Part II Order requests are received, the project will be able to proceed through design and construction after the 30 calendar day review period.

Any information collected during the project and review period will be managed in accordance with the Freedom of Information and Protection Act. With the exception of personal information, all comments become part of the Public Record. Proprietary information (i.e., equipment manufacturers) and pricing could provide competitors with some advantage and will not be released (in detail) as part of the Freedom of Information and Protection Act.

3.0 Relevant History

3.1 Chronological History of the Existing Kemptville WPCP and Bridge Street PS

The following is a chronological history of the Kemptville WPCP and Bridge Street PS:

1980	Report on Sewage Treatment recommended construction of a new secondary treatment plant that would reduce total phosphorous and improve overall effluent quality.
1988	An Environmental Study Report (Gore & Storrie Limited) was conducted to investigate alternatives for upgrading the sewage treatment system. The preferred solution was determined to be the design and construction of a new wastewater treatment plant with effluent pumped to the Rideau River.
1990	ESR Addendum prepared by Gore & Storrie Limited to document design flow revisions, reassess the impacts to the receiving stream and revise costs associated with the new wastewater treatment plant.
1990	Gore & Storrie Limited prepared a Wastewater Treatment Works Upgrading Predesign Brief to identify the proposed design for the new WWTP and apply for the required sewage C of A.

1992	Certificate of Approval (C of A No. 3-1871-88-927) was obtained from the MECP for the decommissioning of the previous sewage treatment plant and raw sewage pumping station (located elsewhere). The C of A also approved the construction of the Bridge Street PS and Kemptville WPCP at their current locations. The Bridge Street PS was noted to be designed for a firm pumping capacity of 11,370 m^3/d. The WPCP was noted to be designed and approved for an average daily flow of 4,510 m^3/d and a peak flow rate of 11,370 m^3/d. A C of A (Air) No. 8-4017-92-006 is also approved by the MECP for a diesel generator set and a natural gas fired hot water boiler at the WPCP. A C of A (Air) No. 8-4018-92-006 is also approved by the MECP for a diesel generator set at the Bridge Street PS.
2000	Ontario Clean Water Agency (OCWA) in association with XCG prepares a preliminary capacity evaluation to identify the potential capacity available at the WPCP based on existing conditions and theoretical design of the plant.
2005	Water and Wastewater Servicing Master Plan is prepared by Stantec. The Master Plan identified optimization and expansion of the WPCP as one of the key requirements to allow additional development within North Grenville.
2006	Amended C of A No. 2754-6WESQL is obtained to re-direct forcemain influent to the new screening facility, to lower the peak pumping capacity of the Bridge Street PS to 8,631 m^3/d, and to construct new discharge channel to the WPCP grit channel inlet from the eQuinelle Screening Facility that can accommodate a peak flow of 2,739 m^3/day.
2006	A study report titled Feasibility Assessment for Septage Receiving at the Kemptville WPCP is prepared by Simcoe Engineering Group Ltd. (Simcoe) for the Municipality of North Grenville. The report identified septage receiving scenarios, presented modifications required to the WPCP to accept septage, and identified capital and operation and maintenance costs of the upgrades.
2007	The Municipality of North Grenville Situational Analysis Report is prepared by R.V. Anderson Associates Limited (RVA), which provided recommended timelines for the commencement of the WPCP Optimization and Expansion Class EA.
2010	Kemptville WPCP Optimization and Expansion Class Environmental Assessment is prepared by XCG in association with JLR. The 2010 Class EA identified the preferred alternative to be the following: Phosphorous Offsetting Program Development and Implementation, Stage 1A – Influent Equalization Facility and Select Near-Term Upgrades, Stage 1B – WPCP Expansion (ADF of 9,020 m^3/d) and Stage 2 – WPCP Expansion (ADF of 11,800 m^3/d). The preferred design concept identified was to utilize the conventional activated sludge process with or without WAS co-thickening (to be evaluated during preliminary design).

2011	JLR is retained by the Municipality to address recurring hydraulic issues in the pre-existing variable frequency driven duplex pumping system at the Bridge Street PS, including excessive pump noise and vibration and clogging of discharge piping and valves. JLR provided design and contract administration assistance services for the replacement of Pump No. 3 and installation of Pump No. 2, consisting of close-coupled dry-pit submersible pumps.
2013	JLR provided design and contract administration assistance services for upgrades to dual-fired (i.e., methane and natural gas) Boilers No. 1 and No. 2 at the Kemptville WPCP. In addition, the Municipality implemented boiler control modifications to prevent heat from escaping through the waste heat exchanger when the boilers were operated in natural gas fired mode.
2014	Pilot study of BioMag™ Technology at the WPCP is completed by XCG. The study results illustrated that the Total Phosphorous concentration could be reduced to an average of 0.18 mg/L through the BioMag process. It was demonstrated that the hydraulic residence time in the secondary clarifiers could potentially be reduced with the process.
2014/2015	JLR provided condition assessments, design and contract administration assistance services for the rehabilitation of the primary and secondary anaerobic digesters at the Kemptville WPCP. The scope of rehabilitation consisted of construction of new brick masonry veneers, installation of a pre-purchased linear motion primary digester mixer, replacement of digester gas proofing membranes, roofing systems and process piping. Construction was initiated in 2014 and was completed in 2015. Amended ECA 9628-9Q4LRN was issued for the upgrades to the primary digester mixing system.
2015/2016	2015 North Grenville Potable Water and Wastewater Master Plan Update is prepared by Stantec. The Master Plan Update was prepared to meet the requirements of Phases 1 and 2 of the Municipal Engineer's Class EA planning process. The 2015 Master Plan Update identified lower flow projections (ADF – 6,061 m^3/d in 2034 and PDF – 15,758 m^3/d in 2034) than the 2010 Kemptville WPCP Optimization and Expansion Class Environmental Assessment due to a significant decrease in ADF per capita since 2008. The 2015 Master Plan Update proposes to expand the plant capacity to an ADF of 9,020 m^3/d and a peak day flow (PDF) of 21,600 m^3/d by 2027.
2017	Long-Term Population, Housing and Employment Forecast Report (Watson, 2017) is prepared by Watson & Associates Economists Ltd. The existing service population in North Grenville is estimated as 5,200 people (2016) and the service population is projected to increase to 8,100 people by 2031.

2016/2019	JLR is retained by the Municipality to update the 2010 Class EA due to changes in the environment (i.e., changes in projected flows, biosolids management, innovative technologies, project costs, other) as well as recommendations from the 2015 Master Plan Update to update the 2010 Class EA.

4.0 Relevant Studies/Reviews

4.1 Relevant Studies/Reviews Completed Prior to ESR Addendum

As noted previously, the 2010 Class EA represented a significant undertaking by the Municipality. Previous work completed during the 2010 Class EA process still holds significant value, which was carried forward as part of the ESR Addendum. As the proposed study area remained unchanged from the 2010 Class EA, previous archaeological, geotechnical, capacity, natural environment, and assimilative capacity studies undertaken as part of the 2010 Class EA process were considered. In addition, other studies that were completed for the WPCP and Bridge Street PS following the filing of the 2010 ESR were also considered in the preparation of the ESR Addendum.

The following is a summary of the relevant studies completed prior to the ESR Addendum, regarding the WPCP and Bridge Street PS:

4.1.1 Outfall Capacity Review (2010 Class EA)

An outfall capacity review was completed by XCG as part of the 2010 Class EA. The outfall capacity review identified limitations of the existing forcemain, gravity sewer and outfall. It was noted that these capacities were subject to adjustment based on a more detailed analysis. The below present key information within the above-noted review:

- The hydraulic capacity of the effluent forcemain was determined to range up to 175 L/s (15,300 m^3/d) based on an upper velocity range of 2.5 m/s.

- A hydraulic model of the effluent piping system was developed and simulated under a number of conditions. The predicted threshold for the existing system with all 16 outfall ports open was estimated as 13,700 m^3/d. It was further noted that the existing peak instantaneous flow (PIF) of approximately 15,000 m^3/d, could be best accommodated by the existing system with all diffusers open. Furthermore, the flow was modelled up to 30,000 m^3/d, and it was indicated that this flow may be accommodated by adding a second forcemain, pressurizing the existing gravity sewer and adding the 14 diffuser ports.

The outfall capacity was further reviewed during Phase 3 of the ESR Addendum, a summary of the findings of the theoretical assessment is presented in Section 7.2

4.1.2 Assimilative Capacity Assessment of the Rideau River (2010 Class EA)

An assimilative capacity assessment of the Rideau River was completed by XCG as part of the 2010 Class EA. The below presents some of the information described within the above-noted study (refer to Appendix D within the Phase 2 Update report for a copy of the Kemptville WPCP Assimilative Capacity Assessment of the Rideau River):

- The Rideau River is considered a Policy 2 receiver with respect to phosphorous as defined by the MECP "Water Management - Policies, Guidelines and Provincial Water Quality Objectives", 1994. The Rideau River is also considered a Policy 2 receiver with respect to fecal coliforms.

- Un-ionized ammonia and dissolved oxygen are Policy 1 parameters, and therefore, there is some assimilative capacity in the Rideau River for these parameters.

- The 7Q20 low flows determined from the monthly analysis ranged from 4 m^3/s to 10.4 m^3/s.

- The Total Phosphorous (TP) is the limiting factor with regards to discharge capacity. In order to maintain the approved loading beyond the current ECA rated capacity, the TP effluent criteria will have to be reduced. The current ECA TP loading is 1.35 kg/day based on an average concentration of 0.3 mg/L and average day flow of 4,510 m^3/d.

- No change to effluent loading criteria was proposed for total suspended solids, fecal coliforms or CBOD5. A change to the total ammonia nitrogen concentration effluent limits was proposed for the fall between the months of September to November; the total ammonia nitrogen concentration was to be reduced from 7.0 mg/L to 2.0 mg/L.

Comments were received during the 2010 Class EA from the MECP regarding the Kemptville WPCP Assimilative Capacity Assessment of the Rideau River. It was noted that the MECP was satisfied with the receiving stream assessment and the proposed effluent limits/loadings (refer to Appendix D for a copy of the MECP letter regarding proposed effluent limits):

4.1.3 Assimilative Capacity Assessment of the Rideau River (2015 Master Plan Update)

The 2015 Master Plan Update (Stantec, 2016) also presented information regarding TP within the Rideau River. The below summarizes some of the information presented within the 2015 Master Plan (Stantec, 2016) from stakeholders:

- The MECP indicated that a concentration of 0.15 mg/L is quite low for a TP effluent limit. The MECP also noted that the Municipality would need to demonstrate that the WPCP can consistently meet this lower effluent criteria for a change to be made to the ECA.

- The RVCA provides comments regarding current TP loading and potential future TP loading, noting that the WPCP is currently achieving better quality effluent than required by its ECA. The RVCA suggests that efforts be made to reduce TP loading to the Rideau River to prevent deterioration of downstream water quality.

A meeting was held with the RVCA as part of the ESR Addendum to discuss the proposed total phosphorous effluent concentration limit as well as other environmental aspects of the project (e.g. adjacent lands of the Provincially Significant Wetland, Source Water Protection, Updated Flood Plain Mapping). Refer to Public and Agency Consultation Summary in Appendix C for a copy of the RVCA Consultation Meeting.

4.1.4 Flow Equalization Preliminary Assessment (2010 Class EA)

A preliminary assessment of flow equalization for the Kemptville WPCP was undertaken during the 2010 Class EA. Flow equalization was specifically assessed as a means to reduce peak effluent discharge because the existing effluent system consists of an effluent pumping system, forcemain, gravity effluent sewer and outfall, and the capacity of the effluent system would require significant upgrades to meet future peak flows. It was noted that the use of flow equalization could reduce design peak flow requirements and extend the service life of key infrastructure. Refer to Appendix E for a copy of the ESR Addendum - Phase 2 Update Report and Appendix G for a copy of the 2010 Class EA for further details regarding the previous assessment.

During Phase 3 of the ESR Addendum, conceptual sizing of equalization storage was further reviewed. Refer to Section 7 and Appendix E for a copy of TM – WPCP Liquid Train Alternatives for further information.

4.1.5 Archaeological Assessment Report (2010 Class EA)

A Stage 1 archaeological assessment was completed by Golder Associates Ltd. as part of the 2010 Class EA to identify known or potential heritage and archaeological sites within the study area. The below presents some of the information described within the above-noted study (refer to Appendix F for a copy of the 2010 Class EA for details):

- The study area is reported to have been occupied as early as 1837. Although there are no registered heritage buildings or archaeological sites within the study area, it is reported that there is moderate potential for pre-contact and archaeological resources because the site is located within 3 km of known historic sites.

- The report recommends that a Stage 2 archaeological assessment be undertaken for areas impacted by expansion of WPCP and due to upgrades to the effluent piping.

- The report also recommends that reporting requirements be followed if buried archaeological remains or human remains are found during construction.

- There are no buildings or sites with a heritage designation within the study area.

A screening checklist for evaluating potential for built heritage resources and cultural heritage landscapes was also completed as part of the 2019 ESR Addendum. Based on the checklist, a Cultural Heritage Evaluation Report (CHER) is recommended to be completed with the Stage 2 archaeological assessment because the property is located within the Rideau River watershed.

The Algonquins of Ontario (AOO) provided a review of the 2010 Stage 1 Archaeological Assessment on April 12, 2019. A copy of the e-mail is provided in Appendix C. The Municipality has acknowledged that further work to address the AOO's comments will be undertaken prior to proceeding with the Stage 2 Archaeological Assessment.

4.1.6 Geotechnical Overview Report (2010 Class EA)

A desktop geotechnical overview of the study area was completed by Golder Associates Ltd. as part of the 2010 Class EA to provide context regarding potential geotechnical issues that could affect the design of an upgraded WPCP. The below presents some of the information described within the above-noted overview (refer to Appendix F for a copy of the 2010 Class EA for details):

- The subsurface conditions generally consist of fill materials from past use of the site over river channel deposits and glacial till. Bedrock consists of limestone and dolomite of the Oxford formation.
- Ground water levels are influenced by the water levels in Kemptville Creek and the Rideau River. It was reported that groundwater levels typically range from approximately 1 to 2.5 metres deep.
- Peat exists in the foreshore of the Rideau River in thicknesses up to 8 metres.
- No unusual problems are expected for excavations within the soil overburden above the groundwater level and to about 0.5 metres below the groundwater level.
- Bedrock is considered hard and competent, and will require a drill and blast procedure for removal.
- Additional subsurface information will be required during design to address specific requirements and to characterize the hydrogeological conditions.

4.1.7 Natural Environment (2010 Class EA and 2015 Master Plan Update)

A Natural Environment Habitat Assessment was completed by Muncaster Environmental Planning Inc. as part of the 2010 Class EA. The 2015 Master Plan Update (Stantec, 2016) also describes the natural environment in Kemptville. The below presents some of the information described within the above-noted studies:

- The area adjacent to the WPCP generally consists of the Ferguson Forest Centre, including seedlings, plantations and natural forests. Many of the forested areas are identified as significant woodlands on Schedule A-1 of the North Grenville Official Plan. Butternut trees were identified to be present in the area. Kemptville Creek is located to the east of the WPCP, and this portion is reported to be designated as a Provincially Significant Wetland. The Rideau River is located north of the WPCP and is also reported to be designated as a Provincially Significant Wetland.
- Fish nursery areas were identified along the Kemptville Creek and fish spawning areas along the Rideau River near the existing outfall. The water quality of Kemptville Creek downstream is noted to be degraded in the 2015 Master Plan Update.
- The area was not designated as part of an Area of Natural and Scientific Interest.

- Species at Risk were identified, including the Threatened Musk Turtle in the general area of the existing outfall, the Endangered Henslow's Sparrow, and the Gorgone Crescentspot, which was noted to be a provincially rare species of butterfly.

- Different bird species and other wildlife were identified within the forested areas along Honour Way.

- There is a west-east channel and two tributary that flow towards Kemptville Creek which were identified as appearing to provide cool and warm-water fish habitat. A swamp was observed approximately 2.5 km north of the WPCP.

- Recommendations regarding general mitigation measures for working within the forested areas and in the vicinity of the tributaries of Kemptville Creek were identified by Muncaster Environmental Planning Inc. in the 2010 Class EA.

As part of the 2010 Class EA, Ministry of Natural Resources and Forestry (MNRF) also provided comments regarding the study area; the following summarizes the information provided by MNRF:

- The proposed expansion area and current facility is in close proximity to a Provincially Significant Wetland. Features and functions of the wetland should be maintained during construction and operation of the WPCP. Potential effects on wetland values were noted to include winter hibernating, summer foraging, basking and nesting sites, spawning and nursery habitats for fishes, waterfowl staging areas, vegetation used for foraging and shelter by birds and mammals.

- An ecological site assessment and inventory of wildlife values was recommended to be completed during the planning process. No known species at risk were identified, except for the potential of butternut.

- MNRF and RVCA should be consulted regarding any proposed in-water works.

Additional comments were received by the MNRF as part of the ESR Addendum, refer to Public and Agency Consultation Summary in Appendix C and Section 4.2 for further information.

4.1.8 BioMag™ Process Pilot Demonstration at the Kemptville WPCP (XCG, 2014)

The Municipality retained XCG in 2013 to undertake a pilot full-scale demonstration of the BioMag™ system and assess the feasibility of converting the existing secondary treatment process to a BioMag™ treatment process. Long-term high solids testing and secondary clarifier testing were completed to simulate whether the BioMag™ could be used to meet target secondary effluent performance and to determine the peak day and peak hour process capacity of the secondary clarifier when operating with the BioMag™ treatment process. The results indicated that the BioMag™ treatment process was capable of meeting secondary performance targets of 10 mg/L for BOD_5, 10 mg/L for TSS and 0.3 mg/L for TP. The results also indicated that the secondary clarifiers are capable of treating peak sustained flows at an equivalent surface overflow rate (SOR) of 38.1 $m^3/m^2/d$ and solids loading rate (SLR) of 326 $kg/m^2/d$ as well as peak hour flows at an equivalent SOR of 55.8 $m^3/m^2/d$ and SLR of 476 $kg/m^2/d$. It was noted that the

BioMag^{TM} treatment process is a technically feasible option to increase the secondary treatment capacity at the WPCP. Some of the drawbacks of this process are identified below:

- It was noted that TP concentrations were consistently lower when operating as a conventional activated sludge (CAS) process versus when operating with the BioMag^{TM} process.
- Additional operation and maintenance was required by operations staff during routine annual maintenance of the tertiary filters due to carry-over of solids from the secondary clarifiers and settling of magnetite within the feed pipes and filters.
- Magnetite reduces the reliability and accuracy of magnetic flow meters.
- Magnetite increases the amount of solids generated and may require additional mixing within the digesters to maintain the magnetite impregnated biosolids in suspension due to the increased specific gravity.
- Operation and maintenance costs were estimated to increase by approximately \$29,000/year per 1,000 m^3/d of flow treated compared to CAS.

Due to the above noted drawbacks, this process was screened out and not considered further as part of the ESR Addendum.

4.1.9 Updated Flood Mapping (RVCA, 2017)

The RVCA recently updated flood plain mapping for the Rideau River. Information regarding flood plains near the Kemptville WPCP is available within Technical Memorandum – Rideau River Flood Risk Mapping from Kars to Burritts Rapids, dated July 18, 2017. The 1:100 year floodplain elevation at the reach of Kemptville Creek was noted by the RVCA as 87.72 metres. The RVCA has noted that a portion of the WPCP property is within the 1:100 year floodplain and that the property limits are entirely within the 120 metre adjacent lands of a Provincially Significant Wetland (PSW).

As noted, a meeting was held with the RVCA as part of the ESR Addendum to discuss the requirements associated with expansion within the flood plain and 120 metre adjacent lands of a PSW. Refer to Appendix C for a copy of the RVCA Consultation Meeting.

4.2 Supplemental and Updated Studies

4.2.1 Technical Memorandum No. 1 – Projected Raw Wastewater Flows and Quality Update (2019 ESR Addendum)

This Memorandum provided an update to the 20-year projected raw wastewater flows and quality for the Municipality of North Grenville WPCP. Population projections to 2038 were based on the growth identified in the Alternative Residential Growth Scenario as presented in the Long-Term Population, Housing and Employment Forecast Report (Watson, 2017). Raw wastewater flows and loadings were based on annual reporting information provided by the Municipality. The projections served as the basis for establishing the sewage treatment requirements for the ESR Addendum.

Based on projected growth identified within the Watson 2017 Report, the serviced population was projected as 9,423 persons by 2038. Historical raw wastewater flows were summarized and evaluated to determine updated projected average day, peak day and peak instantaneous flows. An updated estimated per capita flow of 493 L/capita/day is used to project average day flows. A peaking factor of 3.0 was determined for projecting peak day flows. Sewage pumping station (SPS) flows and capacities were summarized to determine future peak instantaneous flows; it was noted that all flows discharge via forcemains at the WPCP. Projected raw wastewater flows are presented in Table 2.

Table 2: Projected Raw Wastewater Flow

Parameter	2010 Class EA (2025)	ESR Addendum 20-Year (2038) (1)
Average Day Flow (ADF) – m^3/d	11,800(2)	4,660
Peak Day Flow (PDF) – m^3/d	28,075	13,980
Peak Instantaneous Flow (PIF) – m^3/d – L/s	43,300(3) 501	31,072 360

Notes:
1. It has been assumed that the average day influent flows and peak influent flows from available reporting data include the by-pass flows.
2. The average day flow for the 2010 Class EA (XCG/JLR, 2010) was based on a mixed use per capita flow of 910 L/capita/day.
3. The 2010 Class EA (XCG/JLR, 2010) estimated the PIF based on the cumulative sanitary pumping station rated capacities (33,310 m^3/d) multiplied by a factor of 1.3.

Historical raw wastewater quality was also reviewed and summarized. Projected raw wastewater quality and loadings were updated based on updated flow projections, updated raw water quality and estimated septage daily volumes and loadings as presented in the 2010 Class EA. The proposed design raw wastewater flows and loadings are presented in Table 3.

Table 3: Proposed Design Raw Wastewater Flows and Loadings

Parameter	Historic (2012-2016)	20-Year Design (2038) No Septage	20-Year Design (2038) With Septage
Average Day Flow (m^3/d)	2,562	5,000	5,000
Peak Day Flow (m^3/d)(1)	11,993	15,000	15,000
Peak Instantaneous Flow (m^3/d)(2) (L/s)	14,235 165	31,072 360	31,072 360
BOD_5 Loading (kg/d) Average Maximum Month	 328 451	 650 900	 825 1060

Parameter	Historic (2012-2016)	20-Year Design (2038) No Septage	20-Year Design (2038) With Septage
TSS Loading (kg/d)			
Average	430	850	1310
Maximum Month	628	1250	1690
TP Loading (kg/d)			
Average	9.5	20	24
Maximum Month	14.9	29	34
TKN Loading (kg/d)			
Average	77	150	170
Maximum Month	123	200	220
TAN Loading (kg/d)			
Average	51	100	100
Maximum Month	87	150	150

Notes:
1. PDF based on peaking factor of 3.0.
2. PIF based on projected peak flows from sanitary pumping stations.

Wastewater loadings due to septage is greatly influenced by the average raw wastewater flows without septage received at the WPCP. For further details regarding updates to the proposed design flows, concentrations and loadings, refer to Appendix G for a copy of TM – Projected Raw Wastewater Flows and Quality (Rev. 1).

4.2.2 Process Capacity Assessment (2010 Class EA / 2019 ESR Addendum)

A desktop process capacity evaluation and secondary clarifier and tertiary sand filter stress testing assessment was completed by XCG as part of the 2010 Class EA. The previous work was reviewed and updated based on current plant conditions. Table 4 summarizes the process capacity assessment information for the Bridge Street PS and Kemptville WPCP. Solids treatment capacity of the existing anaerobic digestion system is described in Section 7.

Table 4: Process Capacity Information for Bridge Street SPS and Kemptville WPCP

Process	Design Parameters/Conditions[1]	Peak Capacity Estimate
Bridge Street SPS		
	Wet Well / Dry Well One mechanical screen and one manual screen (standby). Two dry pit centrifugal pumps (one duty and one standby) rated at 100 L/s (8,640 m^3/d) at 25.9 m TDH and equipped with variable frequency drives. [2] One extended shaft vertical mounted end suction raw sewage pump (standby).	Rated capacity of 8,640 m^3/d; (one pump in operation). Pump No. 1 is to be replaced with a dry pit centrifugal pump as separate project.
Kemptville WPCP		
Screening Facility	One mechanical screen using a channel monster grinder followed by an auger monster and one by-pass channel with a manual screen (standby). Each screen is rated for 435.2 L/s.	37,600 m^3/d (435.2 L/s) (one screen in operation)
Grit Channels	Two horizontal flow grit channels with an effective length and width of 12 m x 0.75 m. The side water depth (SWD) is 0.7 m. The peak capacity of the grit removal system is noted as the firm capacity of 11,370 m^3/d.	11,370 m^3/d (one grit channel in operation)
Primary Clarifiers	Two rectangular clarifiers with effective length x width of 19.3 m x 5.0 m and SWD of 3.6 m, equipped with chain and flight collectors. Waste activated sludge co-thickening occurs within the primary clarifiers. Primary clarifiers have a combined process capacity of 11,580 m^3/d based on a surface overflow rate of 60 $m^3/(m^2 \cdot d)$. Two raw sludge pumps, each with a capacity of 6.3 L/s, and one scum pump.	11,580 m^3/d (both primary clarifiers in operation)
Aeration Tanks	Two rectangular aeration tanks with effective length x width of 40.45 m x 5.0 m and SWD of 4.57 m. The aeration tanks are equipped with fine bubble diffusers; air is supplied by two centrifugal type air blowers with capacities of 55 m^3/min each at 101.3 kPa. The aeration system meets existing rated capacity requirements.	5,661 m^3/d for ADF (two aeration tanks in operation)
RAS/WAS Pumps	Three activated sludge pumps with a capacity of 2,264 m^3/d. Firm capacity of the pumping system is 4,528 m^3/d.	4,528 m^3/d (two pumps in operation)

Process	Design Parameters/Conditions(1)	Peak Capacity Estimate
Secondary Clarifiers	Two rectangular clarifiers with effective length x width of 38.7 m x 5.0 m and SWD of 3.6 m, equipped with chain and flight longitudinal type sludge collector and chain and flight cross sludge collectors. The secondary clarifiers have a combined capacity of 11,550 m^3/d based on stress testing completed during 2010 Class EA and limited by SOR.	11,550 m^3/d (both secondary clarifiers in operation)
Flash Mix Tank(3)	One flash mix tank with a hydraulic retention time (HRT) of 75 s at 4,510 m^3/d. At a minimum detention time of 30 s, the capacity of the flash mixing tank is 11,318 m^3/d.	11,318 m^3/d (30s detention)
Flocculation Tanks	Two tanks with a HRT of 15 min at 11,370 m^3/d. Dimensions of the flocculation tank are 4.1 m by 4.1 m by SWD of 3.6 m. Capacity of the flocculation tanks is noted as 17,567 m^3/d, limited by a minimum flocculation time of 10 min.	17,567 m^3/d (based on 10 min)
Tertiary Filters	Two filters with a surface area of 32 m^2 each, equipped with travelling bridge and automatic backwash. The capacity of the filters based on a filtration rate of 7.6 m/h and 2% allowance for backwash is approximately 11,380 m^3/d.	11,380 m^3/d (two filters in operation)
Disinfection	Disinfection is provided by two ultraviolet (UV) banks with a firm capacity of 11,370 m^3/d. Operations staff noted that two new ultraviolet banks (one standby) are to be installed with a peak flow capacity of 15,143 m^3/d each.	15,143 m^3/d (one UV bank in operation)
Effluent Pumping	Effluent pumping is provided by three VFD driven centrifugal pumps (one standby) with a rated capacity of 65.8 L/s (5,685 m^3/d) and firm capacity of 11,370 m^3/d.	11,370 m^3/d (two pumps in operation)

Notes:
1. Based on information from the 2010 Class EA, amended ECA No. 9628-9Q4LRN issued December 9, 2014 and Wastewater Treatment Facilities Operations Manual, 1994.
2. The rated capacity of the Bridge Street PS is to be rerated based on the existing pumping capacity and upgrades to the WPCP.
3. Metcalf & Eddy (2003), typical detention times for rapid mixing range from 5 to 30 seconds.

Other process and/or operational/maintenance constraints were identified by operations staff during a site visit of the WPCP on October 19, 2017. The main bottlenecks and/or issues identified by operations staff included the following:

- The channel monster grinder was recently replaced and has experienced high wear and tear on its cutters.

- Odour control for headworks and other facilities should be considered; there are no existing provisions for odour control. HVAC fans cannot be used at all times at the WPCP because the fans draw odours into the facility.

- Maintenance and/or replacement of various components of aeration equipment are needed. It was noted that the couplers are cracking within the piping and the fine bubblers are being replaced. It was noted that the blower VFDs are from the original installation in 1993.

- It was noted that there is carryover of solids from the secondary treatment system when flowrates rapidly increase at the plant.

- The channel between the aeration tank and secondary clarifier is a bottleneck for the system as a result of the configuration.

- The chemical storage tank is from the original installation; its condition and the need for an enclosure for the storage tank should be considered as part of the preferred solution.

- The effluent valve from the WPCP is ceased and cannot be replaced because the system must remain operational at all times.

- Issues with the SCADA power supply and grounding should be considered as part of the preferred solution.

- An emergency overflow from the tertiary treatment tanks should be reviewed with the MECP.

4.2.3 Source Water Protection Review (2019 ESR Addendum)

The Mississippi – Rideau Source Protection Plan (SPP) (January 2015) was reviewed to determine whether the Kemptville WPCP or Bridge Street SPS is located within an area in which these facilities would be considered as a significant drinking water threat. The municipal water supply system in North Grenville consists of three separate groundwater wells located within Kemptville. The SPP provides mapping of the wellhead protection areas (WHPA) associated with these groundwater supply wells. Based on SPP mapping, the Kemptville WPCP and Bridge Street SPS are located in an area identified as WHPA-B which has been assigned a vulnerability score of 6 in the Draft Official Plan (North Grenville, 2017). In addition, it is noted that almost all of North Grenville has been designated as a highly vulnerable aquifer and has also been assigned a vulnerability score of 6 based on the SPP.

Since the vulnerability score of both the Kemptville WPCP and Bridge Street PS are below a vulnerability score of 8.0, these facilities are not considered as significant drinking water threats based on the SPP. Nevertheless, it is noted that the Draft Official Plan indicates that a notice is required to be submitted to the Risk Management Official prior to approval for Planning Act or Building Code Act applications.

4.2.4 Land Use and Property Constraints (2019 ESR Addendum)

The WPCP is located at 2899 County Road 43, adjacent to Kemptville Creek. A portion of the WPCP property is within the 1:100 year floodplain and that the property limits are entirely within the 120 m adjacent lands of a Provincially Significant Wetland. A large portion of the lands adjacent to the WPCP are owned by the Municipality and leased to the Ferguson Forestry Centre.

Another aspect of land use planning that must be considered is MECP (formally MOECC) Guideline D-2 "Compatibility between Sewage Treatment and Sensitive land Use". This Guideline states that the minimum separation distance is 100 m and recommended separation distances between property/lot line of sensitive land uses (e.g., residences) and sewage treatment plants is 150 metres for wastewater treatment plants of capacity between 500 m^3/day and 25,000 m^3/day. In addition, the guideline indicates that the recommended separation distances vary from 100 to 400 metres for waste stabilization ponds depending on the type of pond and characteristics of the waste.

The existing WPCP is located approximately 150 m from the closest sensitive user (animal hospital) located south of the WPCP. The expansion of the WPCP is anticipated to reduce the minimum separation distance from the closest sensitive user property line to the potential odour producing source to approximately 130 m based on the expansion of the digestion system with a new primary digester. Separation will remain above the minimum requirement of 100 m. Odour control mitigation measures are to be provided for the expansion upgrades. Refer to Section 7 for information regarding odour control measures to be implemented.

4.2.5 MNRF Information Request (2019 ESR Addendum)

The MNRF provided general information on the databases available. Natural heritage values were identified within the general study area, including an evaluated wetland (Kemptville Creek), various non-sensitive fish nurseries, various fish species, and unevaluated wetland. The MNRF recommended the project be discussed with the Conservation Authority and Municipality regarding the possible requirement for an Environmental Impact Study (EIS).

The MNRF noted that the site contains woodlands and should be evaluated for wildland fire. According to the definition of *development* in the 2014 PPS, this project does not meet the definition of development, as the definition does not include *activities that create or maintain infrastructure authorized under an environmental assessment process.* As such, wildland fire policies do not apply to this project. Furthermore, according to Schedule 'B2' Wildfire Hazard Mapping of the Municipality of North Grenville Draft Official Plan, the area proposed for expansion of the WPCP is not within an extreme or high wildfire hazard designation.

The MNRF also noted that there may be significant wildlife habitat within the study area and provided several guiding documents which may be useful in identifying these habitats and mitigation options. The potential for Blanding's Turtle, Butternut, Henslow's Sparrow, Little Brown Bat, Bobolink, Eastern Meadowlark and Barn Swallow (threatened or endangered species) was identified and it was noted that the area may be a suitable habitat for special concern species, including Bald Eagle, Eastern Musk Turtle, Snapping Turtle, Wood Thrush, Eastern Woodpeewee and Monarch. An ecological site assessment was recommended to identify the presence of any natural heritage features, any Species at Risk and/or their habitat. If Species at Risk are determined to be present onsite, permits/approvals would be required for any construction upgrades or site alterations.

As such, an ecological site assessment is recommended to be completed during preliminary and/or detailed design of the proposed upgrades. Any necessary permits/approvals identified shall be obtained prior to on-site construction activities. Reports prepared as part of an ecological site assessment should be provided to MNRF.

A letter providing updated in-water work timing guidelines for the Kemptville District was also provided by MNRF. Timing guidelines for the Rideau River (Oxford area) indicates restrictions between January 1 and June 30. Appropriate measures to minimize and mitigate impact on water quality should be considered; refer to Section 8 of the ESR Addendum.

5.0 Phase 1: Updated Problem and Opportunity Statement

The Problem Statement presented within the 2010 Class EA ESR for the wastewater treatment infrastructure requirements is provided below:

North Grenville is currently experiencing very high growth and development pressures and initiated the Kemptville WPCP Optimization and Expansion Class EA to address the need for additional wastewater treatment capacity to service community growth.

The Kemptville WPCP has a design average day flow of 4,510 m^3/day and a design peak flow of 11,370 m^3/day. The facility currently services a population of approximately 3,650 and operates at 50 percent of the rated average day flow capacity. The projected future population is approximately 13,000 with associated build-out average day flow requirements of 11,800 m^3/day and 28,075 m^3/day, respectively. Additional wastewater treatment capacity is needed to service the projected future wastewater flows.

Due to the reduction in ADF per capita since the 2010 Class EA as identified within the Master Plan Update (Stantec, 2015) and new population projections established by Watson, the Municipality has decided to amend the 2010 Class EA ESR through re-evaluation of the WPCP upgrades and/or expansion requirements as to ensure that any future modifications best meet their needs.

The following Problem and Opportunity Statement will be used as a basis for this ESR Addendum:

- **Problem Statement:** *"North Grenville is currently experiencing high growth and development pressures and is undertaking an Environmental Study Report (ESR) Addendum to address their need for additional wastewater treatment capacity to service community growth. A review of the Kemptville Water Pollution Control Plant (WPCP) suggests that there are hydraulic constraints limiting the treatment capacity of the WPCP, specifically its ability to provide tertiary treatment of high peak flows. The WPCP requires additional wastewater treatment capacity and/or equalization storage to accommodate these current peak* *demands as well to meet projected growth and sewage flow demands associated with future developments.*

- **Opportunity Statement:** *"The Municipal Class Environmental Assessment planning process provides an opportunity to evaluate existing systems and infrastructure at the Kemptville Water Pollution Control Plant (WPCP) in the context of meeting or exceeding current treatment standards, projected demands and long-term reliability and sustainability."*

6.0 Phase 2: Alternative Solutions

6.1 2010 Class EA Preferred Solution

The preferred solution identified within the 2005 Master Plan consisted of twinning the existing treatment plant. The 2010 Class EA refined the preferred solution by considering additional concepts such as influent equalization storage, expansion staging and phosphorous offsetting. The five main refined alternatives considered in the 2010 Class EA were the following:

1. Build out WPCP expansion with enhanced tertiary treatment.
2. Staged WPCP expansion with phosphorous offsetting program.
3. Influent equalization facility and WPCP expansion with enhanced tertiary treatment.
4. Influent equalization facility and WPCP expansion with phosphorous offsetting program.
5. Staged WPCP expansion with equalization facility and enhanced tertiary treatment.

Table 5 provides a summary of these 2010 Class EA alternatives:

Table 5: Summary of Refined Alternatives from 2010 Class EA

Alternative	Evaluation Comments
1. Build out WPCP expansion with enhanced tertiary treatment	This alternative envisioned providing a new enhanced tertiary treatment train and retrofitting the existing tertiary treatment train to reduce effluent total phosphorous concentrations. Additional requirements included installation of a second effluent forcemain and pressurize effluent sewer system; installation of a second effluent sewer and expansion of the existing outfall to the Rideau River. Near term upgrades required expansion to an ADF of 11,800 m^3/d.

Alternative	Evaluation Comments
2. Staged WPCP expansion with phosphorous offsetting program	This alternative considered a 2-stage expansion and potential implementation of a phosphorous offsetting program. Implementation of phosphorous offsetting was being considered because TP was identified as the limiting factor for discharging to the Rideau River. The first stage of upgrades was to be limited to an ADF increase that would permit the approved TP daily effluent loading to be maintained while reducing the TP effluent concentration limit to 0.2 mg/L. Further reduction of the TP effluent limit or phosphorous offsetting was to be required for the second stage. This alternative included expanding the tertiary treatment system to an ADF of 6,800 m^3/d, installing a second effluent forcemain and pressurized effluent sewer system during Stage 1, including review of phosphorous offsetting program. Stage 2 included expanding to 11,800 m^3/d by phosphorous offsetting or enhanced tertiary and installing a second effluent sewer and expanding the outfall to the Rideau River.
3. Influent equalization facility and WPCP expansion with enhanced tertiary treatment	This alternative included the reduction of peak flows using equalization storage which would reduce requirements to upgrade the effluent sewer, forcemain and outfall. An equalization volume of 24,000 m^3 was used as a baseline for evaluation. Eventually, a WPCP expansion to an ADF of 11,800 m^3/d, including installing a second effluent forcemain and pressurized effluent sewer and upgrading/expanding to enhanced tertiary treatment.
4. Influent equalization facility and WPCP expansion with phosphorous offsetting program	This alternative combined the influent equalization facility with phosphorous offsetting to defer expansion of the plant and maintain the existing tertiary treatment (i.e., no enhanced required). Initially, this alternative would include installation of an equalization storage facility and development of a phosphorous offsetting program. Eventually, it would involve expanding to an ADF of 11,800 m^3/d by installing a second effluent forcemain and pressurized effluent sewer system as well as implementing phosphorous offsetting or enhanced tertiary treatment.
5. Staged WPCP expansion with equalization facility and enhanced tertiary treatment	This alternative involved the installation of an influent equalization facility and staged expansion of the WPCP. This alternative is the same as Alternative 3 with staging.

The 2010 Class EA identified the preferred alternative to be Phosphorous Offsetting Program Development and Implementation, Stage 1A – Influent Equalization Facility and Select Near-Term Upgrades, Stage 1B – WPCP Expansion (ADF of 9,020 m^3/d) and Stage 2 – WPCP Expansion (ADF of 11,800 m^3/d).

Based on the updated population projections and flows for the 20-year design period, the above 2010 Class EA refined alternatives were reviewed to determine whether any of these remain applicable or whether updated alternatives are required. The following was considered in the review of the 2010 Class EA alternatives:

- The updated projected 20-year flows remain below an ADF of 6,800 m^3/d, and therefore, **enhanced tertiary treatment and/or phosphorous offsetting is not required** to meet the approved loading of 1.35 kg/d. Based on previous correspondence with the MECP as part of the 2010 Class EA, an increase in the ADF from 4,510 m^3/d to 6,800 m^3/d would require the effluent TP concentration limit to be reduced from 0.3 mg/L to 0.2 mg/L.

- The 20-year projected ADF for the ESR Addendum (4,660 m^3/d) is below the Stage 1 expansion (6,800 m^3/d) identified for this alternative; therefore, **staged expansion is not being considered further for the ESR Addendum**.

Since expansion with enhanced tertiary treatment, phosphorous offsetting and staging is not required, updated alternatives were considered in the ESR Addendum.

6.2 Updated Preferred Solution

Two alternatives were evaluated as part of the ESR Addendum to determine the overall preferred solution prior to proceeding to Phase 3. Both alternatives were evaluated and scored based on a list of criteria which included environmental, social, technical and economic considerations. The two alternatives evaluated are summarized below:

<u>Alternative 1 - WPCP expansion without influent equalization storage</u>

With this alternative there is no attenuation of the peak flows to the plant. Conceptually, the WPCP expansion would require the upgrades identified in Table 6 to meet the projected 20-year design flow:

Table 6: Review of Alternative 1 – WPCP Expansion without Influent Equalization Storage

Parameter/Component	Comments
Equalization Storage	No attenuated flow
Septage Receiving(1)	New Septage Receiving Facility
WPCP Expansion	Based on the above design flows, conceptually the following expansion to the WPCP would be required for an expansion without equalization: • Headwork upgrades (screens, grit chambers, odour control) • An additional primary clarifier • An additional aeration tank • Tripling of the secondary clarifier capacity • Doubling of the flash mix and flocculation tank capacity • Tripling of the tertiary filters capacity • Tripling of disinfection capacity
Biosolids	Additional primary digestion Additional secondary digestion biosolids storage

Parameter/Component	Comments
Effluent Pumping System	Major expansion to the effluent pumping system required to accommodate the peak flows; tripling of the firm capacity of the pumping system would be needed.
Outfall Infrastructure Requirements	Major upgrades to effluent piping infrastructure would be needed. Install second effluent forcemain and pressurize effluent sewer system. Diffuser outfall upgrades required.
Notes: 1. For this evaluation, it is assumed that septage would be treated by the same processes as the WPCP (i.e., not a separate treatment train).	

Alternative 2 - WPCP expansion with influent equalization storage.

For Alternative 2, the increased peak flows projected would be attenuated by influent equalization storage. The equalization storage would reduce the design peak flow requirements (above peak day) for the WPCP expansion and reduce infrastructure upgrades to the effluent forcemain, sewer and outfall over the 20-year period. Conceptually, the WPCP expansion would require the upgrades identified in Table 7 to meet the projected 20-Year design flow:

Table 7: Review of Alternative 2 – WPCP Expansion with Influent Equalization Storage

Parameter/Component	Comments
Equalization Storage	New Equalization Storage Facility
Septage Receiving(1)	New Septage Receiving Facility
WPCP Expansion	Based on the above design flows, conceptually the following expansion to the WPCP would be required for an expansion with equalization ahead of the plant: • Headwork upgrades (screens, grit chambers, odour control) • An additional primary clarifier • An additional aeration tank • An additional secondary clarifier • An additional tertiary filter • Upgrade UV disinfection
Biosolids	Additional primary digestion required Additional secondary digestion biosolids storage required
Effluent Pumping System	Upgrades as required to increase pumping capacity
Outfall Infrastructure Requirements(2)	No forcemain or effluent gravity sewer infrastructure piping upgrades; all 16 ports at the outfall are to be opened for maximum flow conditions.
Notes: 1. For this evaluation, it is assumed that septage would be treated by the same processes as the WPCP (i.e., not a separate treatment train). 2. Converting transition chamber to a pressurized Air Release/Vacuum relief chamber by capping the open connection is to be further reviewed as part of preliminary design and pump upgrades.	

6.3 Updated Preferred Solution

Based on the evaluation methodology utilized, it was determined that **expanding the WPCP with influent equalization storage** provided the highest overall net benefit to the Municipality. Refer to Phase 2 Update Report for further details regarding the evaluation.

The results of this evaluation are similar to the 2010 Class EA in that the overall solution includes equalization storage and an expansion to the WPCP. The key change is that the updated preferred solution does not require phosphorous offsetting or enhanced tertiary treatment and does not require major upgrades to the effluent infrastructure over the 20-year period. The updated preferred solution also involves increasing the rated capacity of the Bridge Street SPS by upgrading its pumping capacity to 11,370 m^3/d, refer to Section 7.1 for information regarding this SPS.

7.0 Phase 3: Evaluation of Design Alternatives

7.1 Review of Bridge Street Sewage Pumping Station and Forcemain

A review of the Bridge Street SPS was undertaken during Phase 3. The existing rated capacity of the Bridge Street SPS is 100 L/s. The existing rated capacity of the SPS is currently limited by the rated capacity of the Kemptville WPCP and its ability to handle peak flows. The Municipality of North Grenville plans to complete a second phase of upgrades to the Bridge Street SPS. Upgrades include replacing the existing Raw Sewage Pump No. 1 with a dry pit submersible pump and VFD motor combination to match that of existing Raw Sewage Pumps No. 2 and 3. The pump replacement will include the removal and replacement of the reinforced concrete pump and piping supports, replacement of the existing starter with a new VFD, new power feed and instrumentation cabling to the new motor, and modification of the control narrative to maintain consistency with the Raw Sewage Pumps No. 2 and 3 installations. The pumps will continue to operate as a one duty, two standby arrangement until upgrades to the Kemptville WPCP increase its ability to handle higher peak flows. Following upgrades at the WPCP, the Bridge Street SPS is anticipated to be rerated to a flow of 11,370 m^3/d.

The condition of the existing forcemain was not reviewed as part of the ESR Addendum. The 2015 North Grenville Potable Water and Wastewater Master Plan Update (Stantec, 2016) recommended that the Municipality consider twinning the existing forcemain to increase reliability and redundancy of the system.

7.2 Review of WPCP Effluent Infrastructure and Outfall

The 2010 Class EA indicated that the hydraulic capacity of the effluent forcemain was determined to range up to 175 L/s (15,300 m^3/d) based on an upper velocity range of 2.5 m/s. During the ESR Addendum, the transient flows anticipated at a maximum effluent flow of 15,000 m^3/d were reviewed. In the case of the effluent forcemain, the pipe material is high-density polyethylene (HDPE) DR-26 with a pressure rating of 64 psi.

The maximum hydraulic capacity of the existing forcemain is defined by its maximum allowable working pressure, which represents the maximum allowable surge pressure plus normal operating pressure exerted on a forcemain. The frequency of hydraulic transient events and corresponding surge conditions, and the maximum allowable working pressure that should be applied in each case, is dependent on the pump starters and drive technologies for the existing system. Constant speed pumps and full voltage, non-reversing (FVNR) starters typically produce frequent and sudden flow changes that are more susceptible to surge conditions. Pumps equipped with soft starters or variable frequency drives (VFDs) produce more gradual flow changes which mitigate surge conditions. The effluent pumping system is operated with VFDs, and therefore, the maximum flow for infrequent/occasional surge conditions was reviewed.

The maximum permitted surge pressure for an occasional surge occurring in HDPE pipe is two times the pressure rating of the pipe. At a flow of 15,000 m^3/d, the working pressure plus the surge pressure within the forcemain is less than maximum allowable surge pressure of 128 psi, and therefore, the forcemain should be able to operate at this flow rate.

A theoretical desktop review of the effluent gravity sewer was also completed. Energy equations were utilized to verify whether the existing gravity sewer and transition chamber are able to accommodate a flow of 15,000 m^3/d. Surcharged conditions within the transition chamber and a full effluent pipe under pressure with all 16 ports open was assumed. Based on the theoretical review, no modifications are required with a maximum pumped flow of 15,000 m^3/d. Converting transition chamber to a pressurized Air Release/Vacuum relief chamber by capping the open connection should be further reviewed and considered as part of preliminary design and pump upgrades. It is noted that the effluent gravity sewer is also HDPE DR-26 with a pressure rating of 64 psi.

Based on feedback from the Municipality, not all diffuser ports are currently open at the outfall. In order to minimize headloss through the diffusers which would limit the flow within the effluent sewer, all diffuser ports should be opened at the maximum flow of 15,000 m^3/d.

7.3 Identification and Evaluation of Alternative Designs for the Kemptville WPCP

This section provides a summary of the alternatives and preferred design concepts for the Kemptville WPCP liquid and solids treatment trains. For further information, refer to Appendix E: TM - WPCP Liquid Train Alternatives and Appendix F: TM - WPCP Solids Train Alternatives.

7.3.1 Conceptual Level Design Basis for Kemptville WPCP

Updated flow projections, raw sewage quality and quantity, and considerations for possible future effluent requirements for the Kemptville WPCP were presented in Section 4.2. The conceptual level design basis used to evaluate alternatives and identify preferred design concepts is summarized in the following tables:

Table 8: Proposed Design Raw Wastewater Flows

Parameter	Existing	Projected[4]	Proposed Design (2038)	WPCP ECA Rated Capacity
Average Day Flow (m^3/d)	2,562[1]	4,660	5,000	4,510
Maximum Day Flow (m^3/d)	12,514[1]	13,980	15,000[2]	11,370
Peak Instantaneous Flow (m^3/d) (L/s)	14,235 165	31,072 360	31,072[3] 360	-

Notes:
1. Average day flow and maximum day flow based on data from 2012 to 2017.
2. Maximum day flow calculated based on a peaking factor of 3.0.
3. Peak flows above the maximum day flow are to be attenuated by influent equalization storage to 15,000 m^3/d.
4. Projected raw wastewater flow from Technical Memorandum No. 1 – Projected Raw Wastewater Flows and Quality Update.

Table 9: Proposed Design Raw Sewage Quality and Quantity (2038)

	BOD_5	TSS	TP	TKN	TAN
Average Concentration (mg/L)	165	262	4.7	34	20
Average Loading (kg/d)	825	1310	24	170	100
Maximum Monthly Concentration (mg/L)	212	338	6.8	44	30
Maximum Monthly Loading (kg/d)	1060	1690	34	220	150

BOD_5: 5-day Biological Oxygen Demand; TSS: Total Suspended Solids; TP: Total Phosphorous; TKN: Total Kjeldahl Nitrogen; TAN: Total Ammonia Nitrogen

Table 10: Proposed Future Effluent Requirements

Parameter	Objectives	Limits	
		Concentration	Loading
5-Day Biological Oxygen Demand[1]	5.0mg/L	13.5mg/L	67.7kg/d
Total Suspended Solids[1]	5.0mg/L	13.5mg/L	67.7kg/d
Total Phosphorous[1]	0.2mg/L	0.27 mg/L	1.35kg/d
Total Ammonia Nitrogen[1]	1.0 mg/L (May 1 to Nov 30)[2] 4.0 mg/L (Dec 1 to Apr 30)[2]	2.0 mg/L (May 1 to Nov 30) 7.0 mg/L (Dec 1 to Apr 30)	10.0 kg/d 35.0 kg/d
E. Coli[3]	150 cts/100mL	200 cts/100mL	-
Toxicity Testing for Damphia and Rainbow Trout	Pass	Pass	

Notes:
1. Monthly average concentration and loading. Based on maintaining existing ECA loading.
2. Objective timelines for TAN have been updated to match existing ECA dates for effluent limits; no change proposed for TAN concentrations.
3. Monthly geometric mean.

Design waste sludge generation rates were developed based on the above design raw wastewater loadings, a primary clarifier solids removal efficiency of 60%, the design solids yield of 0.70 kg TSS/kg BOD5 within the biological treatment process, and a VSS:TSS ratio of 0.7. Chemical sludge from phosphorous removal was estimated based on a required alum dosage of 2.3 mol alum: 1 mol P removed (USEPA, 1976). Design waste sludge generation rates, at the future design ADF of 5,000 m^3/d, are presented in Table 11.

Table 11: Conceptual Level Sludge Generation Design Basis

Parameter	Average Design	Maximum Month Design
Primary Sludge (1) (4)		
TS Mass	786 kg/d	1014 kg/d
VS Mass	550 kg/d	710 kg/d
Waste Activated Sludge (2) (4)		
TS Mass	404 kg/d	519 kg/d
VS Mass	283 kg/d	364 kg/d
Chemical Sludge (3) (4)		
TS Mass	135 kg/d	203 kg/d
VS Mass	94 kg/d	142 kg/d
Total Sludge		
TS Mass	1,325 kg/d	1,736 kg/d
VS Mass	927 kg/d	1,215 kg/d

Notes:
1. Based on 60%TSS removal in the primary clarifiers.
2. Based on 30% BOD5 removal in primary clarifiers, WAS yield of 0.70 g TSS/g BOD_5.
3. Chemical sludge estimated based alum dosage of 2.3 mol alum: 1 mol P removed and formation of $Al(OH)_3$ and $Al(PO)_4$ precipitates.
4. VSS:TSS ratio of 0.7 was used for all sludge types.

Based on Ontario Regulation 267/03, sufficient storage capacity must be available to the WPCP that is capable of storing biosolids for a period of 240 days which accounts for periods when restricted land application applies (i.e., December 1 to March 31), and when the ground is snow covered or frozen. The minimum of 240 days of biosolids storage is required based on a combination of permanent biosolids nutrient storage facilities and/or temporary field nutrient storage sites (MOE 2008). Based on the strategy currently employed by the Municipality, conceptual design biosolids storage requirements were developed based on providing 180 days of storage for liquid biosolids generated at the Kemptville WPCP. Provision of 180 days of storage would allow sufficient storage for the restricted period, while providing some buffering capacity in the event that land application is not possible outside the restricted period. The biosolids management strategy, including storage requirements should be confirmed during preliminary design.

Table 12 presents the design biosolids storage requirements for the Kemptville WPCP. Biosolids generation rates were developed based on standard mesophilic anaerobic digestion; liquid biosolids volume is based on a dry solids content of 3.5%, whereas the biosolids cake volume is based on a dry solids content of 20%. Design provisions to allow new digesters to be upgraded in the future to a thermophilic anaerobic digestion process for enhanced VS destruction is to be considered similar to the 2010 Class EA.

Table 12: Conceptual Level Biosolids Generation Rates

Parameter	Design Capacity
Anaerobic Digestion	
Average Biosolids Mass (1)	815 kg/d
Maximum Month Biosolids Mass (1)	1,068 kg/d
Average Liquid Biosolids Volume Generation (2)	23 m^3/d
Liquid Biosolids Volume Requirements (3)	4,140 m^3
Biosolids Cake Volume Generation (4)	4.1 m^3/d
Cake Storage Volume Requirements (3)	738 m^3

Notes:
1. Based on typical VS destruction of 55% in primary anaerobic digesters at 15 d HRT.
2. Based on liquid biosolids dry solids concentration of 3.5% and specific gravity of 1.02.
3. Based on providing 180 days of onsite biosolids storage.
4. Based on dewatered biosolids dry solids concentration of 20% TS (MOE 2008).

In addition to the above, influent equalization storage is proposed to attenuate the peak instantaneous flows to the WPCP, by temporarily storing wet weather flows that exceed the proposed design maximum day flow of the WPCP (i.e., 15,000 m^3/d). A review of annual reporting data (January 1, 2012 to June 7, 2017) provided by the Municipality was used to determine the maximum peak wet weather event. Using this historical peak wet weather event, the projected 20-Year wet weather flow event was determined as identified in the following table.

Table 13: Projected 20-Year Wet Weather Flow Event

Parameter	Historical - 2014	20-Year - 2038
Annual Average (m^3/d)	2,847	4,660
Maximum 8-day event (m^3/d)	9,783	16,012
Peaking Factor	3.44	3.44

The 20-year equalization storage volume was calculated based on diverting flows associated with the projected maximum 8-day event to maintain the proposed design MDF of 15,000 m^3/d. Table 14 presents the estimated storage volume required. A contingency volume of 1,815 m^3 has been included to account for a potential process performance problem (e.g. one filter out of service) occurring during a peak wet weather event for a 12-hour period.

Table 14: Estimated Equalization Storage Volume Required

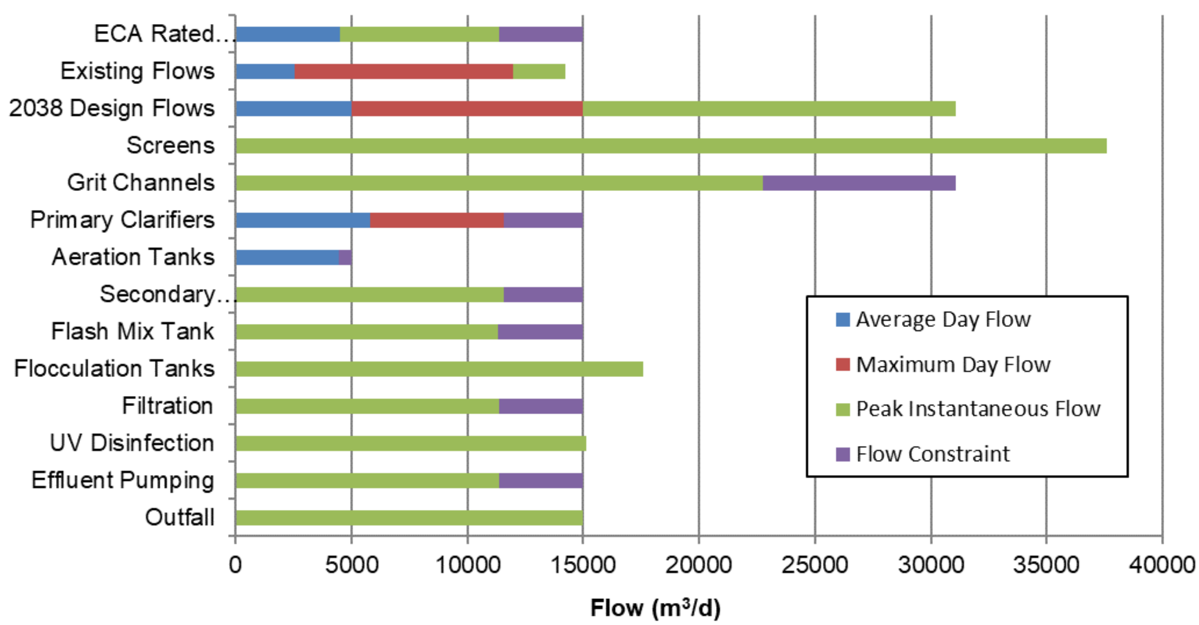
Description	Estimated Effective Storage Volume Required
Projected Maximum Day Flow (8-day event)	16,012 m^3/d
Total Diverted Wet Weather Flow(1)	1,012 m^3/d x 8 d = 8,096 m^3
Contingency(2)	3,630 m^3/d x 0.5 d = 1,815 m^3
Total (Rounded)	**9,911 m^3 (10,000 m^3)**

Notes:
1. Based on maintaining flow through the WPCP at 15,000 m^3/d during the projected maximum day flow (8-day event); (16,012 m^3/d – 15,000 m^3/d = 1,012 m^3/d).
2. Based on reducing flow through the plant to 11,370 m^3/d due to potential process performance problem (e.g. one filter out of service) for a 12-hour period; (15,000 m^3/d – 11,370 m^3/d = 3,630 m^3/d).

A volume of 10,000 m^3 was used to develop and evaluate different types of equalization storage design concepts. The storage volume required should be re-evaluated during preliminary design based on return flows to the equalization storage basin.

Based on a review of the capacity constraints of the existing WPCP and attenuating the maximum day flows to 15,000 m^3/d, the below figure illustrates the flow constraints of the existing WPCP processes to meet the conceptual design basis.

Figure 1: ECA Capacity, Existing Flows, 2038 Design Flows and Theoretical Capacity of WPCP



Theoretical flow capacity from Phase 2 Update Report. Aeration tank capacity updated considering septage.
Outfall: Based on Environmental Study Report 2010, XCG Consultants Ltd.

7.3.2 TM – WPCP Liquid Train Alternatives

An updated preferred alternative design concept for the influent equalization storage and WPCP liquid treatment train expansion was determined during Phase 3 of the ESR Addendum.

The following subsections summarize the selection process for the preferred design concepts of the liquid treatment train. For further details, refer to Appendix H: TM – WPCP Liquid Train Alternatives.

7.3.2.1 Liquid Treatment Train (2010 Class EA)

As previously noted, previous work completed during the 2010 Class EA process still holds significant value, and therefore, this work has been considered and carried forward as part of the ESR Addendum where appropriate. As such, a review of Technical Memorandum No. 6 – Alternative Design Concepts (XCG/JLR 2010) was undertaken as part of the ESR Addendum and the following items from the 2010 Class EA have been carried forward and modified based on the updated conceptual level design basis.

- A condition assessment and hydraulic evaluation of the liquid channels should be considered during preliminary design.

- Upgrades to the secondary treatment process considered different types of aerated biological processes (i.e., suspended growth and attached growth treatment processes) including conventional activated sludge (CAS); moving bed biofilm reactor (MBBR); integrated fixed-film / activated sludge (IFAS); membrane bioreactor (MBR); sequencing batch reactor (SBR); and rotating biological contactor (RBC). The SBR and RBC processes were screened out during the preliminary assessment, and from the remaining three alternatives, the results of the analysis and evaluation identified CAS (with and/or without co-thickening) as the preferred design concept for secondary treatment upgrades at the WPCP.

- Upgrades to the phosphorous removal system were proposed, including upgrades to existing chemical metering and storage system and installation of a pre-precipitation alum addition point upstream of the primary clarifiers. The Kemptville WPCP is currently capable of dosing downstream of the aeration tanks and downstream of the secondary clarifiers.

- A major expansion to the existing filtration system was identified based on the projected PIF and estimated peak loading rate, including new filters and an expansion to the existing filter building and/or the construction of a new building.

7.3.2.2 Primary and Secondary Treatment Process

Although there has been a change in the design basis since the 2010 Class EA, these changes do not significantly alter the relative evaluation of the primary and secondary treatment technologies previously considered.

Activated sludge with ballasted mixed liquor, a secondary treatment technology that was not considered during the 2010 Class EA, was also reviewed as part of the ESR Addendum. The Municipality retained XCG in 2013 to undertake a pilot full-scale demonstration of the BioMag™ system and assess the feasibility of converting the existing secondary treatment process to a BioMag™ treatment process. Although the demonstration determined that the BioMag™ treatment process was a technically feasible option to increase the secondary treatment capacity at the WPCP, there were various drawbacks. As such, this technology was removed from further consideration as part of the ESR Addendum.

No change to the preferred primary and secondary treatment technology identified in the 2010 Class EA is proposed as part of the ESR Addendum. The preferred design concept for the primary and secondary treatment trains is to consist of CAS with and without co-thickening of WAS in the primary clarifiers. Thickening was also further reviewed as part of TM – WPCP Solids Train Alternatives. Based on the review, it was determined that thickening is not expected to result in a significant reduction in the capacity of the primary digesters required and maintaining the practice of co-thickening is compatible with the existing system. As such, co-thickening was used for the development of conceptual level design.

7.3.2.3 Liquid Treatment Train Design Concepts – Equalization Storage

Two design concepts for equalization storage were assessed based on a conceptual storage volume of 10,000 m^3 for the 20-year period. The two design concepts that were considered consisted of a pond type equalization storage basin and equalization storage tanks. Table 15 summarizes the equalization storage design concepts evaluated.

Table 15: Equalization Storage Design Concept Alternatives

Description	Comments
Design Concept Alternative 1: Equalization Storage Tank	
• Two glass fused to steel bolted storage tanks downstream of preliminary treatment • Each tank would have an effective volume of 5,000 m^3 • Low-lift pumping system at the WPCP to pump excess flow above the design MDF to the equalization storage tank • Overflow structure downstream of the screening and grit removal where the excess flow would discharge into a tank prior to pumping • When flows drop below the design MDF, the equalized flow would be directed back to the primary clarifiers (either by gravity or low lift pumping)	**Advantages vs. Basins** • Greater ability for odour control • Limits mechanical components to impacts from environmental conditions • Lower footprint • Lower operations and maintenance costs **Disadvantages vs. Basins** • Potentially higher capital costs
Design Concept Alternative 2: Equalization Storage Basins	
• 2-cell pond type storage facility downstream of preliminary treatment • Each cell would have an effective volume of 5,000 m^3 • A storage facility lined with geomembrane and constructed with low permeability soil berms around each storage cell was considered • Overflow structure downstream of the screening and grit removal where the excess flow would discharge into a basin prior to pumping • Constructed at an elevation with berms above grade to permit the wastewater to flow by gravity back to the WPCP upstream of the primary clarifiers	**Advantages vs. Tanks** • Greater ability for expansion (if land is available) • Potentially lower capital costs **Disadvantages vs. Tanks** • Higher operation costs due to year-round aeration • Minimum operational levels for aeration equipment • Increased difficulty in controlling odours

The equalization storage design concepts were evaluated based on the following criteria:

- Impact to groundwater or surface waters;
- Disruption of terrestrial features;
- Disruption of adjacent residential, community and recreational features;
- Constructability;
- Performance and experience in similar climates and sizes;
- Operational complexity/familiarity of Operations staff with process;
- Capital and operational costs; and,
- Ability to accommodate future expansion on existing site.

Based on the evaluation, the preferred alternative is the Design Concept Alternative 1: Equalization Storage Tanks. This is mainly due to smaller overall footprint, lower risk of odour control, and lower operational costs.

The potential for phasing of the equalization storage was also considered. It was noted that further review of equalization storage phasing should be completed during preliminary and detailed design. For the purpose of this ESR Addendum, the overall preferred design concept is to provide the full 20-year conceptual equalization storage volume during the expansion to the WPCP.

7.3.2.4 Liquid Treatment Train Design Concepts – Headworks

It was determined that expanding the WPCP headworks to include septage receiving, provisions for odour control, provisions for rerouting to equalization storage, and screening and grit removal upgrades were part of the preferred solution. Alternative design concepts for the screening and grit removal systems, as well as alternative locations for a new Headworks Building were considered.

Evaluation of Screening Design Concepts

Screening is used to remove larger material from the incoming waste stream. Screenings material can be a maintenance issue due to its tendency to float, recombine downstream, collect on submerged components, and form blockages in pumps and other equipment such as nozzles. Additionally, screenings material discharged in the plant effluent and/or biosolids is aesthetically not acceptable. The screening design concepts that were considered for this assessment were:

- Upgrading the existing equipment with similar type screening rotating drums and grinder;
- Upgrading the existing screening equipment with a mechanical bar screen type system.

Table 16 summarizes the screening design concept alternatives evaluated.

Table 16: Screening Design Concept Alternatives

Description	Comments
Design Concept Alternative 1: Upgrade with Similar Screening System (Grinder)	
The existing primary screen system consists of dual rotating perforated drums and an Auger Monster® system that grinds and removes solids with an enclosed auger and discharges solids into a waste bin for disposal at an approved landfill. • New screening channel and similar type rotating drums and grinder system with a manual bar screen	• Common practice is to place the equipment downstream of grit removal to protect the cutters from damage caused by grit. • Operations staff have noted difficulties with the operation of the existing headworks facility due to the high wear experienced on the cutters of the channel grinder. • It is expected that influent grit loadings will increase as a result of the Northwest Quadrant Pump Station's self-cleaning design and as a result of septage receiving.
Design Concept Alternative 2: Upgrade with a Mechanical Bar Screen System	
Mechanical screens with automatic cleaning mechanisms driven by small electric motors. Screen size should be reviewed during preliminary design. • New screening channel in new headworks building with a new mechanical bar screen system (two screens – one duty and one standby)	• Most common form of wastewater screening. • Based on experience with other wastewater treatment plants in Ontario, mechanical bar screens are an effective and reliable method to remove screening materials prior to grit removal. • Limit the amount of manual cleaning required by operations staff.

Experience with the grinder type screening system at the Kemptville WPCP has resulted in additional operational maintenance and replacement of components due to excessive wear. Therefore, since mechanical bar screens have been successful in other plants, and the overall cost of both alternatives is expected to be similar, a new mechanical bar screen system was selected as the preferred alternative. Screen opening size should be reviewed during preliminary design.

Evaluation of Grit Removal Design Concepts

Using a design basis peak flow of 435.2 L/s, which considered future buildout flows and is equal to the existing rated capacity of the screening channel at the WPCP, the screening design concepts that were considered for this assessment were:

- Maintaining the existing grit channels for grit removal and add an additional channel to increase capacity;
- Upgrading the existing grit removal system with aerated grit tanks;
- Upgrading the existing grit removal system with vortex grit chambers.

Table 17 summarizes the grit removal design concept alternatives evaluated.

Table 17: Grit Removal Design Concept Alternatives

<table>
<tr><th>Description</th><th>Comments</th></tr>
<tr><td colspan="2">Design Concept Alternative 1: Maintain the Existing Grit Channels</td></tr>
<tr><td>The existing rectangular horizontal-flow grit channels are designed to maintain a flow through velocity to carry organic particles through the chamber and to provide sufficient time for grit particles to settle.

• Maintain the existing channel and provide odour control, aeration and mechanical cleaning
• Additional channel to increase treatment capacity</td><td>Disadvantages:
• Difficulty in maintaining a velocity of 0.3 m/s over a wide range of flows
• Excessive wear of mechanical cleaning equipment (if used)
• Potential issues removing excessive organics causing odours and requiring additional washing
• High head losses
• Possible re-suspension of grit during high flows</td></tr>
<tr><td colspan="2">Note: Based on the necessity to modify these channels to provide odour control, aeration and mechanical cleaning, and the opportunity to take advantage of the hydraulics associated with the existing raw sewage pumping systems, this alternative was not considered for further evaluation.</td></tr>
<tr><td colspan="2">Design Concept Alternative 2: Upgrade with Aerated Grit Tanks</td></tr>
<tr><td>Air (quantity is adjustable) is provided to form a spiral pattern in a tank which helps wash the grit from organic material.

• Two aerated grit tanks sized to meet a peak flow of 435.2 L/s (future buildout)</td><td>• Common for plants of similar size
• Considered suitable for CAS
• Variety of grit removal mechanisms (chain-and-bucket conveyors, screw conveyors, jet pumps or air lifts)
• Higher annual operational cost and higher capital cost compared to vortex grit chambers</td></tr>
<tr><td colspan="2">Design Concept Alternative 3: Upgrade with Vortex Grit Tanks</td></tr>
<tr><td>Vortex grit tanks use a vortex flow pattern to separate grit from wastewater.

• Two vortex grit tanks sized to meet a peak flow of 435.2 L/s (future buildout)
• For the purpose of this ESR Addendum, a rotating-paddle type vortex mixer was used</td><td>• Smaller footprint (estimated as four times smaller) than the aerated grit tanks
• Odour generation is reduced due to no aeration and because the chambers can be designed to remove grit from the bottom of the hopper in an enclosed system
• More effective at grit removal at smaller particle sizing
• No additional energy requirements to keep organics suspended
• Relatively lower operational and capital costs</td></tr>
</table>

Based on the above, the preferred alternative for grit removal at the Kemptville WPCP as part of the ESR Addendum is the vortex grit chambers. Further evaluation of the hydraulics associated with the vortex grit system, including the type of mixing to be used, should be completed during preliminary design.

Overall Preferred Headworks Design Concept

For the purpose of the ESR Addendum, the following conceptual design for preliminary treatment and control of equalization storage is proposed:

- A new headworks/equalization pumping facility would be required to house the screening equipment, grit removal equipment, pumping system, and odour control unit. Two alternative locations have been identified for the new headworks facility; one adjacent to the existing headworks facility and the other adjacent to the new equalization storage facility. The location of the headworks building is to be selected during preliminary design based on further refined building dimensions, equipment and hydraulics review. Refer to Table 18 for a review of each location and Figure 7 to view the alternative locations considered.

- The receiving basin and equalization control wet wells would be located adjacent to this facility.

- A septage receiving unloading area would be located in proximity to the new facility.

- Existing raw wastewater forcemains would be redirected to the inlet of the new receiving basins and flow through a mechanical screen prior to the grit removal system.

- A manual bypass screen would also be available for bypassing two mechanical screens during maintenance.

- Following the grit chambers, the flow would enter an equalization flow control structure that would allow up to 15,000 m^3/d of preliminary treated wastewater to flow to the existing primary treatment tanks. Flow in excess of 15,000 m^3/d would be diverted to an equalization wet well, which would then be pumped to the equalization storage facility.

- Following a peak event, controlled flow from the equalization storage facility would be discharged to the primary treatment tanks (either by gravity or low lift pumping).

- If the existing grit channels are to be reused, modifications (e.g. aeration) to these channels would be required for odour control.

Table 18: Alternative Locations for the Headworks Building

Description
Location 1: New Headworks Building Adjacent to the Existing Headworks Facility
The northwest portion of the existing WPCP site is currently used for parking and preliminary treatment. Space is limited in this area due to the existing treeline and existing influent screening channels. Locating a new building in this area could pose difficulties depending on the overall building size required. Nevertheless, all existing forcemains currently outlet at this location, and therefore, locating the headworks building in an alternate location may require additional pumping. The constructability of a headworks building at this location should be further reviewed during preliminary design once the sizing of various components are refined. It is noted that if the undeveloped area adjacent to the WPCP and Kemptville Creek requires expanding, an Environmental Impact Study (EIS) would likely be required based on the meeting held with the RVCA during the ESR Addendum.
Location 2: New Headworks Building Adjacent to the New Equalization Storage Facility
An alternate location for the headworks building would be across the existing access road west of the existing WPCP. This area is owned by the Municipality and will be impacted by the construction of the new equalization storage facility; therefore, additional disturbance would be minimal. This area is not limited by space and would permit construction to proceed without being constrained by the on-going operations of the WPCP. Modifications to the existing forcemains would be required, and any changes in head loss through these forcemains would need to be reviewed. Based on the existing location of the Bridge Street PS forcemain, it is anticipated that rerouting of the forcemain or additional pumping of this flow could be required depending on the elevation of the receiving basin. Further review of hydraulics will be required during preliminary design to determine if additional pumping is required.

7.3.2.5 Liquid Treatment Train Design Concepts – Primary Treatment

The treatment capacity of the primary clarifiers is impacted by the method used to thicken WAS. The primary clarifiers are currently used for co-thickening WAS, and therefore, this practice is compatible with the existing system. Although, the primary clarifiers could accommodate higher average day and maximum day surface overflow rates (SORs) by eliminating this practice, a separate thickening process would need to be constructed for WAS prior to its conveyance to the digestion process. As previously indicated, sludge thickening prior to digestion was reviewed as part of TM – WPCP Solids Train Alternatives, and it was determined that the alternatives to co-thickening are not expected to result in a significant reduction in the capacity of the primary digesters required. As such, conceptual upgrade requirements to meet the 20-year design basis were determined based on typical design guideline values with WAS co-thickening and are presented in Table 19.

Table 19: Primary Design Requirements with Co-Thickening

Parameter	Design Requirement	Typical Design Guidelines
With Co-Thickening		
Number of Existing Primary Clarifiers	2	n/a
Number of New Primary Clarifiers	1	n/a
Total Clarifier Surface Area (m^2)	289.5	n/a
ADF (m^3/d)	5,000	n/a
MDF (m^3/d)	15,000	n/a
WAS Flow Rate (m^3/d)	2,500(2)	n/a
Average Daily SOR ($m^3/(m^2 \cdot d)$)	25.9	25 – 30 (1)
Peak Daily SOR ($m^3/(m^2 \cdot d)$)	60.4	50 – 60 (1)

Notes:
1. MOE Guidelines (2008). Average and peak daily SOR value based on primary clarifiers receiving WAS for co-thickening.
2. Assumed equal to a RAS flowrate using a return sludge mass concentration of 9,000 mg/L.

7.3.2.6 Liquid Treatment Train Design Concepts – Secondary Treatment

Currently, primary effluent is conveyed through two rectangular aeration tanks equipped with fine bubble diffusers. From the aeration tanks, the wastewater flows through a 750 mm wide channel that is split to distribute flow to the secondary settling tanks complete with chain and flight sludge collection systems and two activated sludge pumping systems for returning activated sludge to each aeration tank and wasting WAS to the primary clarifier for co-thickening.

The following tables identify the upgrade requirements for the conventional activated sludge process to meet the 20-year design basis based on typical design guideline values.

Table 20: Aeration Tank Requirements and Design Parameters

Parameter	Design Requirement	Typical Design Guidelines
Number of Existing Aeration Tanks	2	n/a
Number of New Aeration Tanks	1	n/a
Total Aeration Tank Volume (m^3)	2,772.9	n/a
ADF (m^3/d)	5,000	n/a
Operating MLSS (mg/L)	3,000	3,000 – 5,000(1)(2)

Parameter	Design Requirement	Typical Design Guidelines
Estimated MLVSS:MLSS Ratio	0.7(3)	n/a
HRT (hrs)	13.3	>6(1) 15(2)
F/Mv (kg BOD/(kg MLVSS·d))	0.10(4)	0.05 – 0.25(1) 0.05 – 0.15(2)
OLR (kg BOD/(m^3/d))	0.21(4)	0.31 – 0.72(1) 0.17 – 0.24(2)
RAS Flow (m^3/d)	Up to 5,000(6)	50 – 200(1) %Q_{AVG}
SRT (days)	11.2	>10(1) >15(2)

Notes:
1. MOE Guidelines (2008). Aeration design parameter for CAS with nitrification.
2. MOE Guidelines (2008). Aeration design parameter for CAS with extended aeration.
3. Based on ratio used for 2010 Class EA and typical value.
4. F/Mv and OLR based on design BOD_5 loading, assuming 35% removal of BOD_5 in the primary clarifiers.
5. Metcalf & Eddy, 2003.
6. RAS design limited to 100% Q_{AVG}.

Table 21: Secondary Clarifier Requirements and Design Parameters

Parameter	Design Requirement	Typical Design Guidelines
Number of Existing Secondary Clarifiers	2	n/a
Number of New Secondary Clarifiers	1	n/a
Total Surface Area of Clarifiers	580.5	n/a
PHF(1) (m^3/d)	15,000	n/a
MDF (m^3/d)	15,000	n/a
RAS Flow Rate (m^3/d)	Up to 5,000(3)	50 – 200(2) %Q_{AVG}
Peak Hourly SOR (m^3/(m^2·d))	34.4	<37(2)
Peak Daily SLR (kg/(m^2·d))	103.4	<170(2)

Notes:
1. The PHF is attenuated using influent equalization storage to 15,000 m^3/d.
2. MOE Guidelines (2008). Peak hourly flow SOR and design peak daily SLR values based on an activated sludge process with single-stage nitrification and chemical addition for phosphorous removal.
3. RAS design limited to 100% Q_{AVG}.

7.3.2.7 Liquid Treatment Train Design Concepts – Other

Phosphorous Removal Design Concepts

The existing WPCP is currently setup with dosing points located upstream of the primary clarifiers (Primary Precipitation), downstream of the aeration tanks (Simultaneous Precipitation), and downstream of the secondary clarifiers prior to filtration (Post-Precipitation).

- Alum addition upstream of the primary clarifiers is not currently practiced by the Municipality. It is noted that for the ESR Addendum, sludge production and process capacities for the primary and secondary treatment processes have been reviewed based on alum addition for Simultaneous Precipitation and Post-Precipitation as currently practiced at the WPCP. Modifying the approach and dosing prior to primary clarification could increase the sludge produced and affect thickening prior to digestion. A separate evaluation of the impact of Primary Precipitation should be undertaken prior to modifying current dosing.

- Upgrades to the existing chemical pumping, metering and storage system were identified to be reviewed during preliminary design based on increased design capacity and the condition assessment of the chemical system components.

- Upgrades to the flash mix tank prior to filtration to maintain a minimum detention time of 30 seconds at peak flow were also identified to be considered.

Tertiary Treatment Design Concepts

The existing tertiary treatment system is provided by two continuous backwash travelling bridge filters; each filter has a surface area of 32 m^2. These filters were designed for a peak flow capacity of 11,370 m^3/d and a maximum solids loading rate of 113.3 g/($m^2 \cdot h$).

The filtration upgrade requirements to meet the 20-year design basis were determined based on typical design guideline values.

Table 22: Filtration Requirements and Design Parameters

Parameter	Design Requirement	Typical Design Guidelines
Number of Existing Filters	2	n/a
Number of New Filters	1	n/a
Total Surface Area (m^2)	96	One filter out of service(4)
PIF(1) (m^3/d)	15,000	n/a
Peak Filtration Rate (3) (m/h)	7.2	7.56 (2)
Estimated Peak SLR(5) ($g/(m^2 \cdot h)$)	130.2	183.6(2)

Notes:
1. The PIF is attenuated using influent equalization storage to 15,000 m^3/d.
2. MOE Guidelines (2008). For shallow bed filters.
3. A 10% allowance for backwashing has been included for filter backwash flows (16,500 m^3/d).
4. MOE Guidelines (2008) indicate that the filtration rate should be calculated based on the total filter area with one filter out of service; however, since equalization storage is provided it has been assumed that during backwashing, flows to the WPCP will be controlled to maintain a maximum filtration rate of 7.6 m/h based on one filter out of service.
5. Using a conservative secondary effluent TSS concentration of 20 mg/L.

Disinfection Design Concepts

Based on the attenuated PIF of 15,000 m^3/d, the new units to be installed by the Municipality as part of a separate project were determined to be adequate for the projected 20-year design period.

Emergency Bypass to Kemptville Creek

Provisions for an emergency bypass of disinfected tertiary treated flow from the WPCP to Kemptville Creek should be considered as part of the upgrades to limit potential flooding of the plant in the event of failure of the effluent pumping system. The provision of an emergency bypass to Kemptville Creek should be discussed further with the MECP during preliminary design prior to an application to amend the current ECA. The construction of an emergency bypass pipe to Kemptville Creek would likely require an EIS to be completed in consultation with the RVCA.

Effluent Pumping Design Concepts

It was determined that additional pumping will need to be provided in order to increase the firm capacity of the effluent pumping system to 15,000 m^3/d. This could potentially be accomplished by replacing the pumps with higher capacity pumps or by adding additional pumps to provide increased firm capacity; this should be further reviewed during preliminary design.

Effluent Infrastructure Design Concepts

Based on the theoretical review, no modifications are required with a maximum pumped flow of 15,000 m^3/d to the effluent forcemain and/or effluent gravity sewer. However, as the pumping system is to be upgraded to increase its firm capacity, a more detailed analysis should be undertaken during preliminary design. Converting transition chamber to a pressurized Air Release/Vacuum relief chamber by capping the open connection should be further reviewed and considered based on pump upgrades.

In order to minimize headloss through the diffusers which would limit the flow within the effluent sewer, all diffuser ports should be opened at the maximum flow of 15,000 m^3/d.

7.3.3 TM No. 2 – WPCP Solids Train Alternatives

An updated preferred alternative design concept for the WPCP's solids treatment train was determined during Phase 3 of the ESR Addendum.

The following subsections summarize the selection process for the preferred design concepts. For further details, refer to Appendix I: TM – WPCP Solids Train Alternatives.

7.3.3.1 Overview of Current Solid Treatment Train and Operational Constraints

The solids treatment train, generally consists of the following:

- **Grit and Screening:** Screenings are removed during preliminary treatment with a mechanically cleaned mechanical screen/grinder consisting of a channel grinder followed by an auger. Grit is removed via two horizontal flow grit channels. Screenings and grit are hauled off site for final disposal.

- **Primary Treatment Sludge:** Sludge is collected from the primary clarifiers via a chain and flight collection system. The primary clarifiers are also used for co-thickening waste activated sludge (WAS). The primary clarifiers are both equipped with a raw sludge pump to pump from a sludge hopper to the primary digester. Each pump has a rated capacity of 6.3 L/s (544 m^3/d). The primary treatment system is also equipped with one scum pump that discharges to the primary digester.

- **Secondary Treatment Sludge:** Sludge is collected from the secondary settling tanks via a chain and flight collection system. The secondary clarifiers are equipped with a total of three activated sludge return pumps for returning activated sludge to each aeration tank and wasting WAS to the primary clarifier for co-thickening. Each pump has a rated capacity of 26.2 L/s (2,264 m^3/d). The secondary treatment system is also equipped with scum collection mechanisms; collected scum is pumped to the primary digester.

- **Digestion and Biosolids Storage:** Co-thickened sludge from the primary clarifiers is stabilized in a 309 m^3 primary digester complete with linear motion mechanical mixer. A 1,882 m^3 secondary digester complete with supernatant return piping to the headworks is also used for biosolids storage. A digester gallery is located between both digesters, and houses two primary digester recirculation pumps, two secondary sludge transfer pumps and a sludge heat exchanger on the basement level. Average total sludge flow in 2016 was approximately 12.4 m^3/d. The Municipality has noted that the biosolids concentration from the digesters has a solids content of approximately 3.5%.

- **Biosolids Disposal:** Biosolids are hauled twice annually during the fall/spring and land applied.

There is currently no sludge or biosolids dewatering at the WPCP. Thickening is limited to co-thickening the WAS in the primary clarifiers with the primary sludge.

The following previously identified constraints associated with the Kemptville WPCP solid treatment train form the objectives for identifying and evaluating various concepts to improve sludge and biosolids management at the WPCP:

1. **Biosolids Management**: The current biosolids management practice is to haul liquid biosolids offsite twice per year in the fall and spring. Liquid biosolids are currently stored within the secondary digester at the WPCP. The Municipality has noted a preference to continue to utilize land application as the primary method of biosolids disposal. No opportunity to increase hauling of biosolids has been identified, and therefore, biosolids (either liquid or cake) storage of 180 days is needed to maintain hauling at twice per year.

2. **Septage Receiving:** Currently, the WPCP does not receive septage. Septage will increase sludge generation at the WPCP. Upgrades to the primary digesters and biosolids will be required to accommodate septage.

7.3.3.2 Solid Treatment Train – Sludge Stabilization (2010 Class EA)

A review of Technical Memorandum No. 6 – Alternative Design Concepts (XCG/JLR 2010) was undertaken as part of the ESR Addendum and the following items from the 2010 Class EA have been carried forward and modified based on the updated conceptual level design basis.

- Maintaining the mesophilic anaerobic digestion process was noted to be very compatible with the existing infrastructure. Operations staff are familiar with this process and anaerobic digestion is a proven technology that is commonly used in the activated sludge process, which generates both primary and secondary waste.

- Temperature phased anaerobic digestion (TPAD) was also considered which consists of a first phase thermophilic digestion with higher temperature (e.g. 55 ºC), followed by a second phase mesophilic digestion (e.g. 35ºC). A third phase would involve a digester for sludge settling, thickening, cooling, storage and decanting. This process can provide an increase in pathogen destruction and it was noted that if USEPA Class ‘A’ biosolids criteria was adopted in the future, modifications to mesophilic anaerobic digestion could be required to meet higher levels of stabilization.

- The preferred solution identified a new primary anaerobic digester to operate in parallel with the existing primary anaerobic digester. Both mesophilic and thermophilic type digesters were identified as feasible options for implementation at the WPCP. It was also noted that a mesophilic anaerobic digester could be designed with provisions to allow the new digester to be converted to higher thermophilic temperature in the future, if required.

The preliminary preferred design concept for sludge stabilization during the 2010 Class EA consisted of adding one new primary anaerobic digester and new/additional liquid biosolids storage and biosolids management strategies. Although there has been a change in the design basis since the 2010 Class EA, these changes did not alter the type of stabilization carried forward as part of the ESR Addendum.

7.3.3.3 Solid Treatment Train Design Concepts – Sludge Thickening

The following thickening technologies were considered for implementation at the Kemptville WPCP to reduce hydraulic loading on the digesters, refer to Appendix I: TM – Solids Train Alternatives for a description of each thickening technology.

- Co-thickening
- Gravity thickening
- Gravity belt thickeners
- Rotating drum thickeners
- Dissolved air flotation
- Thickening centrifuges

Upon review of the thickening technologies, it was determined that additional thickening relative to co-thickening is not expected to result in a significant reduction in the capacity of the primary digesters required. This is due to an expected increase in volatile solids loadings which would necessitate an increase in digester volume. Given this information, and given that maintaining the practice of co-thickening is compatible with the existing system, co-thickening was used for the development of conceptual level design.

7.3.3.4 Solid Treatment Train Design Concepts – Stabilization

As previously noted, the type of stabilization to be carried forward as part of the ESR Addendum is mesophilic anaerobic digestion with provisions to allow the new digester to be converted to higher thermophilic temperatures in the future, if required. It was noted that increasing capacity of the current system would involve expanding the existing digestion process by providing additional digester tankage, as well as upgrading the existing process as required. Furthermore, additional tankage for the biosolids storage or, alternatively, providing sludge dewatering and a new cake storage facility, would be needed.

It was determined that upgrading the existing anaerobic digestion process would consist of expanding the existing mesophilic anaerobic digestion process by:

- Operating the existing primary digester;
- Constructing a new primary digester to increase digestion capacity;
- Continued operation of the secondary digester as a digested sludge storage tank; and
- Providing additional biosolids storage.

Primary Digester Design Concepts

For the purpose of updating the sludge stabilization design concept, the following assumptions were made:

- The design of the sludge stabilization system was based on the design maximum month sludge generation rate as identified in Section 7.3.1.
- All process equipment/tankage would be located on the existing site.

Table 23 presents the primary digester tankage requirements for sludge stabilization. Operating parameter values are also shown, along with typical design guideline values.

Table 23: Conceptual Level Design Requirements – Mesophilic Anaerobic Digestion

Parameter	Design Value	Typical Design Guidelines[(1)]
Number of Existing Primary Digesters	1	n/a
Volume of Existing Primary Digesters	309 m^3	n/a
Number of New Primary Digesters	1	n/a
Volume of New Primary Digesters	542 m^3	n/a
Total Primary Digester Volume[(2)]	851 m^3	n/a
Average Sludge Feed		
VS Loading	927 kg/d	n/a
Volumetric Loading	43 m^3/d	n/a
Maximum Month Sludge Feed		
VS Loading	1,215 kg/d	n/a
Volumetric Loading [(2)]	57 m^3/d	n/a
Primary Digester		
Average VS Loading	1.09	n/a
Maximum Month VS Loading [(2)]	1.43	<1.6 kg/($m^3 \cdot$d)
Primary Digester Maximum Month HRT	15	>15

Notes:
n/a – not applicable
1. Typical values based on MOE (2008).
2. Design values based on a maximum month co-thickened sludge generation rate of 1,736 kg/d, a VS:TS ratio of 0.7, design TS concentration of 3%, sludge specific gravity of 1.02 and HRT of 15 days.

Based on the conceptual design sludge generation rates and as indicated in the above table, a new digester with a minimum operating volume of 542 m^3 would need to be provided. The following items were noted:

- The primary digester volume should be further reviewed during preliminary design.
- Consideration should also be given during preliminary design to retrofitting the existing primary digester, such that it could be operated in TPAD mode in the future.
- Modifications to sludge piping would be required to allow the effluent from the existing primary digester to be directed to the new digester and/or the secondary digester.
- The feasibility of implementing the retrofits to the existing primary digester should be reviewed during preliminary design.
- Operating in TPAD mode would have an impact on the design of the digestion system, and as such, if the Municipality selects to proceed with TPAD mode, the design requirements should be revisited during preliminary design.

Biosolids Management/Storage Design Concepts
For the purpose of evaluating the biosolids storage alternatives, the following assumptions were made:

- Biosolids storage design concepts were based on providing 180 days of biosolids storage based on the biosolids generation rates identified in Section 7.3.1.
- Liquid biosolids process equipment/tankage would be located on the existing site.
- Dewatering building and storage facility would be located west of the WPCP on the west side of the existing access road (part of an area currently leased to the Ferguson Forestry Centre.

The following tables identify the conceptual design requirements for liquid and cake biosolids storage:

Table 24: Conceptual Level Design Requirements – Liquid Biosolids Storage (Alternative 1)

Parameter	Alternative 1 – Liquid Biosolids Storage
Number of Existing Secondary Digesters	1
Volume of Existing Secondary Digesters	1,882 m^3
Number of New Secondary Digesters	1
Volume of New Secondary Digesters	**2,258 m^3**
Total Secondary Digester Volume (1)	4,140 m^3

Notes:
1. Based on volumetric loading of 23 m^3/d and liquid biosolids dry solids concentration of 3.5% and specific gravity of 1.02.

Table 25: Conceptual Level Design Requirements – Biosolids Cake Storage (Alternative 2)

Parameter	Alternative 2 – Biosolids Cake Storage
Number of Existing Secondary Digesters	1
Volume of Existing Secondary Digesters	1,882 m^3
Estimated Existing Liquid Biosolids Storage (1)	81.8 days
Additional Storage Days Required	98.2 days
Biosolids Cake Volume Generation (2)	4.1 m^3/d
Estimated Minimum Cake Storage Requirements(3)	**738 m^3**

Notes:
1. Based on volumetric loading of 23 m^3/d and liquid biosolids dry solids concentration of 3.5% and specific gravity of 1.02.
2. Based on biosolids mass of 815 kg/d and typical dewatered biosolids dry solids concentration of 20% TS (MOE 2008).
3. Based on 180 days of biosolids cake storage, hauling biosolids cake twice per year.

It was noted that dewatering to produce a biosolids cake would be required with Alternative 2. Different types of dewatering technologies are available for cake dewatering and are expected to result in sludge solids concentrations of 20% or more:

- Centrifuge

- Belt filter press
- Plate press
- Geotube®

It was also noted that, due to the availability of liquid biosolids storage at the Kemptville WPCP, the capacity of the dewatering system could be selected to operate intermittently during regular operator working hours.

The production of a dewatered cake will reduce hauling requirements due to the volume of biosolids to be handled. The current land applier used by the Municipality has the ability to handle both liquid and biosolids cake.

Based on the reduced footprint requirements, the reduced transportation costs, and the increased ability to store the material at the farm(s) prior to land application, Alternative 2 – Biosolids Cake Storage has been identified as the preferred design concept for expanding biosolids storage at the WPCP.

In reviewing the dewatering technologies identified above, the Geotube® technology has been determined to be the preferred dewatering technology as it is relatively simple to operate, easily expandable, land is available to the Municipality for storage, operational costs are relatively low, biosolids produced at other facilities with Geotube® have been land applied (e.g. Eganville), and it requires less maintenance than the equipment needed for the other dewatering technologies considered.

It is conceptually envisioned that liquid biosolids would be pumped from the secondary digester to the Geotubes® at a dewatering storage area located west of the existing WPCP near or adjacent to the new headworks and equalization storage area. Dewatering cells (either concrete storage pads or other storage area with perimeter containment berms) would be provided to contain the Geotubes® and polymer would be added as needed. Filtrate would be collected in a holding tank and recirculated to the head of the WPCP. If winter dewatering is needed, a building would be required to house a Geotube®. It is noted that since there is secondary digestion storage available, optimizing the size of the building should be considered coupled with storing biosolids within the secondary digester during winter months. Phasing of storage should be considered during preliminary design such as deferring the requirement for winter dewatering and building requirements.

The storage requirements should also be further assessed during preliminary design to optimize the size of the biosolids storage and hauling requirements.

7.4 Odour Control Provisions

Odour control measures to minimize the impact on residents within the proximity to the Kemptville WPCP will be incorporated into the design of the new facility upgrades. Although there is a buffer distance from sensitive receptors, a proactive approach of preventative measures for potential odours, and treatment for known odour sources is recommended. Recommendations include the following:

- ongoing housekeeping and cleaning;
- documentation and investigation of complaints;

- in-house odour surveys to establish approximate impact of varying conditions such as operations and/or weather dispersion modeling during the preliminary design phase to further quantify risks;
- provide odour treatment for exhaust streams from the Headworks Building, Equalization Tanks and the Septage Receiving Station;
- minimizing turbulence in channel upgrades;
- optimizing biosolids pumping and polymer addition for dewatering;
- scheduling odour producing maintenance activities and dewatered sludge hauling to correspond to favourable times with respect to wind direction and outdoor use of residential property.

Maintaining the recommended buffer distance will be part of the odour control strategy for new and existing works, allowing for some degree of dispersion and dilution of potential odours before reaching the surrounding residential neighbourhood. The existing primary clarifiers, aeration tanks and secondary clarifiers are currently uncovered at the WPCP. No significant odour issues have been reported for these tanks, and therefore, providing covers to these tanks is not part of the proposed upgrades. A Pre-consultation Meeting should be arranged with the MECP early during preliminary design to define MECP's expectations for this site.

7.5 Preferred Design Concept

Based on the evaluation and review of the liquid and solid treatment trains, a summary of the preferred design concept was compiled and presented in Table 26. The following figures were also created to help visualize the proposed preferred design concepts for the WPCP:

- A conceptual site layout for the preferred design concept is presented in Figure 7
- A conceptual liquid process flow schematic is presented in Figure 8
- A conceptual solid process flow schematic is presented in Figure 9

The layout and locations for the various proposed upgrades are to be further reviewed during preliminary design.

Table 26: Updated Preferred Design Concept

Process Description	Summary
Liquid Treatment Train	
Equalization Storage	• Two new equalization storage tanks (total 10,000 m^3)
Headworks	• New septage receiving truck unloading enclosure and pumping system • New headworks building complete with odour control • Two new mechanical bar screens • One new manual bar screen • Two new vortex grit chambers • Equalization control provisions
Primary Treatment	• One new primary clarifier • Two existing primary clarifiers • Co-thickening of WAS in the primary clarifiers
Secondary Treatment	Conventional activated sludge process • One new aeration tank • Two existing aeration tanks • One new secondary clarifier • Two existing secondary clarifiers
Tertiary Treatment	• One new tertiary filter • Two existing tertiary filters
Phosphorous Removal	• Upgrades to flash mix tank
Disinfection	• Existing UV disinfection system
Effluent Pumping	• Upgrades to increase firm capacity
Outfall Piping System	• Existing forcemain • Existing gravity sewer; converting transition chamber to a pressurized Air Release/Vacuum relief chamber to be considered as part of preliminary design and pump upgrades. • All existing 16 diffuser ports are to be opened for max flow.
Solid Treatment Train	
Sludge Pumping	• Upgrades to sludge pumping system as required to meet additional sludge production
Thickening	• Maintain co-thickening of primary and secondary sludge
Stabilization	• Existing mesophilic anaerobic primary digester • Modify existing digested sludge piping as needed • One new mesophilic anaerobic primary digester with future provisions considered to operate in TPAD mode
Biosolids Management/Storage	• Existing Secondary Digester • New Geotube® Dewatering Facility

7.6 Opinion of Probable Costs

An OPC with a Class ‘D’ (Indicative Estimate) level of accuracy was developed for the preferred design concept as part of the ESR Addendum and includes allowances for design elements that have not been fully developed. The OPC was developed based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers.

- The estimated costs for various items are order-of-magnitude only and are based on the experience and current (2018) unit prices in the construction industry.
- All costs, including those for future years, are expressed in 2018 dollars. If these costs are to be used for long-range cash-flow projections, the implications for potential future trends of inflation and interest must be applied accordingly.
- Conceptual level of order-of-magnitude OPC may range from ± 30%. The scope of the design upgrades are to be further refined during preliminary and detailed design; costs will vary depending on the scope considered for implementation.

The OPC for the preferred design concept is estimated at $31 M, which includes a 30% engineering and construction contingency. Refer to the below table identifying costs for various processes.

Table 27: Conceptual Level Opinion of Probable Cost

Process Description	ESR Addendum OPC[1]
Site Works and Maintenance Building	$2.8 M
Headworks and Equalization Storage	$11.3 M
Septage Receiving	$4.2 M
New Primary Clarifier	$1.0 M
New Aeration Tank	$1.6 M
New Secondary Clarifier	$1.6 M
Tertiary Filtration, Building Expansion and Effluent Pumping Upgrades	$3.5 M
Sludge Stabilization (Primary Anaerobic Digester and Control Building)	$3.2 M
Biosolids Dewatering	$1.8 M
Total Conceptual Cost	**$ 31 M**

Notes:
1. Estimated costs include a 30% engineering and construction contingency, conceptual level of order-of-magnitude OPC may range from ±30%.

7.7 Potential Staging of Conceptual Upgrades

The timing for implementation of the conceptual upgrades has been reviewed as part of the ESR Addendum. Timing depends on a number of factors such as implementation of septage receiving, population growth, development phasing, growth within existing serviced areas, rehabilitation of existing infrastructure, etc. The below table presents conceptual timelines for implementation of the various process upgrades.

It is noted that the Municipality is encouraged to continue to undertake sewer rehabilitation projects within Kemptville to further reduce I&I within the sewer system which may help to recover some treatment capacity of existing process trains at the WPCP which are limited by peak flows. Phasing of the upgrades should be further reviewed during preliminary and detailed design.

Table 28: Conceptual Timing for Process Upgrades

Process Description	Conceptual Timing [1,2,3]	Comment
Site Works – Electrical Distribution	2020 - 2023	Timing of the electrical distribution upgrades should be further reviewed based on timing of other new works; the electrical substation would need to be relocated prior to the construction of a secondary clarifier.
Headworks and Equalization Storage	2020 - 2023	Based on historical data, peak flows to the WPCP have been in some instances above the peak flow capacity of various treatment processes. Therefore, equalization storage and associated headworks upgrades would be required in the short term.
Septage Receiving	TBC	Implementation of septage receiving will impact the loading to various treatment processes downstream
New Primary Clarifier	2025 – 2028	Based on projected peak daily flows; primary sludge pumping and collection may be affected by septage receiving.
New Aeration Tank	2025 – 2028	Timing of the construction of a new aeration tank has been envisioned to coincide with the upgrades to the primary clarifiers based on possible construction efficiencies. Timing for aeration upgrades to meet design guidelines for organic loading rates which include septage are expected to be similar.
New Secondary Clarifier	2025 – 2028	Timing influenced by equalization storage and its ability to attenuate flows up to existing capacity of the secondary clarifiers (~11,550 m^3/d); Timing to coincide with the upgrades to the primary clarifiers.
Tertiary Filtration, Building Expansion and Effluent Pumping Upgrades	2025 – 2028	Timing influenced by equalization storage and its ability to attenuate flows up to existing capacity of the tertiary filters (~11,380 m^3/d); Timing to coincide with the upgrades to the primary clarifiers.

Process Description	Conceptual Timing [1,2,3]	Comment
Sludge Stabilization (Primary Anaerobic Digester and Control Building)	2020 - 2023	A new primary digester would be required in the near term based on maintaining a minimum hydraulic residence time of 15 d.
Biosolids Dewatering	2020 - 2023	Based on feedback received from the Municipality regarding the volume of biosolids hauled bi-annually, the secondary digester biosolids storage is nearing its full capacity. Therefore, additional storage will be needed in the near future.
Notes: 1. Timing associated with various process upgrades should be further reviewed during preliminary and detailed design. 2. Conceptual timing of upgrades is based on providing equalization storage and attenuating peak flows to the rated capacity of the existing treatment system (11,370 m^3/d). 3. Receiving septage at the WPCP may impact the timing associated with other processes due to the increased loadings associated with septage;		

8.0 Mitigation of Impacts

As noted previously, the 2010 Class EA represented a significant undertaking by the Municipality. Previous work completed during the 2010 Class EA process still holds significant value, which was carried forward as part of the ESR Addendum. As the proposed study area remained unchanged from the 2010 Class EA, archaeological, geotechnical, capacity, natural environment, and assimilative capacity studies that were undertaken as part of the 2010 Class EA process, were considered. For this reason, the potential environmental effects and the impact mitigation measures that were determined during the 2010 Class EA will continue to be valid following the 2019 ESR Addendum. The following table presents a partial overview of the mitigation measures identified within the 2010 Class EA and modified based on updated information received during the ESR Addendum:

Table 29: Mitigation Measures (Adapted from 2010 Class EA)

Considerations	Suggested/Representative Mitigating Measures
Terrestrial Vegetation and Wildlife	• Any work conducted within 25 m of a butternut tree is to be assessed by a species at risk specialist. • Removal of woody vegetation to be minimized as much as possible. • If vegetation is disturbed/removed, re-vegetation or compensating restoration to be provided. • Sediment and erosion control measures to be in place and maintained until re-vegetation of disturbed areas is complete. • Timing windows for tree and shrub removals to protect breeding birds should be confirmed with MNRF prior to construction. • Trees adjacent to expansion area to be protected by fencing at a recommended distance – heavy machinery/materials not permitted within fencing.

Considerations	Suggested/Representative Mitigating Measures
	• Native tree planting to replace trees that may be removed. Recommended native species include sugar maple, red maple, basswood, bur oak, red oak, tamarack, butternut, white cedar and white spruce trees, along with nannyberry, other native *Viburnums*, elderberry, and dogwood shrubs.
Fish, Aquatic Wildlife, and Vegetation	• Dewatering flows to receive proper filtering and treated water to be directed away from watercourses. • Rock check dams with filter cloth and/or straw bale carriers to be placed, as required, in swales and silt fencing properly installed and maintained. • Avoid tree removal near surface waterbodies to prevent sunlight from reaching the waters. Restoration planting to take place in the case that tree removal is required. • No in-water work is to be completed between March 15 to June 30 to prevent disturbances to fish spawning and breeding. • In disturbed areas, watercourse beds and banks are to be stabilized with clean shot rock.
Residential, Institutional, Commercial, and Industrial	• Notify public agencies and adjacent owners of construction scheduling. • Advise/distribute contact number to adjacent owners and develop protocol to document and address inquires and/or complaints. • Stage construction activities to minimize impacts. • Incorporate odour control measures identified during design phase. • Preparation of emergency programs to ensure quick resolution of possible servicing problems.
Outdoor Recreation	• Construction to be staged to minimize disruption to open space activities. • Protect or temporarily relocate existing public walking trail (Management / Turtle Trail) within and adjacent to expansion area.
Soils Geology	• Additional subsurface information will be required at the site to address specific design features as well as to characterize the hydrogeological conditions. • Erosion and sediment control measures to protect stockpiled material. • Prevent soil contamination by employing measures to avoid spills and leaks. Ensure contractor has a contingency plan prepared, and appropriate spill containment measures on-hand in the case of spills or other accidents.
Heritage Resources and Cultural Heritage Value	• A Stage 2 archaeological assessment is to be undertaken of the areas to be impacted by the planned expansion of the WPCP. • A Cultural Heritage Evaluation Report is also to be completed.
Climatic Features	• Vegetation to be retained as much as possible, and if necessary, restored promptly to prevent the reduction of windscreen effect on adjacent activities.
Public Health	• If any spill or emergency condition, provide notice and make appropriate contact with emergency services and potentially affected public and government agencies. • Good practice measures for noise, dust, odour, and emission control and minimization, to be employed during construction and operation.
Agricultural	• Continued notification and liaison with Ferguson Forestry Centre.

Considerations	Suggested/Representative Mitigating Measures
	• Locate and design facilities so as to minimize land requirements and construction disturbance.
Operational and Construction Noise	• Apply noise and vibration control measures as appropriate. • Municipal by-laws and provincial regulations for working hours and noise to be followed. • Incorporate noise reduction measures identified during design phase.
Aesthetics	• Incorporate landscaped plantings to improve site screening, as identified during design phase. • Incorporate berms and other forms of visual screening. • Blend structures in with surroundings and adjacent building forms.

It is noted that the proposed expansion area is located on municipal property, including areas adjacent to the Kemptville WPCP owned by the Municipality and leased to a private company. As noted in the 2010 Class EA, much of the study area has been disturbed previously. It is anticipated that tree removal will be required as part of the proposed expansion in the area of the proposed equalization storage and one of the alternative locations for the headworks and septage receiving facility; tree removal should be further assessed during preliminary and detailed design. Other mitigation measures identified within the Natural Environment Habitat Assessment completed as part of the 2010 Class EA should be considered. Mitigation measures and associated monitoring should be further developed as part of the design and construction phases.

Refer to the Public and Agency Consultation Summary in Appendix C for information provided by the MECP, MNRF, RVCA and other stakeholders.

9.0 Overview of Consultation Activities

Effective consultation is key to successful environmental assessment planning. Through an effective consultation program, the proponent can generate meaningful dialogue between project planners and stakeholders, including, but not limited to, the public, stakeholder agencies and interest groups.

The level of consultation largely depends on the problem or opportunity being addressed, the level of complexity, potential environmental issues and impacts, specific community characteristics and needs, available resources, and approaches used on similar studies in the community.

9.1 Previous Public and Agency Consultation (2010 Class EA)

Public and agency consultation undertaken during the 2010 Class EA ESR is summarized below:

- A Notice of Commencement was published in local newspaper(s).

- Pre-consultation and communication with the MECP, RVCA, Lower Rideau Watershed Working Group, Ferguson Forestry Centre, and other stakeholders.
- Three Public Information Centres (PIC) were held during the 2010 Class EA.
- A Notice of Completion was completed and published.

9.2 Public and Agency Consultation (2019 ESR Addendum)

As part of ESR Addendum, the consultation plan developed at the beginning of the project was followed in order to facilitate communication with the public and various agencies and other interested parties. Refer to Appendix C for the consultation plan prepared for the ESR Addendum.

9.2.1 Project Liaison Committee

At the inception of the project, a Project Liaison Committee (PLC) was established, which included representatives from the Municipality, JLR and other various interest groups when required. Meetings were held throughout the project to discuss the technical memorandums and reports as well as solicit input from RVCA; refer to Appendix C for a copy of the meeting minutes.

9.2.2 Direct Public Consultation

The public consultation program for the ESR Addendum included the following components:

Notice of Study Commencement

A Notice of Study Commencement was mailed on September 26, 2016 to advise mandatory contacts that an ESR Addendum had been initiated. The list of mandatory contacts, copies of the letters to the mandatory contacts and summaries of the responses can be found in Appendix C. The Notice of Study Commencement was also published in the North Grenville Times on November 2, 2016 and November 9, 2016 and posted on the Municipality website.

Notice of Public Information Centre

Two PICs were held during the 2019 ESR Addendum project.

The first PIC was held on December 14, 2017 at the North Grenville Municipal Centre. A Notice of Public Open House was mailed on December 7, 2017 to the mandatory review agencies as well as members of the public who attended the Public Information Centres during the 2010 Class EA and requested to be on the contact list. The Notice of Public Open House was also published in the North Grenville Times on December 7, 2017 and December 14, 2017 and posted on the Municipality website.

The second PIC is expected to be held in March 2019 at the North Grenville Municipal Centre. A Notice of Public Open House will be mailed to the mandatory review agencies as well as members of the public who attended the Public Information Centres during the 2010 Class EA and during PIC No. 1 of the ESR Addendum and requested to be on the contact list. The Notice of Public Open House will also be published in the North Grenville Times and posted on the Municipality website.

Notice of Filing of ESR Addendum

In accordance with MCEA guidelines, a Notice of Filing of Addendum will be prepared by the consulting team following preparation of the Addendum to the ESR. The Notice will be sent to all potentially affected members of the public and agencies as well as the stakeholders who were notified in the preparation of the 2010 Class EA ESR. The Notice will identify the recommended alternative, identify the location of the Addendum to the ESR for review during the 30-day review period, and provide information pertaining to Part II Order Requests, including the name and address of the Minister and Director to be contacted.

10.0 References

1. Golder Associates Ltd., Stage 1 Archaeological Assessment – Kemptville Water Pollution Control Plant – Lots 28-29, Concession 1 and Lot 28, Concession 2 – Geographic Township of Oxford – Leeds and Grenville County, Ontario, Report No. 07-1122-0348 – July 2009.

2. Gore & Storrie Limited, Corporation of the Town of Kemptville, Upgrading of Wastewater Treatment Works, Predesign Brief.

3. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Edition, 2003.

4. Ministry of the Environment, Certificate of Approval, Municipal and Private Sewage Works – Number 3916-6X9SWR.

5. Ministry of the Environment and Climate Change, Amended Environmental Compliance Approval – Number 9628-9Q4LRN, December 9, 2014.

6. Ministry of the Environment and Climate Change, D-2 Compatibility between Treatment and Sensitive Land Use, August 1996.

7. Ministry of the Environment, Design Guidelines for Sewage Works, 2008.

8. Municipal Class Environmental Assessment, Municipal Engineers Association, 2015.

9. Mississippi Valley Conservation Authority and Rideau Valley Conservation Authority, Mississippi – Rideau Source Protection Plan, Effective January 2015.

10. North Grenville, Draft – Municipality of North Grenville Official Plan, 2017.

11. Simcoe Engineering Group Limited, Feasibility Assessment for Septage Receiving at the Kemptville WPCP, Study Report, January 2006.

12. Stantec Consulting Ltd., 2015 North Grenville Potable Water and Wastewater Master Plan Update, 2016.

13. Watson & Associates Economists Ltd., Long-Term Population, Housing and Employment Forecast Report, July 2017.

14. XCG Consultants Ltd. in association with J.L. Richards & Associates Limited, Kemptville WPCP Optimization and Expansion - Class Environmental Assessment, 2010.

15. XCG Consultants Ltd., BioMag™ Process Pilot Demonstration at the Kemptville WPCP - Summary Report, 2014.

This report has been prepared for the exclusive use of Municipality of North Grenville, for the stated purpose, for the Kemptville Water Pollution Control Plant. Its discussions and conclusions are summary in nature and cannot be properly used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report was prepared for the sole benefit and use of Municipality of North Grenville and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:	Reviewed by:
LICENSED PROFESSIONAL ENGINEER J.M.C. MORRISSETTE 100151410 April 13, 2019 PROVINCE OF ONTARIO	LICENSED PROFESSIONAL ENGINEER S.J. GORE 100049941 Apr. 13/19 PROVINCE OF ONTARIO
Jordan Morrissette, P.Eng., M.Eng. Environmental Engineer	Sarah Gore, P.Eng. Executive Director Senior Environmental Engineer

Appendix A

Figures

Appendix B

Amended Environmental Compliance Approval No. 9628-9Q4LRN

Appendix C

Public and Agency Consultation Summary

Appendix D

Copy of the Municipality of North Grenville – WPCP and SPS Optimization and Expansion – Phase 2 Update Report

Appendix E

Technical Memorandum – WPCP Liquid Train Alternatives

Appendix F

Technical Memorandum – WPCP Solids Train Alternatives

Appendix G

Copy of the Kemptville WPCP Optimisation and Expansion – Class Environmental Assessment, 2010 table

www.jlrichards.ca

Ottawa

864 Lady Ellen Place
Ottawa ON Canada
K1Z 5M2
Tel: 613 728-3571

ottawa@jlrichards.ca

Kingston

203-863 Princess Street
Kingston ON Canada
K7L 5N4
Tel: 613 544-1424

kingston@jlrichards.ca

Sudbury

314 Countryside Drive
Sudbury ON Canada
P3E 6G2
Tel: 705 522-8174

sudbury@jlrichards.ca

Timmins

201-150 Algonquin Blvd. East
Timmins ON Canada
P4N 1A7
Tel: 705 360-1899
timmins@jlrichards.ca

North Bay

200-175 Progress Road
North Bay ON Canada
P1A 0B8
Tel: 705 495-7597

northbay@jlrichards.ca

Hawkesbury

326 Bertha Street
Hawkesbury ON Canada
K6A 2A8
Tel: 613 632-0287

hawkesbury@jlrichards.ca

Guelph

107-450 Speedvale Ave.
West Guelph ON Canada
N1H 7Y6
Tel: 519 763-0713

guelph@jlrichards.ca