CITY OF WINDSOR BIOSOLIDS MANAGEMENT STRATEGY - “SCHEDULE C” CLASS EA ENVIRONMENTAL STUDY REPORT

Final

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Prepared for:

City of Windsor

Prepared by:

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GENERAL

The City of Windsor owns and operate two municipal wastewater treatment plants, the Lou Romano Water Reclamation Plant (LRWRP) and the Little River Pollution Control Plant (LRPCP). The LRWRP provides secondary level treatment for municipal and industrial wastewater from the central and western portions of the City of Windsor and from the northern area of the Town of LaSalle. The plant has a rated primary treatment capacity of 273,000 m^3/d, and a rated secondary treatment capacity of 218,000 m^3/d. The liquid treatment process at the LRWRP consists of coarse and fine screening, grit removal, primary enhanced clarification, biological aerated filtration (BAF), and UV disinfection. The LRPCP provides secondary level treatment for municipal wastewater and industrial wastewater from the eastern portions of the City of Windsor and from the Town of Tecumseh. The LRPCP has a rated secondary treatment capacity of 73,000 m^3/d. The LRPCP treatment process consists of fine screening, grit removal, primary clarification, activated sludge process, secondary clarification, and UV disinfection.

The LRWRP and LRPCP produce approximately 8,500 and 2,500 dry tonnes of biosolids each year, respectively. The dewatered biosolids, which have a dry solids content of approximately 30%, are heat dried and pelletized at the City-owned Windsor Biosolids Processing Facility (WBPF). The finished pellets are used as a Class A fertilizer and soil conditioner throughout Southwestern Ontario. The servicing contract and upgrade requirements for the WBPF will be revisited by 2029 as the capacity of existing biosolids management facility is unable to accommodate projected wastewater biosolids or community growth.

To address biosolids management needs at the two wastewater treatment plants, the City initiated a study to identify the preferred means of processing biosolids. A primary goal of this study was to prioritize solutions which would move the two wastewater treatment plants towards a ‘net-zero’ energy future and improve upon energy conservation commitments outlined in the City of Windsor Corporate Energy Management Plan and Community Energy Plan. To achieve this goal, the biosolids management strategy will consider biosolids management solutions that improve energy efficiency, plan for effective land use, reduce energy consumption, limit greenhouse gas (GHG) emissions, and promote smart / green energy solutions.

This Study Report presents the completed planning and decision-making process from the identification of the opportunity and the evaluation of alternative solutions to the recommendation of the preferred solution. This is a study, which follows the Class Environmental Assessment (Class EA) process of the Municipal Engineers Association (MEA). This study report comprises **Sections 1 to 10** and **Appendices A to C,** inclusive. A brief description of each section follows.

SECTION 1 - INTRODUCTION

This section provides background information regarding the project including applicable regulatory requirements, relevant municipal planning reports, and purpose of the report as well as a description of the Class EA process. This study and the resulting Environmental Study Report (ESR) is being undertaken in accordance with the requirements of the MEA Municipal Class EA.

SECTION 2 – EXISTING WASTEWATER TREATMENT FACILITIES

This section provides a description of energy consumption, GHG emissions, and major process units at the Lou Romano Water Reclamation Plant, the Little River Pollution Control Plant, and Windsor Biosolids Processing Facility.

SECTION 3 – STUDY AREA CONDITIONS

All projects identified through the Municipal Class EA process must be evaluated based on the potential impact to the existing conditions of the study area. This section provides a general description of the existing natural environmental, social, and economic conditions in the study area as a basis for the potential impact analysis.

SECTION 4 – PROBLEM STATEMENT

This section defines the problem statement, project objective, and describes the needs for the management and processing of biosolids.

SECTION 5 - ALTERNATIVE DESIGN SOLUTIONS AND RECOMMENDATIONS

This section involves the identification of various alternative design solutions which best address the identified problem and needs based on the potential impact to the natural, social, and economic environments. The following alternative solutions have been considered and evaluated for managing and processing biosolids while moving the two wastewater treatment plants towards a "net-zero" energy future and significantly reduced GHG emissions:

1. Do Nothing
2. Waste Minimization
3. Incineration
4. Composting
5. Anaerobic Digestion

SECTION 6 – ALTERNATIVE DESIGN CONCEPTS AND RECOMMENDATIONS

This section involves the identification and evaluation of various alternative design concepts which best fulfill the identified design solution. This includes alternative design concepts for the sludge handling, pre-treatment technologies, type of anaerobic digestion, site location, digestate handling, and biogas utilization technologies.

SECTION 7 – PREFERRED DESIGN

This section outlines the preferred design as well as recommendations for project delivery method, and implementation schedule.

SECTION 8 – ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This section identifies the environmental impacts of the preferred solution and describes the recommended mitigation measures.

SECTION 9 – PUBLIC CONSULTATION

This section documents agency and public consultations that occurred during Phases 1 through 3 of the process. This section includes documentation of consultation with the public and review agencies. To complete Phase 4 of the Class EA process, this report will be made available for review and comment by the public and review agencies as a part of the consultation process.

SECTION 10 – SUMMARY

This section summarizes conclusions that can be drawn from the completion of this study, and recommendations that are made with respect to this study.

Abbreviations

Anaerobic Digestion	AD
Combined Heat and Power Generation	CHP
Corporate Climate Action Plan	CCAP
Corporate Energy Management Plan	CEMP
Community Energy Plan	CEP
Environmental Compliance Approval	ECA
Environment and Climate Change Canada	ECCC
Energy Conservation and Demand Management Plan	ECDMP
Environmental Master Plan	EMP
Essex Region Conservation Authority	ERCA
Essex-Windsor Solid Waste Authority	EWSWA
Fats, Oils and Grease	FOG
Greenhouse Gas	GHG
High Strength Organic Wastes	HSO
Reciprocating Internal Combustion Engine	IC
Industrial, Commercial, and Institutional	ICI
Little River Pollution Control Plant	LRPCP
Lou Romano Water Reclamation Plant	LRWRP
Lump Sum	LS
Mesophilic Anaerobic Digestion	MAD
Ontario Ministry of Environment Conservation and Parks	MECP
Opinion of Probable Cost	OPC
Provincial Policy Statement	PPS
Primary Sludge	PS
Renewable Natural Gas Pipeline Quality (also referred to in industry as biomethane)	RNG
Renewable Compressed Natural Gas (for vehicle fuel)	R-CNG
Source Separated Organics	SSO
Thermal Hydrolysis Process	THP
Temperature Phased Anaerobic Digestion	TPAD
Total Solids	TS
Total Suspended Solids (total solids - dissolved solids)	TSS
Ultraviolet	UV
Volatile Solids	VS
Volatile Solids Reduction	VSR
Volatile Suspended Solids	VSS
Waste Activated Sludge	WAS
Wastewater Treatment Plant	WWTP
Windsor Biosolids Processing Facility (formerly Prism Berlie)	WBPF

1.0 INTRODUCTION

1.1 BACKGROUND

1.1.1 General

The City of Windsor (City) is Canada's southernmost city with a population of 230,000 and an area of 146 km^2. The City is located on the south bank of the Detroit River directly across from Detroit, Michigan. The City owns and operates two municipal wastewater treatment plants, the Lou Romano Water Reclamation Plant (LRWRP) and the Little River Pollution Control Plant (LRPCP).

The LRWRP, formerly the West Windsor Pollution Control Plant, is located at the intersection of Ojibway Parkway and Sandwich Street in the City of Windsor. The LRWRP provides secondary level treatment for municipal and industrial wastewater from the central and western portions of the City of Windsor, the northern area of the Town of LaSalle and a portion of the Town of Tecumseh (Oldcastle). The LRWRP receives wastewater via the (1) Riverfront Interceptor Sewer, which services the core section of the City west of Pillette Road, and (2) Western-Grand Marais Sanitary Trunk Sewer, which services the existing and recently developed areas in South Windsor. The plant provides primary physical-chemical treatment for up to 273,000 m^3/d, which includes capacity for combined storm and sanitary flows. The LRWRP has a rated secondary biological treatment capacity of 218,000 m^3/d which is followed by ultraviolet (UV) disinfection.

The LRPCP is located at 9400 Little River Road in the City of Windsor. The plant serves the portion of the City of Windsor east of Pillette Road and the surrounding municipality of Tecumseh. Major unit operations at the LRPCP consists of fine bar screening, grit removal, primary enhanced clarification, conventional activated sludge with nitrification, UV disinfection, and centrifuge dewatering. The LRPCP has a rated treatment capacity of 73,000 m^3/d.

The LRWRP and LRPCP produce approximately 8,500 and 2,500 dry tonnes of biosolids each year, respectively. The dewatered biosolids, which have a dry solids content of approximately 30%, are heat dried and pelletized at the City-owned Windsor Biosolids Processing Facility (WBPF), formerly known as Prism-Berlie. The WBPF, which is located at 4365 Sandwich Street near the LRWRP is operated on behalf of the City by Synagro Technologies Inc. The finished biosolids pellets are used as a fertilizer and soil conditioner. This fertilizer is classified under Title 40 CFR, Part 503 as Class A biosolids in the USA. In Canada, the fertilizer product was registered under the federal Fertilizer Act as a farm fertilizer with trade name Eco Pearl (formerly Windsor Propell) and is sold throughout Southwestern Ontario. The servicing contract and upgrade requirements for the WBPF will be revisited by 2029 as the capacity of the existing biosolids management facility is unable to accommodate projected wastewater biosolids or community growth.

1.1.2 Biosolids Master Plan Class Environmental Assessment (1997)

Prior to the implementation of the WBPF, sludge produced at the City's two wastewater treatment facilities were transferred to the LRWRP to be disposed of by open air composting with lime stabilization and application on agricultural land. Odours emanating from the open method of stabilization and storage of the resulting biosolids created unacceptable conditions for the residential properties surrounding the LRWRP. The City of Windsor recognized the need to correct this issue and to provide an effective, environmentally friendly biosolids management system to meet the City's long-term needs. Therefore, they carried out a municipal class environmental assessment known and the 'Biosolids Master Plan' in 1996 and 1997.

The selection of a long term biosolids management system was done through a request for proposal (RFP) process. Proposals were invited through a public advertising process and evaluated by a committee formed of community representatives, environmental organizations, City administration, and an engineering consultant. The evaluation considered environmental, technical, and financial aspects of all proposals received. The proposal submitted by Prism-Berlie for a heat drying pelletization plant was recommended as the preferred alternative. The proposed drying system was a Berlie/Swiss Combi rotary drum dryer with a closed loop drying air circuit. This technology was favourable at the time due to its good track record, broad application, and consistency to provide a desirable and marketable final product. An agreement was reached between the City of Windsor and Prism-Berlie on August 11th, 1997, for a 20-year contract for biosolids management services. The proposed facility was constructed and placed into service in 1999. This agreement has since been updated and is now known as the Windsor Biosolids Processing Facility, which is operated and maintained by Synagro Technologies Inc. Synagro is responsible for the transportation and dewatering of wastewater sludge cakes from the two wastewater treatment facilities.

1.1.3 Environment and Energy Management Planning Reports

The City of Windsor has a long-standing commitment to the environment including energy management, climate change mitigation, and long-term adaptation planning. This corporate environmental commitment has been established through the development of numerous environmental plans over the past few decades, including:

1. Corporate Energy Management Plan
2. Environmental Master Plan
3. Community Energy Plan
4. Corporate Climate Action Plan
5. Climate Change Adaptation Plan

The City of Windsor Corporate Energy Management Plan (CEMP) was prepared in compliance with the Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (O. Reg. 507/18) of the Electricity Act. As per this regulation the CEMP is updated on a five-year basis with the most recent amendment posted in 2019. The CEMP records and evaluates energy consumption and costs for all municipally owned buildings and facilities. Further, the CEMP identifies strategies to reduce energy consumption, benefit the environment, and mitigate costs to the City.

The City of Windsor Environmental Master Plan (EMP) was originally developed in 2006 and was amended in 2012. The EMP acts as a guide for the municipality to address environmental issues with the goals to make the City cleaner, greener, healthier, and more sustainable. The purpose of the EMP is to identify actions the municipality can take over the short and long term to improve the City's environment. The five main goals of the EMP are to (A) Improve Our Air and Water Quality, (B) Create Healthy Communities, (C) Green Windsor, (D) Use Resources Efficiently, and (E) Promote Awareness.

The Community Energy Plan (CEP) is an extension of the EMP and was approved by council in 2017. The plan focuses on improving energy efficiency, effective land use planning, reducing energy consumption, limiting Greenhouse Gas (GHG) emissions, and promoting smart / green energy solutions. The CEP provides recommendations for municipal projects and identifies opportunities to incorporate smart energy solutions in various municipal programs such as the Official Plan, strategic plans, community economic strategies and development priorities.

The Corporate Climate Action Plan (CCAP) is an extension of the CEP and was approved by council in 2017. This plan focuses on reducing energy and GHG emissions from municipal operations and fleets. The CCAP sets emission reduction targets in order to develop a local action plan and provides recommendations for municipal projects.

The Climate Change Adaptation Plan was developed by the City of Windsor in 2020 with the goal to prepare for the climate future by creating a more climate resilient city. The City will continue to minimize climate change risks to the community through the advancement of sustainable policies, infrastructure investment, and public education. Forward thinking and proactive actions will benefit the community health, environment, and economy. The climate change mitigation and planning objectives for the City of Windsor include: (1) Integrate Climate Change Thinking and Response, (2) Protect Public Health and Safety, (3) Reduce Risk to Buildings and Property, (4) Strengthen Infrastructure Resilience, (5) Protect Biodiversity and Enhance Ecosystem Functions, (6) Reduce Community Service Disruptions, and (7) Build Community Resilience.

1.1.4 Integrated Site Energy Master Plan

On January 1st, 2012, the Energy Conservation and Demand Management Plans Regulation (Ontario Regulation 397/11) came into effect under the Green Energy Act (2009). The regulation requires public agencies to report their annual energy consumption and GHG emissions as well as to implement an Energy Conservation and Demand Management Plan (ECDMP) beginning in 2014. These plans are required to be reviewed and updated every 5 years. Requirements from the City of Windsor under the Green Energy Act 2009, O. Reg. 397/11 include:

- Report on Energy Use
- Prepare Energy Plan, which includes:
  - Annual energy consumption reports
  - Planning goals and objectives
  - Past and current energy conservation and demand management (CDM) measures
  - Proposed CDM measures and details on lifespan, capital cost, and potential savings estimates
  - Existing or planned renewable energy (e.g., heat pumps, solar technologies, wind, bioenergy, etc.)

To comply with Regulation 397/11 under Green Energy Act 2009, the City of Windsor completed the Community Energy Plan (CEP) and Climate Change Action Plan (CCAP) in 2017. The CEP looks at all residential heating and cooling activities as well as power industry and businesses; and recommends strategies for a smart energy future. The CEP is complemented by the CCAP Plan that guide the City towards reducing GHG emissions and energy use to help the City prepare for legislative changes and Cap-and-Trade initiatives by senior levels of government. The City of Windsor, with funding assistance from the senior governments, initiated an Integrated Site Energy Master Plan in 2020 to reduce energy consumption and mitigate climate change impacts at the two municipal wastewater treatment plants.

The Integrated Site Energy Master Plan identified and evaluated various alternatives for energy conservation, improved energy efficiency, and on-site renewable energy generation. The plan provided a list of actions that will move the two wastewater treatment plants towards a "net-zero" energy future and significantly reduced GHG emissions associated with both wastewater treatment plants. Throughout the course of the study, four conceptual planning level alternative solutions were reviewed and evaluated in detail to ensure the most cost effective and viable long-term solution was identified. The results of the study identified the following as the recommended solution:

- Process Improvements at the LRWRP and LRPCP
- Energy Recovery from Waste via Anaerobic Digestion and Biogas Utilization
- Implement Sustainable Energy Initiatives and Technologies (including solar energy)

1.1.5 Food and Organic Waste Policy Statement

In recent years, there has been increasing attention paid to managing the organic fraction in waste streams. The environmental benefits of diverting organic materials from landfills include reduced methane emissions (a potent greenhouse gas) and decreased leachate discharges. On April 30th, 2018, the Food and Organic Waste Policy Statement came into effect under the Resource Recovery and Circular Economy Act (2016). The policy provides direction to municipalities, industrial, commercial, and institutional (ICI) establishments, and the waste management sector to increase waste reduction and resource recovery of food and organic waste. The Policy provides support and encouragement for the innovative utilization of waste organics as well as biosolids as resources to help achieve a more sustainable economy. More specifically, clause 6.16 of the Policy states that municipalities are encouraged to plan for the management and beneficial use of biosolids including considering new and enhanced biosolids processing technologies and co-management practices. The Policy also identifies that infrastructure for the processing and utilization of waste organics must be developed in compliance with applicable environmental and land use planning approvals. Clause 6.5 of the Policy identifies that the province and municipalities as well as other planning authorities, (e.g., Conservation Authorities) should co-ordinate and complement approaches to provincial and municipal approvals to facilitate timely decisions for the development of resource recovery systems.

Requirements under the Policy Statement include:

- The City of Windsor to achieve 70% waste reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2025;

- The City of Windsor to provide curbside collection of food and organic waste to single-family dwellings in the urban settlement area within the municipality;
- Multi-unit residential buildings to achieve 50% waste reduction and resource recovery of food and organic waste generated at the building by 2025;
- Industrial and commercial facilities to achieve 50% waste reduction and resource recovery of food and organic waste generated in the facility by 2025; and
- Educational institutions and hospitals to achieve 70% waste reduction and resource recovery of food and organic waste generated in the facility by 2025.

The City does not currently have an organic waste collection facility or program in place and must implement one in the near future to meet the requirements of the Food and Organic Waste Policy Statement.

The source separate organic (SSO) waste materials which may potentially be accepted through this program include municipal food and organic waste, ICI food and organic waste, agricultural organic waste, and high strength organic waste (HSW) such as food processing waste, dairy waste, and fats, oils, and grease (FOG). In recent years, municipalities throughout Canada have implemented integrated organics programs. This involves processing both municipal sludge and SSO waste (also called supplementary organic feedstock) within one management facility. The focus in not only processing the wastes, but also maximizing the recovery of their remaining value in the form of electricity, thermal energy, and/or fuel. Benefits of integrated programs include improved nutrient balance, synergistic effects of microorganisms, improved digestion rate, increased load of volatile solids and biodegradable organic matter resulting in increased biogas yield. Based on the benefits of integrated management plans and the requirements outlined in the Food and Organic Waste Policy, co-processing municipal sludge and SSO waste would be considered a favorable long-term solution on a municipal and regional level. Further, there is support from the provincial government for the development of increased organics utilization with emphasis on innovative approaches. It is reasonable to assume that the Province will see the City's interest in developing a stand-alone, expandable facility to effectively management both biosolids and waste organics to generate renewable energy as innovative.

1.1.6 Purpose of Report

This is an Environmental Study Report (ESR) to address biosolids management needs in the City of Windsor and prioritize solutions that move the two wastewater treatment plants towards a 'net-zero' energy future including energy savings and GHG reductions. This Biosolids Management Strategy will explore the opportunities for processing wastewater biosolids for improved energy recovery, biogas production, and energy savings. The ESR will identify the preferred design solution and concepts recommended to manage and process the wastewater biosolids with consideration for potential addition of SSO wastes in the future.

This ESR presents the complete planning and decision-making process for the Biosolids Management Strategy. This includes all stages of the Class EA, from the review of background information and problem identification to the evaluation of alternative solutions and design concepts, finishing with the selection of the preferred alternatives. Throughout this ESR, alternative design solutions and concepts are presented and evaluated leading to the selection of a cost effective and viable long-term solution. The decision-making process is based upon minimizing undesirable natural environmental, social, and economic impact. Where impacts to these factors are unavoidable, proposed measures are presented to mitigate those impacts.

1.2 CLASS ENVIRONMENTAL ASSESSMENT PROCESS

1.2.1 Project Schedules in the Class Environmental Assessment

The Environmental Assessment Act (the Act) was passed in 1975 by the Province of Ontario to provide a mechanism for public participation in public projects. The Act provides a means for the public or interested groups to receive the needed assurances that the environment is being protected from adverse effects on any significant public project. If there are necessary adverse effects on the environment, the public also needs assurances that all essential measures are being taken to minimize these impacts. The proponent is to weigh the impacts of several possible alternative ways to achieve the desired objective and to select the best alternative based on a thorough examination of each.

The Act recognized that certain municipal undertakings occur frequently, are small in scale, have a generally predictable range of effects or have relatively minor environmental significance. To ensure that a degree of standardization in the planning process is followed throughout the province, the Act contemplated the use of the Class EA procedure for projects which require approval under the Act, but which are not considered to be major environmental works.

Municipal staff and consultants can use the Class EA process in planning, design, and construction of projects to ensure that the requirements of the Act are met. The projects shall follow the planning and design process of the Municipal Engineers Association (MEA) Class EA, October 2000, as amended in 2007, 2011 and 2015. As part of the Class EA procedure, the proponent is required to state how the project is to proceed and gain approval under the Act. There are four approval mechanisms available to the proponent under the Class EA:

- **Schedule A and Schedule A+** projects are limited in scale, have minimal adverse environmental affects, and include several normal or emergency municipal maintenance and operational objectives. Projects listed in these schedules are now exempt from the Act**.**
- **Schedule B** projects generally include improvements and minor expansions to existing facilities. In these cases, there is a potential for some adverse environmental impacts and therefore the proponent is required to proceed through a screening process including consultation with those who may be affected.
- **Schedule C** projects generally include the construction of new facilities and major expansions to existing facilities. These projects proceed through the environmental assessment planning process outlined in the Class EA and require preparation of an Environmental Study Report (ESR) to document the planning process.

Schedule C projects generally include the construction of new facilities and major expansions to existing facilities where there is the potential for adverse environmental impacts, and therefore requires completion of Phases 1, 2, 3, and 4 of the Class EA process. Examples of relevant Schedule C projects are given in

Appendix 1 of the Municipal Class EA document and include establishing a new transfer station or new storage lagoon not located at a sewage treatment plant, incinerator, landfill site, or organic soil conditioning site, for purposes of biosolids management.

This biosolids management project includes activities requiring new facility construction, extension, and enlargement of existing biosolids management facility where such facilities may be located outside of an existing sewage treatment plant site. Therefore, this project is being completed under the Municipal Class EA as a **Schedule C** activity, which is the highest identified schedule. Upon completion of Phase 1, Phase 2, Phase 3, and Phase 4 for Schedule C projects, the Owner may proceed directly to Phase 5 and implement the preferred solution.

1.2.2 Phases in Municipal Class Environmental Assessment Process

Figure 1.1 illustrates the steps followed in the planning and design of projects covered by the Municipal Class EA. The Class EA for municipal projects follows a five-phase planning process that can be summarized as follows:

Phase 1 – Identification of the problem

Phase 2 – Identification of alternative solutions to the problem, consultation with review agencies and the public, selection of the preferred solution, and identification of the project as a Schedule A, A+, B or C activity.

Phase 3 – Identification of alternative design concepts (technical alternatives) for the preferred solution, evaluation of the alternative designs and their impacts on the environment, consultation with review agencies and the public and selection of the preferred design.

Phase 4 – Preparation of an Environmental Study Report (ESR) to document the planning, design, and consultation process for the project. The ESR is placed on the public registry for scrutiny by review agencies and the public.

Phase 5 – Final design, construction, and commissioning of the selected technical alternative. Monitoring of construction for adherence to environmental provisions and commitments.

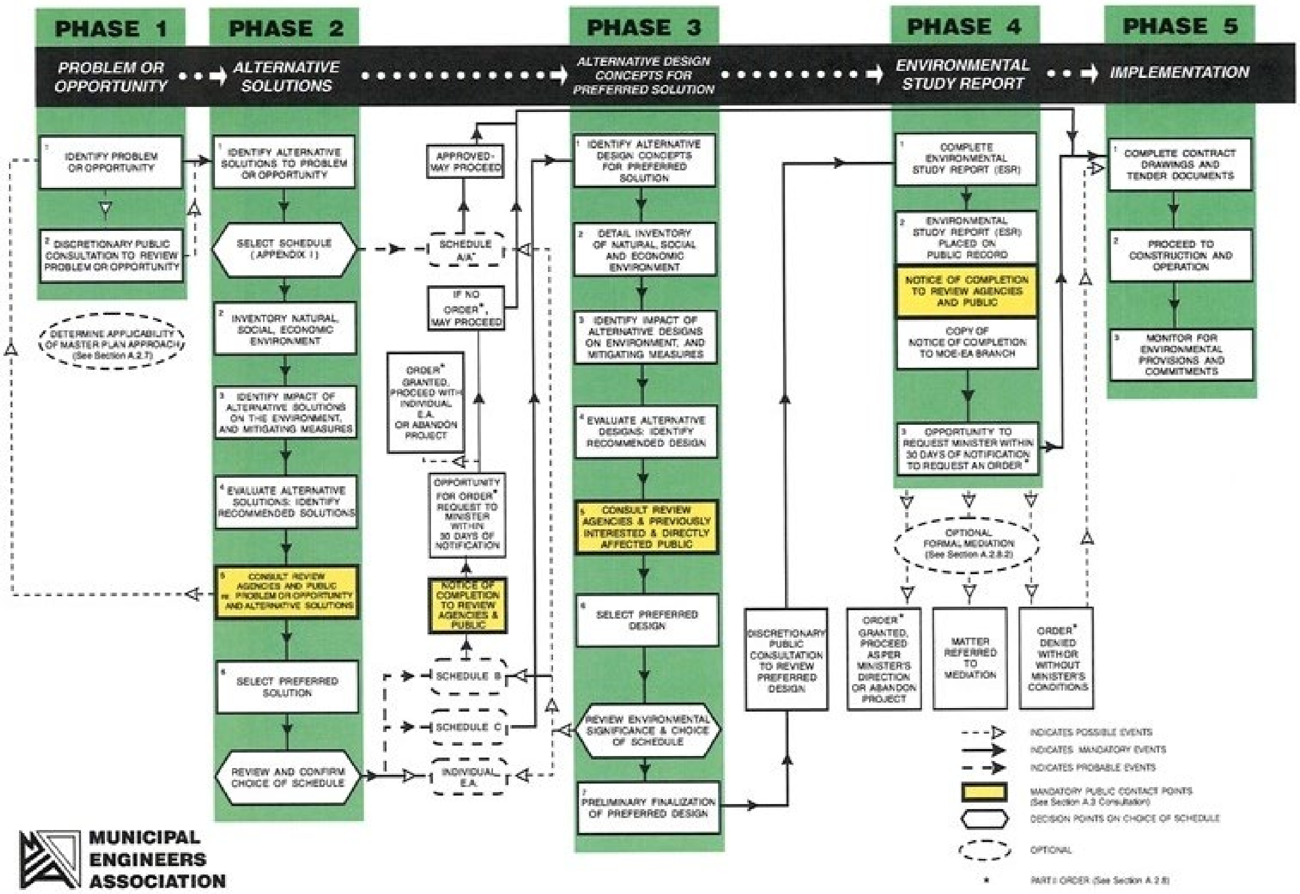

Figure 1.1 Municipal Class EA Planning and Design Process

2.0 EXISTING WASTEWATER TREATMENT FACILITIES

2.1 LOU ROMANO WATER RECLAMATION PLANT

The LRWRP, formerly the West Windsor Pollution Control Plant, is located on a 14.6-hectare site at the intersection of Ojibway Parkway and Sandwich Street in the City of Windsor. The LRWRP provides secondary level treatment for municipal wastewater and industrial wastewater from the central and western portions of the City of Windsor and from the northern area of the Town of LaSalle.

The original plant began its operation in 1970 as a primary treatment plant with a rated capacity of 109,000 m^3/d. The level of treatment was upgraded to "physical chemical" in 1973 to meet provincial phosphorous removal requirements. The plant was expanded in 1980 to a capacity of 159,000 m^3/d, and most recently the expansion to add secondary treatment was completed in 2011. The plant has a rated primary treatment capacity of 273,000 m^3/d, and a rated secondary treatment capacity of 218,000 m^3/d using biological aerated biofilter treatment technology.

The review of historical energy use was initiated by compiling data from drawings, operational records, utility bills, and equipment inventories to develop an understanding of plant energy usage patterns. The LRWRP processes (except for dewatering) operate 24 hours per day, seven days per week. Major unit operations at the LRWRP include the following:

- Coarse Bar Screening
- Raw Wastewater Pumping Station
- Fine Bar Screening
- Grit Removal
- Primary clarifiers
- Primary Effluent Pumping Station
- Biological Aerated Biofilters
- UV disinfection
- Sludge Dewatering by Centrifuges

An aerial photo showing the plant site and the layout of the existing treatment facilities is shown in **Figure 2.1**. Process schematic is shown in **Figure 2.2**. Major unit process data is described in the following sections below. The existing treatment process at the Lou Romano Water Reclamation Plant is described in further detail in the following sections.

Figure 2.1: Aerial Image of the Lou Romano Water Reclamation Plant

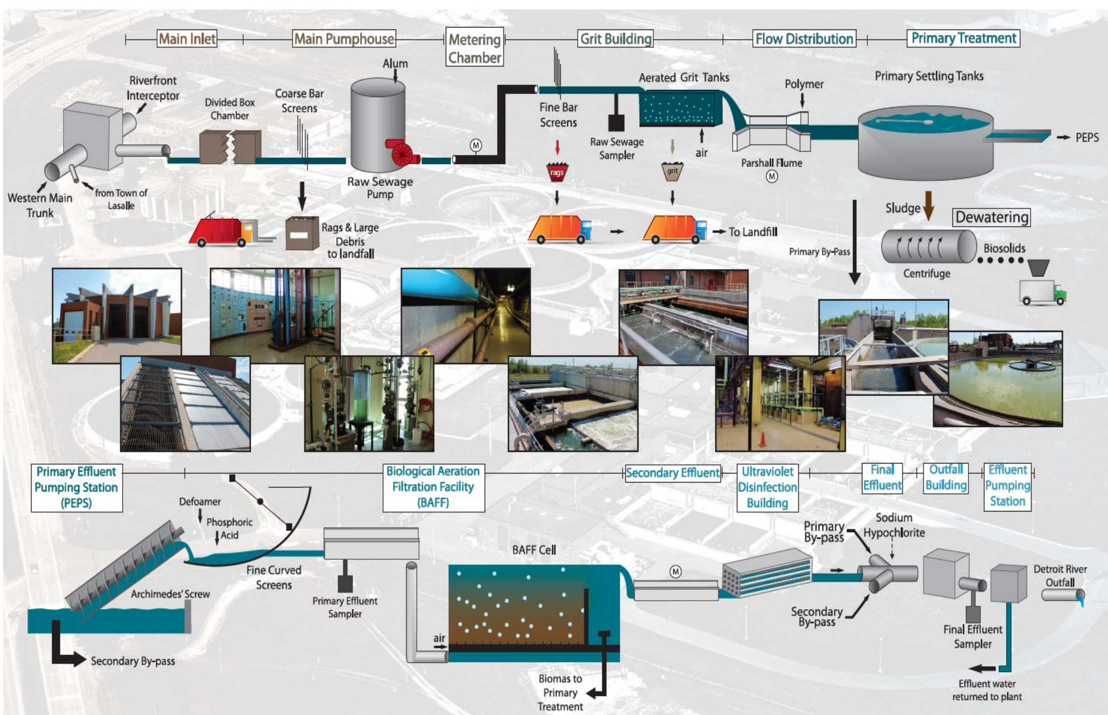

Figure 2.2: Process Schematic of the Lou Romano Water Reclamation Plant

2.1.1 LRWRP Sludge Dewatering

At the LRWRP, sludge is removed from the treatment process train at the primary settling tanks and transferred to the dewatering system. The sludge dewatering system consists of one (1) 75 m^3 sludge holding tank, three (3) centrifuge dewatering units complete with macerators, sludge feed pumps, horizontal/inclined conveyors, sludge storage hoppers/loading facility, and two (2) dry polymer make-up units with two (2) 13.5 m^3 mix tanks and two (2) 54 m^3 age tanks.

Sludge is pumped from the sludge holding tank to dewatering centrifuges. A cationic polymer which promotes dewatering of the sludge solids is introduced to the primary sludge before it enters the centrifuge. The sludge cake produced by the centrifuges is deposited in inclined screw conveyors and transferred to sludge cake storage facilities. The liquid or centrifuge centrate is returned to the plant inlet works through the plant sewer system. Major sludge dewatering process data are summarized in **Table 2.1**.

Table 2.1: LRWRP Sludge Dewatering Facility - Major Unit Process Description

Unit Process	Process Description
Macerators/grinders: No. of Units, Type & Size:	Three (3) - "Muffin Monsters", each 7.5 kW (10 HP) Drives
Sludge Feed Pumps: No. of Units, Type & Size, and Capacity:	Two (2) Vogelsang Rotary Lobe Positive Displacement Pumps, 18.6 kW (25 HP) each, 1,100 L/min – 3,800 L/min at 17.5 m TDH One (1) Vogelsang Rotary Lobe Positive Displacement Pump, 56kW (75 HP) each, 1,100 L/min – 3,800 L/min at 17.5 m TDH
Sludge Dewatering: No. of Centrifuges, Main/Back Driver Systems, and Centrifuge Capacity:	Three (3) dewatering centrifuges • One (1) Alfa Laval (Sharples) DS906 driven by a Reliance 448 kW (600 HP) main drive motor and 30 kW (40 HP) backdrive motor. Capacity 7 DT/hr. • Two (2) Andritz centrifuge, each driven by a 186 kW (250 HP) and 37 kW (50 HP) backdrive motor. Each 2.7 DT/hr.
Sludge Cake Transport System: No. of Units, type & Size: Capacity - each:	Six (6) screw conveyors • Four (4), 20 HP each • Two (2), 25 HP each 120,000 kg/hr
Sludge Cake Storage Hopper: No. of Units, Type & Size	Four (4) unloading screws, 25 HP each
Polymer Make Up Water System: No. of Units, Type & Size: Capacity - each:	One (1) city water boost pump, 22.4 kW (30 HP) 56 L/min at 64 m TDH
Polymer Batching System: No. of Units, Type & Size:	Two (2) StSt mixing tanks each 13,500 L capacity, each with mixing impeller driven by 1 HP electric motor , Two (2) FRP holding tanks each 54,000 L capacity

Polymer Feed Pumps: No. of Units, Type & Size, and Capacity:	Six (6) polymer feed pumps • Four (4) Robbins and Myers Moyno progressive cavity pumps, 3.7 kw (5 HP), 90 L/min – 252 L/min at 15 m TDH • Two (2) Robbins and Myers Moyno progressive cavity pumps, each 15 kW (20 HP), 120 L/min – 360 L/min at 53 m TDH
Odour Control System No. of Units Type & Size:	 Two (2) One (1) Biorem 3,000cfm biofilter system stage with 3,000cfm humidifier One (1) Biorem 9,000cfm biofilter system stage with 9,000cfm humidifier

2.1.2 LRWRP Design Wastewater Flows

The plant has a rated treatment capacity for an average daily sewage flow of 218,000 m^3/day, and a peak flow capacity of 545,000 m^3/d for primary treatment and 436,000 m^3/day for secondary treatment. The primary treatment included the provision of 108,080 m^3/day primary treatment capacity for wet weather flow treatment. Based on historic operating records at the LRWRP from 2015 to 2019, the average daily sewage flow was 134, 000 m^3/day (approximately 61 % of the rated treatment capacity).

2.1.3 LRWRP Design Wastewater Characteristics and Loading

The raw wastewater influent to the LRWRP is primarily of domestic origin, with the exception of a few industrial and commercial sources. **Table 2.2** presents a summary of the raw wastewater characteristics and loadings for the upgrades of the existing plant in 2008.

Table 2.2: LRWRP Raw Wastewater Characteristics and Loadings

Parameter	Concentration(1) (mg/L)		
	Average	Minimum	Maximum
BOD_5	157	15	495
TSS	218	20	1720
TP	4.3	0.6	19.3
Ammonia	11.7	6.2	16.4
Notes: (1) Average concentration based on 1999 to 2002 inclusive historical average.			

2.1.4 LRWRP Treatment and Compliance Requirements

The treatment plant operates under an Amended Environmental Compliance Approval (ECA) No. 1853-B43PVC issued on September 28, 2018. A copy of the current ECA is contained in **Appendix A**. The current ECA outlines the effluent compliance limits and objectives for the facility, which are summarized in **Table 2.3**.

Table 2.3: Effluent Objectives and Non-Compliance Limits

Parameter	Non-Compliance Limits		Effluent Objectives
	Monthly Average Concentration	Annual Average Loading	Concentration
$cBOD_5$	15 mg/L	3,270 kg/d	10 mg/L
TSS	15 mg/L	3,270 kg/d	10 mg/L
TP	0.5 mg/L	109 kg/d	0.4 mg/L
Unionized Ammonia	0.1 mg/L	-	0.08 mg/L
E. coli (1)	200 organisms/100 mL	-	100 organisms/100 mL
pH	6.5 - 9.5 inclusive	-	6.5 – 9.0 inclusive
Toxicity to Rainbow Trout and Daphnia magna	Non-acutely lethal (no more than 50% mortality)	-	-
Notes: (1) Monthly geometric mean density.			

2.2 LITTLE RIVER POLLUTION CONTROL PLANT

The LRPCP is located at 9400 Little River Road in the City of Windsor. The LRPCP provides secondary level treatment for municipal wastewater and industrial wastewater from the eastern portions of the City of Windsor and from the Municipality of Tecumseh. The original plant began its operation in 1966 as a primary treatment plant with a rated capacity of 18,000 m^3/d. It was upgraded and expanded in 1974 to 36,000 m^3/d providing secondary treatment including phosphorous removal as well as activated sludge process. The plant was expanded in the early 90's to a rated capacity of 73,000 m^3/d.

- Major unit operations at the LRPCP include the following:
- Fine Bar Screening
- Raw Wastewater Pumping Station
- Grit Removal
- Primary clarifiers
- Aeration Tanks (activated sludge process)
- Final Clarifiers (activated sludge process)
- UV disinfection
- Sludge Dewatering by Centrifuges

An aerial photo showing the plant site and the layout of the existing treatment facilities is shown in **Figure 2.3**. Process schematic is shown in **Figure 2.4**. Major unit process data are described in the following sections. The existing treatment process at the Little River Pollution Control Plant is described in further detail in the following sections.

Figure 2.3: Aerial Image of the Little River Pollution Control Plant

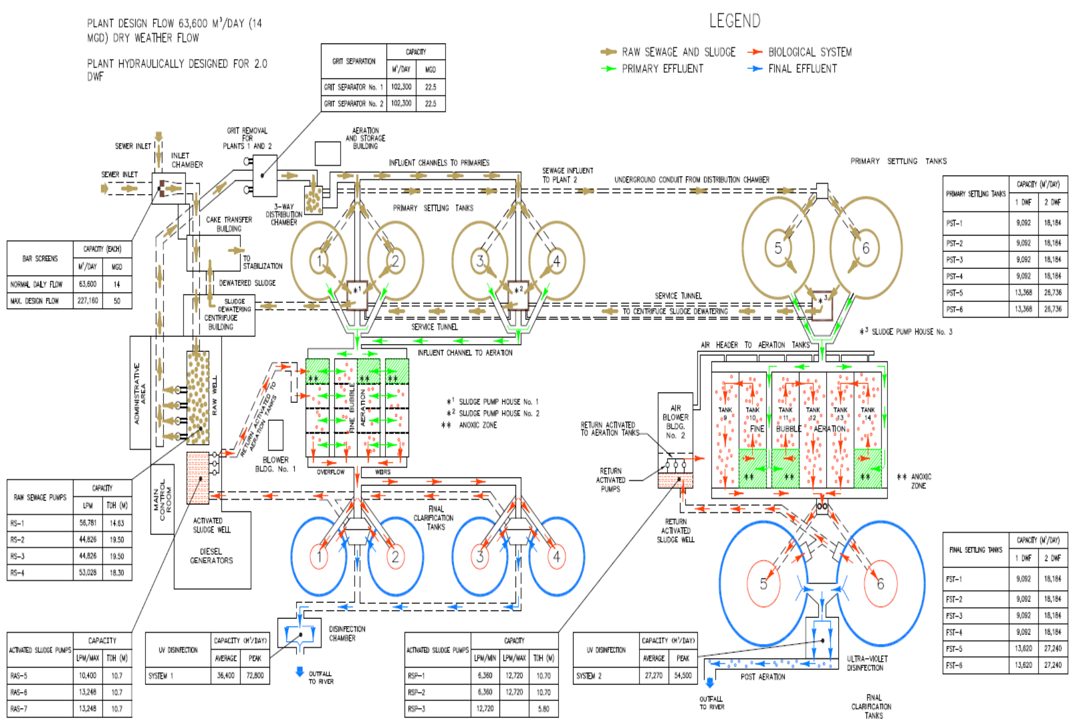

Figure 2.4: Process Schematic of Little River Pollution Control Plant

2.2.1 LRPCP Sludge Dewatering

Primary settling tank sludge is withdrawn from the storage compartment and pumped to sludge dewatering facilities for further treatment. Settled solids are pumped from the sludge compartment of the primary clarifiers to the sludge dewatering facilities. The primary sludge pumps discharge through three underground pipe headers through macerators to a sludge holding tank located in the dewatering building. Prior to discharging into the holding tank the sludge is passed thru two (2) inline macerators to shred stringy and fibrous materials that would adversely affect the operation of the centrifuges. Sludge is pumped from the holding tank to the dewatering centrifuges. Polymer, a sludge conditioning chemical is added to the sludge to aid in bulking of the sludge solids in the centrifuges. The polymer system consists of one polymer makeup water system which provides mixing and dilution water to two polymer solution preparation and feed systems.

Dewatered sludge, or sludge cake, discharges from the centrifuges and is transferred by sludge cake pump and transport systems to the truck loading facility for eventual transport to Windsor Biosolids Pelletizing Facility (WBPF). Liquid removed from the sludge (centrate) is returned to the treatment process by a gravity sewer which discharges into the plant inlet chamber. Major sludge dewatering system data are summarized in **Table 2.4**.

Table 2.4: LRPCP Sludge Dewatering Facility - Major Unit Process Description

Unit Process	Process Description
Macerators: No. of Units: Type & Size:	 Two (2) Robbins and Myers Moyno "Pipeliner" Series 301, 5 HP each
Sludge Feed Pumps: No. of Units: Type & Size: Capacity - each:	 Three (3) Robbins and Myers Moyno progressive cavity pumps, 14.9 kW (20 HP) each 90 L/min – 1,120 L/min at 28.2 m TDH
Sludge Cake Transport System: No. of Units: Type & Size: Capacity - each:	 Three (3) Each consists of Schwing Model SD350 twin auger cake pump screw feeder with screw feed chute with 22 kW (30 HP) hydraulic unit 25 L/min – 167 L/min
Sludge Dewatering: No. of Centrifuges: Centrifuge Driver Systems: Centrifuge Capacity - each:	 Three (3) dewatering centrifuges, each Vee-belt driven by a 225 kW (300 HP), 1800 RPM main drive motor and 75 kW (100 HP) AC backdrive. 25.2 to 34.2 m^3/hr of primary sludge with a solids concentration of 1.5% to 4.5% dry solids
Polymer Make Up Water System: No. of Units, Type & Size: Capacity - each:	 Two (2) centrifugal pumps, 11.19 kW (15 HP) 795 L/min at 44.8 m TDH
Polymer Batching System: No. of Units, Type & Size:	 Two (2) mixing/holding tanks each 3028 L capacity, each with mixing impeller driven by 2 HP electric motor
Polymer Feed Pumps:	

No. of Units, Type & Size: Capacity - each:	Three (3) Netzch Canada - single stage positive displacement 4 L/min – 60 L/min at 50 psi
Odour Control System No. of Units Type & Size:	Two (2) One (1) single stage wet scrubber system with mix tanks and chemical storage tank One (1) 2-stage wet scrubber system with mix tanks and chemical storage tank

2.2.2 LRPCP Design Wastewater Flows

The most recent upgrades of the existing LRPCP were completed in 2008. The plant has a rated treatment capacity for an average daily sewage flow of 72,800 m^3/day. The peak flow capacity of the plant is approximately 143,600 m^3/d.

2.2.3 LRPCP Design Wastewater Characteristics and Loading

The raw wastewater influent to the LRPCP is primarily of domestic origin, with the exception of a few industrial and commercial sources. **Table 2.5** presents a summary of the raw wastewater characteristics.

Table 2.5: LRPCP Raw Wastewater Characteristics

Parameter	Concentration(1) (mg/L)		
	Average	**Minimum**	**Maximum**
BOD_5	139	54	273
TSS	158	78	376
TP	4.1	1.8	8.1
Ammonia	18.1	4.6	31.1
Notes: (1) Average concentration based on 1999 to 2002 inclusive historical average.			

2.2.4 LRPCP Treatment and Compliance Requirements

The effluent compliance limits and objectives for the facility are summarized in **Table 2.6**. The treatment plant operates under an Amended Environmental Compliance Approval (ECA) No. 4681-BT3L39 issued on January 29, 2021. A copy of the current ECA is contained in **Appendix A.**

Table 2.6: Effluent Objectives and Non-Compliance Limits

Parameter	Non-compliance Limits	Effluent Objectives
cBOD5	25 mg/L	Not specified
TSS	25 mg/L	Not specified
TP	1.5 mg/L	Not specified
Total Ammonia	8 mg/L	Not specified
E. coli (1) (2)	1000 organisms/100 mL	Not specified
pH	6.5 - 9.0 inclusive	6.5 – 9.0 inclusive
Dissolved Oxygen	-	4 mg/L

Notes:
(1) Represent monthly geometric mean density.
(2) Not applicable during freezing period when stream temperatures are below 5 ºC, which includes the period from November 1 through April 30.

2.3 WINDSOR BIOSOLIDS PROCESSING FACILITY

2.3.1 Overview

Prior to the implementation of the Windsor Biosolids Processing Facility (WBPF), sludge produced at the City's two wastewater treatment facilities were transferred to the LRWRP to be disposed of by open air composting with lime stabilization and application on agricultural land. Odours emanating from the open method of stabilization and storage of the resulting biosolids created unacceptable conditions for the residential properties surrounding the LRWRP. The City of Windsor recognized the need to correct this issue and to provide an effective, environmentally friendly biosolids management system to meet the City's long-term needs. Therefore, they carried out a municipal class environmental assessment known and the 'Biosolids Master Plan' in 1996 and 1997.

The selection of a long term biosolids management system was done through a request for proposal (RFP) process. Proposals were invited through a public advertising process and evaluated by a committee formed of community representatives, environmental organizations, City administration, and an engineering consultant. The evaluation considered environmental, technical, and financial aspects of all proposals received. The proposal submitted by Prism-Berlie for a heat drying pelletization plant was recommended as the preferred alternative. The proposed drying system was a Berlie/Swiss Combi rotary drum dryer with a closed loop drying air circuit. This technology was favourable at the time due to its good track record, broad application, and consistency to provide a desirable and marketable end product. An agreement was reached between the City of Windsor and Prism-Berlie on August 11th, 1997, for a 20-year contract for biosolids management services. The proposed facility was constructed and placed into service in 1999.

WBPF was constructed under a Public-Private partnership between American Water (formerly Prism-Berlie) and the City of Windsor. The biosolids processing facility was built, financed, owned, and operated by American Water from 1999 to 2019 under a 20-year contract. The facility was repaired in 2002 following an explosion that caused damage to the facility. The facility operator is responsible for transporting dewatered sludge from LRPCP and LRWRP to WBPF and selling the fertilizer pellets to end-users. The ownership of WBPF was transferred to the City in 2019. The City has since contracted Synagro to operate the facility under a new 10-year contract expiring 2029.

The WBPF, formerly known as 'Prism Berlie', is located at 4365 Sandwich Street in the City of Windsor. The facility uses thermal drying to process dewatered sludge from the two City of Windsor wastewater treatment plants (WWTP) into biosolids fertilizer pellets. An aerial photo showing the plant site is shown on **Figure 2.5**.

Figure 2.5: Site Plan of the Windsor Biosolids Processing Facility (formerly Prism Berlie)

2.3.2 Existing Biosolids Management Process

An overview of the existing biosolids management strategy for the two City owned wastewater treatment facilities is shown in **Figure 2.6**. At the LRWRP and LRPCP sludge is removed from the treatment process and dewatered on-site by centrifuge. Following the centrifuge process, the dewatered sludge cake has a dry solids content of approximately 25 to 30 %. Dewatered sludge cake from both of the wastewater treatment facilities is then transferred to the WBPF by tractor trailer for further processing.

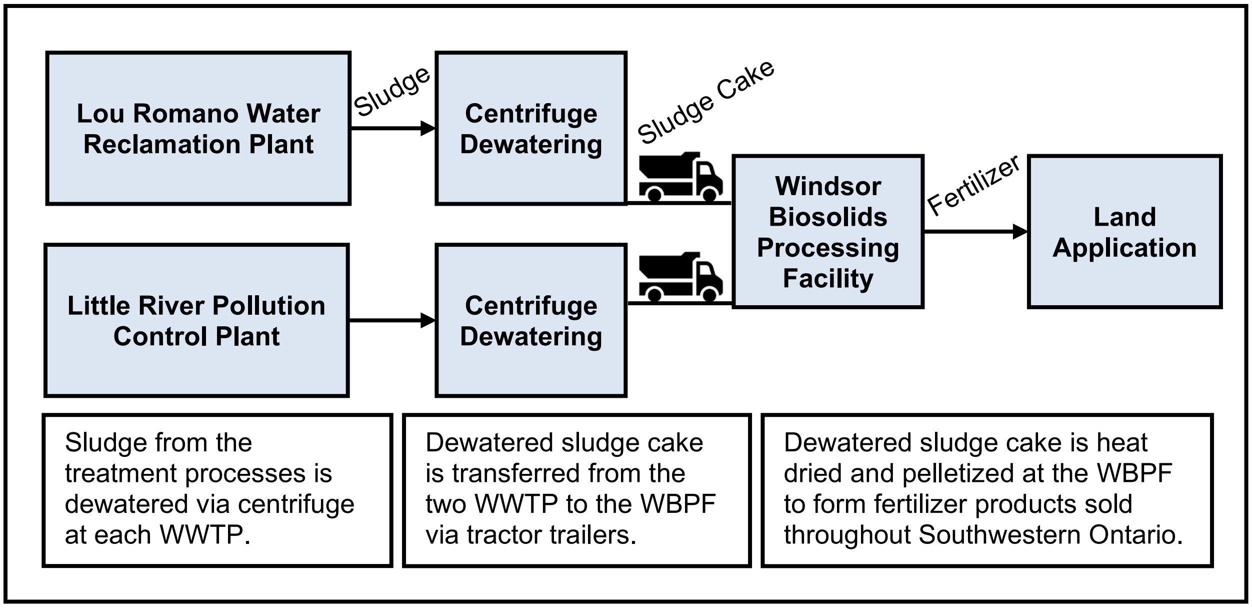

Figure 2.6: Process Schematic of the Windsor Biosolids Management Process

At the WBPF the dewatered sludge from the two wastewater treatment facilities is heat dried and pelletized to remove moisture, stabilize the sludge, and produce fertilizer which is sold by the WBPF operator (Synagro). The process flow diagram at the WBPF is shown in **Figure 2.7**.

The dewatered sludge cake is transported from each wastewater treatment plant to the WBPF using tractor trailers. The dewatered sludge cake is unloaded from the tractor trailers into a receiving bin at the WBPF, which is equipped with an adsorption odor control system. Piston pumps are utilized to transfer the sludge cake from this receiving area to a sludge holding tank located in the drying area. From the sludge holding tank, twin transfer screws move the sludge into a mixer where the dewatered sludge is mixed with dried recycled product to form a homogenous feed material. This homogenized mixture allows for improved management and conveyance of materials through the rotary dryer system.

The WBPF is a heat drying pelletization plant, which uses a rotary drum dryer to thermally dry dewatered sludge. The homogenized feed materials are conveyed into the rotary drum dryer and heated to 400 – 450 ºC to stabilize and remove moisture. The rotary drum dryer has a typical retention time of 20 minutes and has an evaporation capacity of 6,000 kg water/hr. This residence time allows the sludge to dry, pasteurizes it, and eliminates pathogens, while maintaining the nutrient and organic benefits in the final product. The dried product from the dryer is separated from the air/vapour stream by cyclone technology. From here the dried biosolids are conveyed by bucket elevator to the screening area. Off screenings are recycled to the mixer and reincorporated into the homogenized mixture prior to the rotary drum dryer. The screened dried fertilizer product is conveyed pneumatically into silos where the fertilizer is stored prior to being shipped to customers.

The fertilizer is classified under Title 40 CFR, Part 503 as Class A biosolids in the USA. In Canada, the fertilizer product was registered under the federal *Fertilizer Act* as a farm fertilizer under the trade name Windsor Propell. The fertilizer is now marketed under the trade name Eco Pearl.

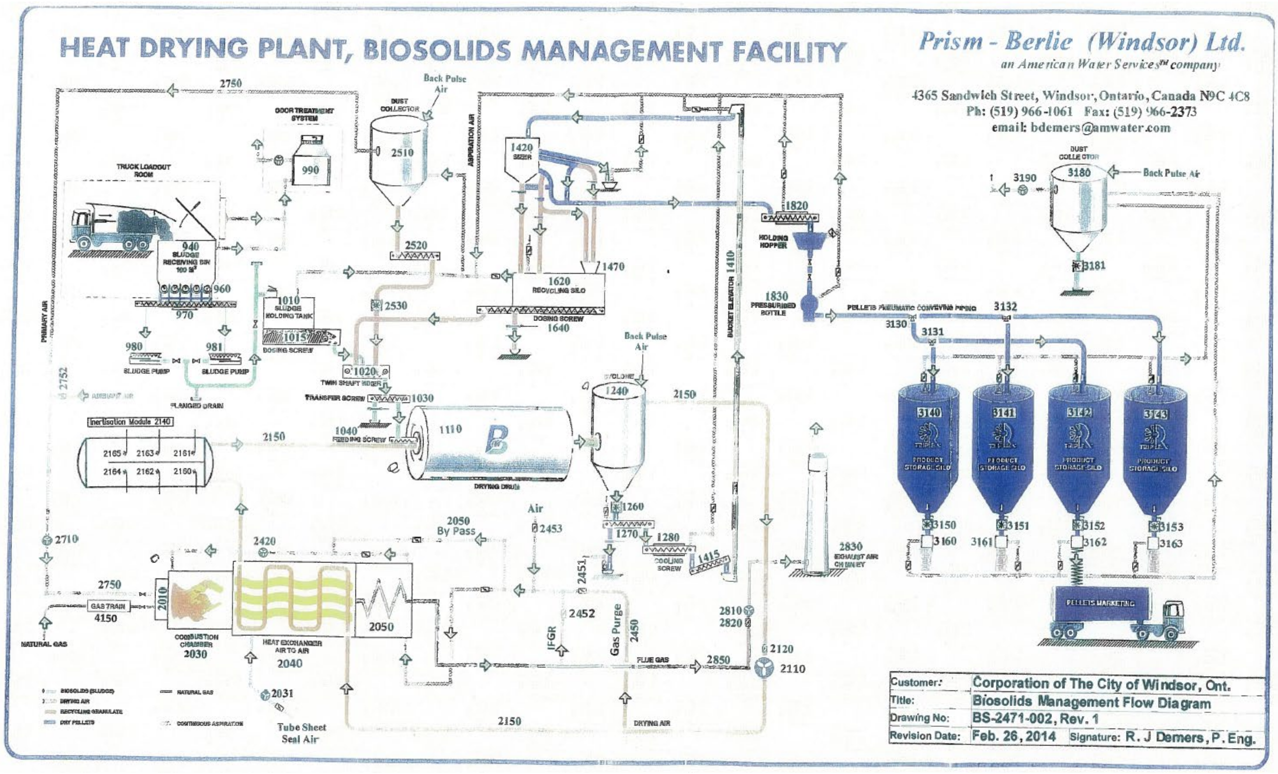

Figure 2.7: Process Schematic of the Windsor Biosolids Processing Facility

2.3.3 Existing Biosolids Treatment Capacity

In 2021, the WBPF processed approximately 40,000 wet tonnes of sludge from the LRWRP and LRPCP into approximately 12,000 dry tonnes of EcoPearl fertilizer product. For a third consecutive year, all of the biosolids produced at the two WWTPs were converted into fertilizer and no biosolids (sludge or fertilizer) was sent to landfill. **Table 2.7** summarizes the approximate amount of dewatered sludge processed at the WBPF in 2021.

Table 2.7: Operating Conditions at the WBPF (2021)

Month	LRWRP (wet tonnes)	LRPCP (wet tonnes)	Total (wet tonnes)	Landfilled (wet tonnes)	Processed (dry tonnes)
January	2,099	771	2,870	0	986
February	1,828	761	2,589	0	734
March	2,561	942	3,503	0	1,076
April	2,496	844	3,340	0	974
May	2,666	833	3,499	0	987
June	2,837	835	3,673	0	1,065
July	2,662	693	3,355	0	1,132
August	2,662	737	3,399	0	948
September	2,503	726	3,229	0	950
October	2,403	731	3,135	0	876
November	2,683	790	3,473	0	940
December	2,814	814	3,628	0	1,078
Total	30,203	9,479	39,692	0	11,748

The treatment process at the existing WBPF is controlled and limited by the capacity of the rotary drum dryer system. The rotary drum dryer at the WBPF has a typical retention time of 20 minutes and an evaporation capacity of 6,000 kg water/hr. Depending on the moisture content of the incoming wet dewatered sludge cake the maximum capacity of the WBPF is 7,500 to 8,300 kg sludge/hr in operation. The typical operating schedule for the WBPF is 24 hours per day from Monday to Friday and maintenance of the plant is completed on Saturday and Sunday. Based on this the WBPF can process approximately 47,000 to 52,000 tonnes of wet dewatered sludge per year. This capacity is sufficient for the current sludge loading in the City of Windsor but would not be able to meet future biosolids management needs as shown in **Figure 2.8**.

2.3.4 Biosolids Storage and General Requirements

The WBPF has two storage facilities on-site for the appropriate storage of (i) wet dewatered sludge cakes and (ii) final fertilizer material. As outlined in **Section 2.3.2**, the wet dewatered sludge cake from the two wastewater treatment facilities is transferred to the WBPF. These sludge cake are unloaded from the tractor trailers into a receiving bin at the WBPF. The receiving bin is equipped with an adsorption odor control system to reduce odour emissions to the surrounding community. Piston pumps are then utilized to transfer the sludge cake from this receiving area to a sludge holding tank located in the drying area. Following the treatment process, the final product, which is a stabile pelletized biosolids material is stored on-site in one of four storage silos.

The Ontario Design Guidelines for Sewage Works outlines the general requirements for sludge storage and disposal. Dewatered sludge with solids content less than 35 % may be stored on-site for a maximum of 7 days, whereas dewatered sludge with solids content greater than or equal to 35 percent may be stored on-site for up to 90 days. Dried sludge with a solids content greater than or equal to 50 percent may be stored on-site without limitation prior to disposal or land application. In Ontario, biosolids may be used as a soil conditioner for agricultural, horticultural, or reclamation purposes as an alternative to sludge disposal through landfilling. Biosolids contain nutrients such as nitrogen, phosphorus, zinc, magnesium, and copper as well as organic matter that are beneficial to agricultural plant growth. When applied in accordance the Nutrient Management Act biosolids can improve soil fertility, reduce the application of commercial fertilizers, add organic matter, enhance soil structure, and improve moisture retention.

2.4 SLUDGE CHARACTERISTICS, QUANTITIES, AND PROJECTIONS

2.4.1.1 Sludge Characteristics

In order to characterize the sludge characteristics samples were collected at the two wastewater treatment facilities for internal and external analysis. The external sludge sample analysis was conducted by a certified laboratory (AGAT Laboratories). Samples were collected twice weekly for the analysis of total solids and volatile solids and monthly for the analysis of pH, Total Kjeldahl Nitrogen, Ammonia, Total Phosphorus, Extractable Phosphorous, Orthophosphorous, Oil & Grease (% of Total Sludges), Conductivity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrate, Potassium, Selenium, Silver, Sodium, Strontium, Thalium, Tin, Titanium, Uranium, Vanadium, and Zinc. A summary of the key parameters for the sludge characterization in the year 2021 is shown in **Table 2.8**. The sample results show that the sludge at the two wastewater treatment plants is typical of municipal sludge. Further, the sample results show that heavy metals, ammonia, sulfides, and other inhibitors of biological decomposition are not a concern.

Table 2.8: Primary Sludge Characteristics (2021)

Parameter	LRWRP			LRPCP		
	10th Percentile	Average	90th Percentile	10th Percentile	Average	90th Percentile
pH	5.49	5.67	5.8	5.5	5.6	5.7
Total Solids (%)	4.0	5.1	6.2	2.7	3.5	4.3
Volatile Solids/ Total Solids Fraction (%)	60.7	69.7	75.5	77.0	80.2	84.3
Total Kjeldahl Nitrogen (mg / kg)	31,770	40,614	49,733	25,976	43,687	57,456
Total Phosphorus (mg / kg)	15,100	49,131	199,900	15,517	17,210	21,370

2.4.1.2 Sludge Cake Production and Operating Conditions at the LRWRP and LRPCP

At the LRWRP, sludge is removed from the treatment process at the primary clarifiers. At this point the primary sludge has a solids content in the range of 4 to 7 %, with an average of approximately 5.5 %. Based on the historical operating conditions, there appears to be a consistent seasonal effect whereby the solids concentration is higher in the winter period and lower in the summer period. The ratio of volatile solids (VS) to total solids (TS) in the primary sludge varies from 60 to 80 %, with an average concentration of 68%. Dewatered sludge cake from the Alfa-Laval Centrifuge (Machine 1) has a solids content of approximately 24 to 28 %, with an average of 26%. Dewatered sludge cake from the Andritz Centrifuges (Machine 2 and 3) has a solids content of approximately 28 to 34 %, with an average of 32%.

The historical operating conditions at the LRWRP Dewatering Facility for the years 2018 to 2021 are summarized in **Table 2.9.** The average dewatered sludge cake production at the LRWRP is 8,500 dry tonnes per year or approximately 31,000 wet tonnes per year with a solids content of 27 %.

Table 2.9: Operating Conditions at the LRWRP Dewatering Facility (2018-2021)

Parameter	Units	Max Month	Average Month	Min Month
Plant Flow	MLD	220	133	100
Primary Sludge [Solids]	% TS	7.0	5.5	4.0
Primary Sludge [VS]/[TS]	%	80	68	60
Primary Sludge Feed (including non-dewatering days)				
Total (machine 1+2+3)	dry tonnes/d	35	28	22
Dewatered Cake Production (including non-dewatering days)				
Wet Total (machine 1+2+3)	wet tonnes/d		84	
Dry Total (machine 1+2+3)	dry tonnes/d	30	23	18
Dewatering Time (including non-dewatering days)				
Total (machine 1+2+3)	hrs runtime/d		10.4	
Machine #1	hrs runtime/d		3.5	
Machine #2	hrs runtime/d		4.5	
Machine #3	hrs runtime/d		2.5	
Dewatered Solids Concentrations				
Machine #1	% dry solids	28	26	25
Machine #2	% dry solids	33	32	28
Machine #3	% dry solids	33	32	28
Polymer Concentration	%	0.3	0.2	0.15
Polymer Usage	kg poly/dry t	8-10	4-8	3-4

At the LRPCP, sludge is removed from the treatment process at the primary clarifiers. At this point the primary sludge has a solids content in the range of 1.5 to 8 %, with an average of approximately 3.6 %. Based on the historical operating conditions, there appears to be a consistent seasonal effect whereby the solids concentration is higher in the winter period and lower in the summer period, which may be due to fermentation. The ratio of VS to TS in the primary sludge varies from 66 to 88 %, with an average concentration of 81 %. Dewatered sludge cake after centrifuging has a solids content of approximately 21 to 33 %, with an average of 27%.

The historical operating conditions at the LRPCP Dewatering Facility for the years 2018 to 2021 are summarized in **Table 2.10.** The average dewatered sludge cake production at the LRWRP is 2,500 dry tonnes per year or 9,500 wet tonnes per year with a solids content of approximately 27 %.

Table 2.10: Operating Conditions at the LRPCP Dewatering Facility (2018-2021)

Parameter	Units	Max Month	Average Month	Min Month
Plant Flow	MLD	60	45	31
Primary Sludge [Solids]	% TS	8.0	3.6	1.5
Primary Sludge [VS]/[TS]	%	88	81	66
Primary Sludge Feed (including non-dewatering days)				
Total	dry tonnes/d		9.8	
Dewatered Cake Production (including non-dewatering days)				
Wet Total	wet tonnes/d		25.6	
Dry Total	dry tonnes/d		6.8	
Dewatering Time (including non-dewatering days)				
Total	hrs runtime/d		6.0	
Machine #1	hrs runtime/d		2.2	
Machine #2	hrs runtime/d		1.8	
Machine #3	hrs runtime/d		2.1	
Dewatered Solids Concentrations				
Total	% dry solids	33	27	21
Polymer Concentration	%	0.60	0.46	0.26
Polymer Usage	kg poly/dry t	14.0	8.2	5.0

The mass of wet dewatered sludge cake measured from the LRWRP and LRPCP from 2018 to 2021 are summarized in **Table 2.11**. The table further shows that LRWRP and LRPCP generate an average of 31,000 wet tonnes/yr and 9,500 wet tonnes/yr, respectively, for a combined total of 40,500 wet tonnes/yr.

Table 2.11: Measured Mass of Dewatered Sludge Cake (2018-2021)

Year	Mass of Wet Dewatered Sludge Cake at approximately 27 % Solids (wet tonnes / yr)		
	LRWRP	**LRPCP**	**Combined**
2018	32,700	8,600	41,300
2019	32,400	9,700	42,100
2020	28,800	9,700	38,500
2021	28,600	9,400	38,000
Average	**31,000**	**9,500**	**40,500**

2.4.1.3 Biosolids Projections

The historical operating data for the average daily sewage flow and the average mass of wet dewatered sludge cake at the LRWRP for period between 2018 and 2021 is shown in **Table 2.12**. In addition, the rated capacity of the LRWRP and the corresponding mass of wet dewatered sludge cake is shown in the table.

The LRWRP services the central and western portion of the City of Windsor as well as the nearby Town of Lasalle. A majority of the land within this region of the City of Windsor are fully developed and are not anticipated to be changed or redeveloped above the existing rated capacity of the sanitary collection system and LRWRP. In the Town of Lasalle there are a variety of areas which have not been developed or are in the process of being redeveloped. However, development within these regions is not anticipated to exceed the original design capacity of the sanitary collection system and LRWRP. Overall, the average daily sewage flow and therefore the mass of wet dewatered sludge cake at the LRWRP is anticipated to increase in the future but not exceed the rated capacity of the LRWRP in the next 20 years.

Table 2.12: Historical Operating Conditions and Rated Capacity at the LRWRP

Parameter	Historical Operating Records (2018 – 2021)	Rated Capacity
Average Daily Flow	131 MLD	218 MLD
Wet Mass of Dewatered Sludge Cake (at approximately 27.4% solids)	31,000 wet tonnes / yr	60,000 wet tonnes / yr
Dry Mass of Dewatered Sludge Cake	8,500 dry tonnes / yr	16,000 tonnes / yr

The historical operating data for the average daily sewage flow and the average mass of wet dewatered sludge cake at the LRPCP for period between 2018 and 2021 is shown in **Table 2.12.** In addition, the current rated capacity of the LRPCP and the corresponding mass of wet dewatered sludge cake is shown in **Table 2.12**.

The LRPCP services the eastern portion of the City of Windsor as well as the nearby Municipality of Tecumseh. These regions are anticipated to undergo intensive growth including residential developments as well as major institutional (Windsor Regional Hospital) and industrial developments (Stellantis/LG Electric Battery Plant and feeder plants). Therefore, the LRPCP is expected to undergo expansions to meet future wastewater servicing needs. The Windsor – Tecumseh Wastewater Servicing Agreement (2004) and the Tecumseh Water and Wastewater Master Plan (2018) outlines that the LRPCP may undergo four expansions in the future. At the time when these studies were carried out the first expansion was anticipated to be completed in 2031 with the subsequent expansion occurring in 2037; however, recent industrial commitments and residential pressures may expediate the expansion of the LRPCP. The final rated capacity of the LRPCP after all expansions are completed, as outlined in the Wastewater Servicing Agreement, is 145 MLD which corresponds to approximately 40,000 wet tonnes / yr of wet dewatered sludge cake or 10,500 dry tonnes / yr.

Table 2.13: Historical Operating Conditions and Rated Capacity at the LRPCP

Parameter	Historical Operating Records (2018 – 2021)	Rated Capacity	Anticipated Rated Capacity (Final Expansion)
Average Daily Flow	45 MLD	73 MLD	145 MLD
Wet Mass of Dewatered Sludge Cake (at approximately 26.6% solids)	9,500 wet tonnes / yr	20,000 wet tonnes / yr	40,000 wet tonnes / yr
Dry Mass of Dewatered Sludge Cake	2,500 dry tonnes / yr	5,250 dry tonnes / yr	10,500 dry tonnes / yr

The projections for future sludge production at the two wastewater treatment plants are summarized in

Table 2.14. These projections are generally based on the rated design capacities of the wastewater treatment plants with the following assumptions:

- The 20-year design basis for the management of sludge from the LRWRP is based on the current rated capacity of the plant.
- The 20-year design basis for the management of sludge from the LRPCP is based on the current rated capacity of the plant multiplied by a factor of 1.5. This factor was introduced to provide accommodation for major developments that are anticipated to occur in the service area over the next 20 years.
- The ultimate design basis for the management of sludge from the LRWRP is based on the current rated capacity of the plant multiplied by a factor of 1.5. This factor was introduced to provide accommodation for future servicing needs and may be re-evaluated based on development pressures and realized sludge production values.
- The ultimate design basis for the management of sludge from the LRPCP is based on the anticipated rated capacity of the plant after the completion of all expansions outlined in the

Wastewater Servicing Agreement. This value may be re-evaluated in the future based on development pressures and realized sludge production values.

This Biosolids Management Master Plan including the evaluation of alternative design solutions, evaluation of alternative design concepts, and recommendations for preferred overall design will be based on the projections summarized in

Table 2.14. The preferred design will be based on the 20-year sludge projection (24,000 dry tonnes / yr) with consideration for future expansion or phasing to the ultimate sludge projection (34,500 dry tonnes / yr).

Table 2.14: Sludge Projections and Design Basis for Biosolids Management

Sludge Projections		**Wet Mass* (tonnes / yr)**	**Dry Mass (tonnes / yr)**
Historic Average 2018 - 2021	LRWRP	31,000	8,500
	LRPCP	9,500	2,500
	Total	**40,500**	**11,000**
20-Year Design	LRWRP	60,000	16,000
	LRPCP	30,000	8,000
	Total	**90,000**	**24,000**
Ultimate Design	LRWRP	90,000	24,000
	LRPCP	40,000	10,500
	Total	**130,000**	**34,500**
Note: *Wet Mass at 26-27% Solids			

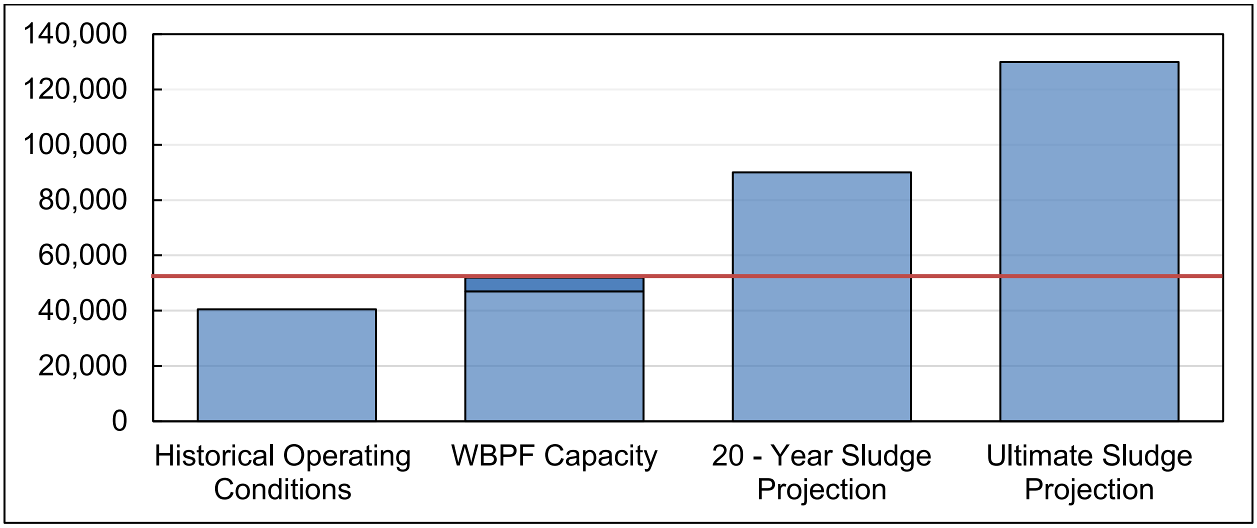

Figure 2.8: Historical Operating Conditions, WBPF Capacity, and Biosolids Projections

2.5 ENERGY CONSUMPTION AT THE WINDSOR WASTEWATER TREATMENT FACILITIES

2.5.1 Lou Romano Water Reclamation Plant

2.5.1.1 Historical Electricity Consumption and Treated Wastewater Flows

Historical electricity use from 2014 to 2018 is summarized in **Table 2.15**. The table shows that LRWRP consumes 16,800 MWh of electricity costing $2.1 million dollars on average annually.

Table 2.15: Historical Electricity Use at the LRWRP (2014-2018)

Year	Utility Electricity Bill Cost ($/yr)	Utility Electricity Consumed (kWh/yr)	Local Utilities Average Unit Cost ($/kWh)	Actual Annual Unit Cost for the facility ($/kWh)
2014	$2,082,617	17,562,931	0.118	0.120
2015	$2,272,270	16,918,046	0.134	0.135
2016	$2,401,254	16,012,165	0.148	0.153
2017	$2,016,343	16,458,437	0.120	0.127
2018	$1,604,845	16,962,231	0.092	0.100
Average	**$2,100,000**	**16,780,000**	**0.122**	**0.127**

Figure 2.9 presents monthly raw sewage flows and electricity use between the years 2014 and 2018. The figure shows that the monthly electricity consumption ranges between 1,090,186 kWh/month and 1,808,379 kWh/month, with an average of 1,398,563 kWh/month. As illustrated in **Figure 2.9**, the monthly average daily flow ranges between 93 MLD and 187 MLD with an average of 133 MLD. In general, the electricity consumed tends to follow the volume of treated wastewater at the plant.

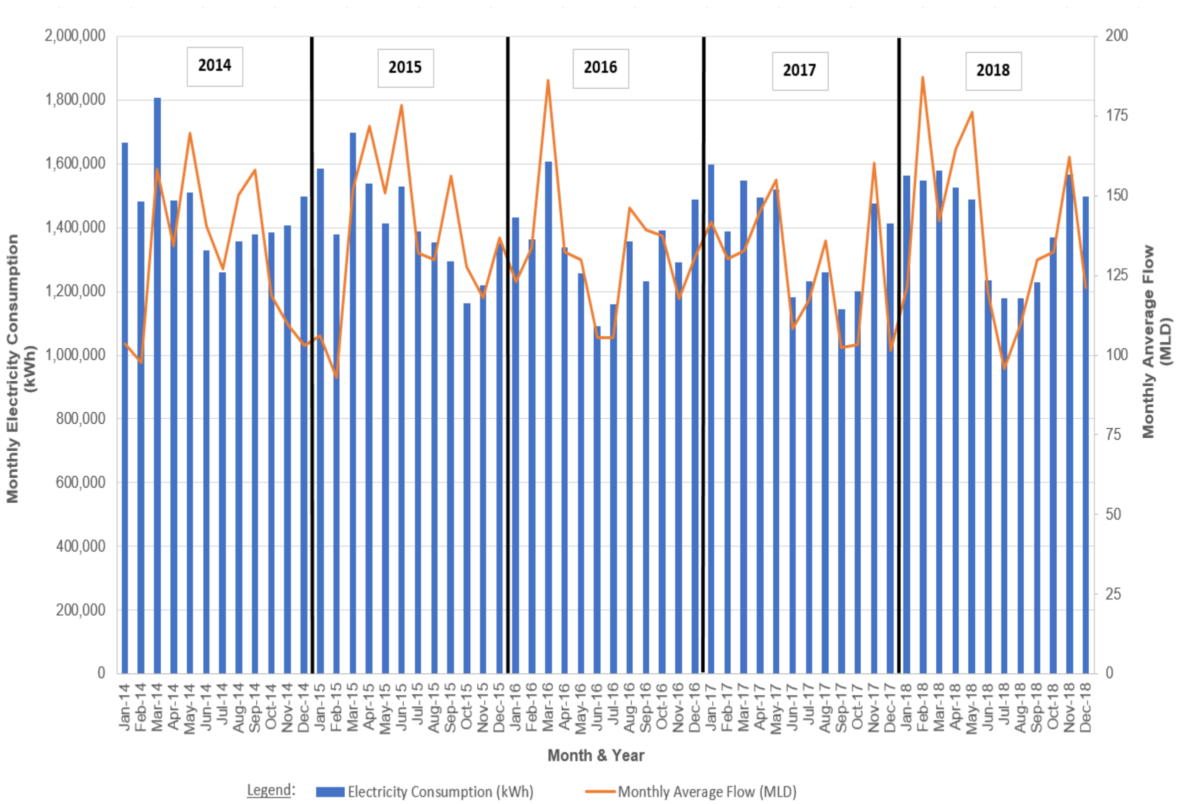

Figure 2.9: Monthly Electricity Use and Treated Flow at the LRWRP (2014-2018)

2.5.1.2 Historical Natural Gas and Diesel Fuel Consumption

Historical natural gas use from 2014 to 2018 is summarized in **Table 2.16**. Gas consumption at the LRWRP was monitored by utility billing invoices. The LRWRP consumes an average of 271,000 m³/yr of natural gas costing $70,000 dollars on average annually. Natural gas consumption in winter months (Jan-April, Oct-Dec) is approximately 95% of the annual gas consumption, which can be attributed to heating the plant.

Table 2.16: Historical Natural Gas Use at the LRWRP (2014-2018)

Year	Annual Gas Consumption (m^3/yr)	Gas Consumption in Winter Months (Jan-April, Oct-Dec) (m^3/yr)	Percentage of Gas Consumption in Winter Months (%)	Utility Natural Gas Cost ($/yr)
2014	316,801	304,608	96%	72,712
2015	264,584	251,862	95%	61,915

2016	215,680	205,604	95%	51,865
2017	Not available	Not available	Not available	Not available
2018	287,566	266,228	93%	84,148
Average	**271,158**	**257,076**	**95%**	**$67,660**

The total diesel fuel purchased at LRWRP was 126,345 L in 2018. This diesel fuel was utilized by onsite generators for backup power generation. The 2018 utility electricity consumed was 16,962,231 kWh. The total power generated by the backup power system was 472,613 kWh, which is approximately 3% of the 2018 total electricity consumed at the plant.

2.5.2 Little River Pollution Control Plant

2.5.2.1 Historical Electricity Consumption and Treated Wastewater Flows

Historical electricity use from 2014 to 2018 is summarized in **Table 2.17**. The table shows that LRPCP consumes 5,765 MWh of electricity costing $0.7 million dollars on average annually.

Table 2.17: Historical Electricity Use at the LRPCP (2014-2018)

Year	Utility Electricity Bill Cost ($/yr)	Utility Electricity Consumed (kWh/yr)	Average Annual Unit Cost ($/kWh)
2014	$710,777	5,939,577	0.120
2015	$761,807	5,614,873	0.136
2016	$848,486	5,673,061	0.150
2017	$691,353	5,784,386	0.120
2018	$584,299	5,813,896	0.101
Average	**$719,000**	**5,765,000**	**0.125**

Figure 2.10 presents monthly raw sewage flows and electricity use between the years 2014 and 2018. The figure shows that the monthly electricity consumption is in the range between 427,326 kWh per month and 553,904 kWh per month with an average of 479,444 kWh/month. As illustrated in **Figure 2.10**, the monthly average daily flow ranges between 31 MLD and 56 MLD with an average of 43 MLD. In general, the electricity consumed is proportional to the volume of treated wastewater at the plant.

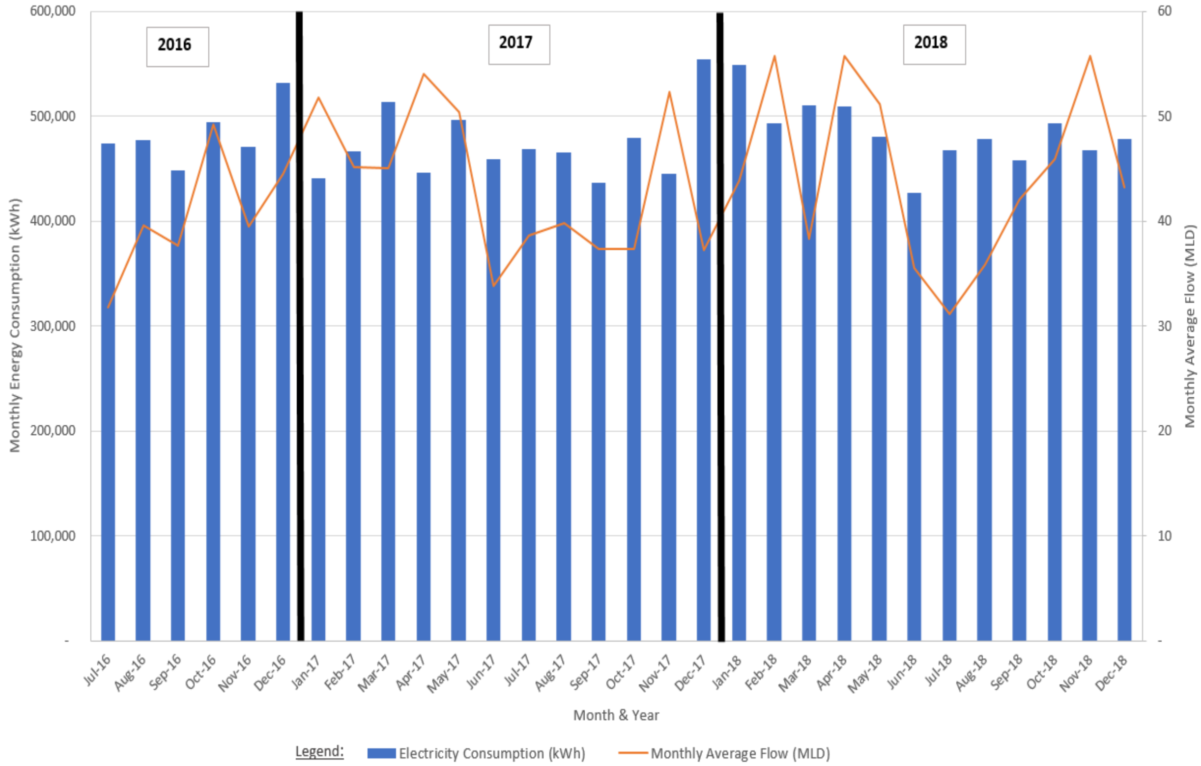

Figure 2.10: Monthly Electricity Use and Treated Flow at the LRPCP (Jul 2016- 2018)

2.5.2.2 Historical Natural Gas and Diesel Fuel Consumption

Historical gas use from 2014 to 2018 is summarized in **Table 2.18**. Gas consumption at the LRPCP was monitored by utility billing invoices. The LRPCP consumes an average of 93,000 m^3/yr of natural gas costing $20,000 dollars on average annually. Natural gas consumption in winter months (Jan-April, Oct-Dec) is above 95% of annual gas consumption because most of the gas load utilized is for building heating.

Table 2.18: Historical Natural Gas Use at the LRPCP (2014-2018)

Year	Annual Gas Consumption (m3/yr)	Gas Consumption in Winter Months (Jan-April, Oct-Dec) (m3/yr)	Percentage of Gas Consumption in Winter Months (%)	Utility Natural Gas Cost ($/yr)
2014	117,311	112,846	96%	28,980.87
2015	72,350	71,294	99%	18,201.72
2016	79,119	75,036	95%	15,276.38
2017	80,489	77,453	96%	21,951.66
2018	119,008	115,693	97%	29,114.99
Average	**93,655**	**90,464**	**97%**	**$22,705.12**

The total diesel purchased at LRPCP was 38,353 L in 2018. This diesel fuel was utilized by onsite generators for backup power generation. The 2018 utility electricity consumed was 5,813,896 kWh. The total power generated by the backup power system was 92,086 kWh, which is approximately 2% of the 2018 total electricity consumed at the plant.

2.5.3 Windsor Biosolids Processing Facility

2.5.3.1 Historical Electricity Consumption

Historical electricity use from 2014 to 2018 is summarized in **Table 2.19**. The table shows that WBPF consumes approximately 2,094 MWh of electricity costing $290,000 dollars each year.

Table 2.19: Historical Electricity Use at WBPF (2014-2018)

Year	Utility Electricity Bill Cost ($/yr)	Utility Electricity Consumed (kWh/yr)	Average Annual Unit Cost ($/kWh)
2014	$246,306	2,035,220	$0.121
2015	$283,285	2,077,060	$0.136
2016	$321,136	2,144,303	$0.150
2017	$313,590	2,124,341	$0.148
2018	$295,600	2,090,622	$0.141
Average	**$292,000**	**2,094,000**	**$0.139**

2.5.3.2 Historical Natural Gas Consumption

Historical gas use from 2014 to 2018 is summarized in **Table 2.20**. The table shows that WBPF consumes 2,600 MCM of natural gas costing $590,000 dollars on average annually. The majority (99%) of the gas consumption at the WBPF was used in the thermal drying process. The remaining natural gas was consumed for building and hot water heating (1%).

Table 2.20: Historical Natural Gas Use at WBPF (2014-2018)

Year	Annual Total Gas Consumption (m^3/yr)	Annual Process Gas Consumption (m^3/yr)	Percentage of Process Gas Consumption (%)	Utility Natural Gas Cost ($/yr)	Average Annual Unit Cost ($/$m^3$)
2014	2,531,576	2,500,415	99%	$672,065	0.265
2015	2,642,644	2,622,578	99%	$533,253	0.202
2016	2,523,830	2,503,541	99%	$453,910	0.180
2017	2,703,482	2,686,728	99%	$697,637	0.258
2018	2,720,396	2,693,487	99%	$614,100	0.225
Average	**2,588,400**	**2,601,300**	**99%**	**$594,200**	**0.210**

2.6 GREENHOUSE GAS EMISSIONS AT THE WINDSOR WASTEWATER TREATMENT FACILITIES

Estimating GHG emissions is an important step in identifying sources (emitters) and sinks that can reduce GHG emissions, so that with intervention GHG concentrations in the future may be at a level that prevents anthropogenic interference and destruction of the earth's atmosphere. To be consistent with GHG accounting standards worldwide, GHG emissions are inventoried into three (3) separate categories or scopes in accordance with industry standard GHG reporting protocols (IPCC 2006). Scope 1 includes all direct GHG emissions (with the exception of biogenic CO_2). Scope 2 includes indirect GHG emissions associated with the consumption of purchased electricity. Scope 3 includes all other indirect emissions not covered in Scope 2, such as emissions resulting from the manufacture of purchased materials or waste disposal occurring outside of an entities jurisdiction.

While organizations worldwide have worked to develop methods to estimate process related GHG emissions from WWTPs, there are no widely accepted standardized guidelines to estimate emissions. The protocols used to compute the historical greenhouse gas emissions at the Windsor Wastewater Treatment Facilities is outlined in the City of Windsor Integrated Site Energy Master Plan. These protocols are the most widely accepted in the municipal wastewater treatment industry in Ontario. They were selected so that process emissions computed from LRWRP and LRPCP use the same emission sources and consistent methodology that are being accounted for by all other WWTPs in Ontario. GHG emissions for the subject analysis were computed for the calendar year 2018. The scope of the analysis started at the headworks of the WWTPs and ended once screenings and grit were hauled to landfill, and the sludge was processed into fertilizer pellets or hauled to landfill.

2.6.1 Lou Romano Water Reclamation Plant and WBPF

The proportion of GHG emissions emitted from each source from LRWRP and WBPF is shown in **Table 2.21**. The total quantity of GHG emitted from the facility is 7,012 tonnes CO_2e in 2018. WWTP's in Ontario that report GHG emissions in the most recent year of reporting reported between 0.1 – 0.3 tonnes CO_2e / ML (for plants with similar treatment process as LRWRP). The LRWRP had a GHG intensity of 0.14 tonnes CO_2e / ML in 2018.

Table 2.21: GHG Emissions from the LRWRP and WBPF (Annually)

IPCC Scope	Description	Fuel Source / Description	GHG Emissions (tonnes CO_2e)
1 (direct emissions from WWTP operation)	Process emissions	Process specific	1,077
	Fuel Oil Burning Equipment LRWRP WBPF Total	Natural Gas	546 + 4,049 4,595
	Vehicles in Fleet	Gasoline	8
	Backup Generator Power	Diesel	354

2 (indirect emissions from purchased electricity)	Electricity LRWRP WBPF Total	Biofuel or Natural Gas	526 + 51 577
3 (indirect emissions from other purchased materials)	Chemicals	Production & Transportation	402
Total GHG Emissions (excluding Biogenic)			**7,010**

Figure 2.11 shows the proportion of GHG's emitted from each source at the LRWRP. The figure shows that the majority (62%) of GHG's were emitted from combusting natural gas. The majority of the natural gas emissions were from the thermal drying process at WBPF (88%). The remainder of natural gas is primarily used for building and hot water heating. GHG's emitted from purchased electricity (8%), and process emissions (25%) were the other two most signficant sources. It should be noted that in other areas of the world the primary source of GHG emissions from wastewater treatment plants is usually from purchased electricity. However, since Ontario decommissioned its last Coal Fired Power Plant prior to 2014, GHG emissions from purchased electricity have signficantly reduced due to lower emissions factors from electricity generating methods that emitt less GHGs. As a result, electricity has a low emission factor per unit energy consumed in Ontario. Typically, electricity has an emission factor of 9g CO_2e/MJ which is much lower than the the next cleanest fossil fuel natural gas which is 49g CO_2e/MJ energy consumed.

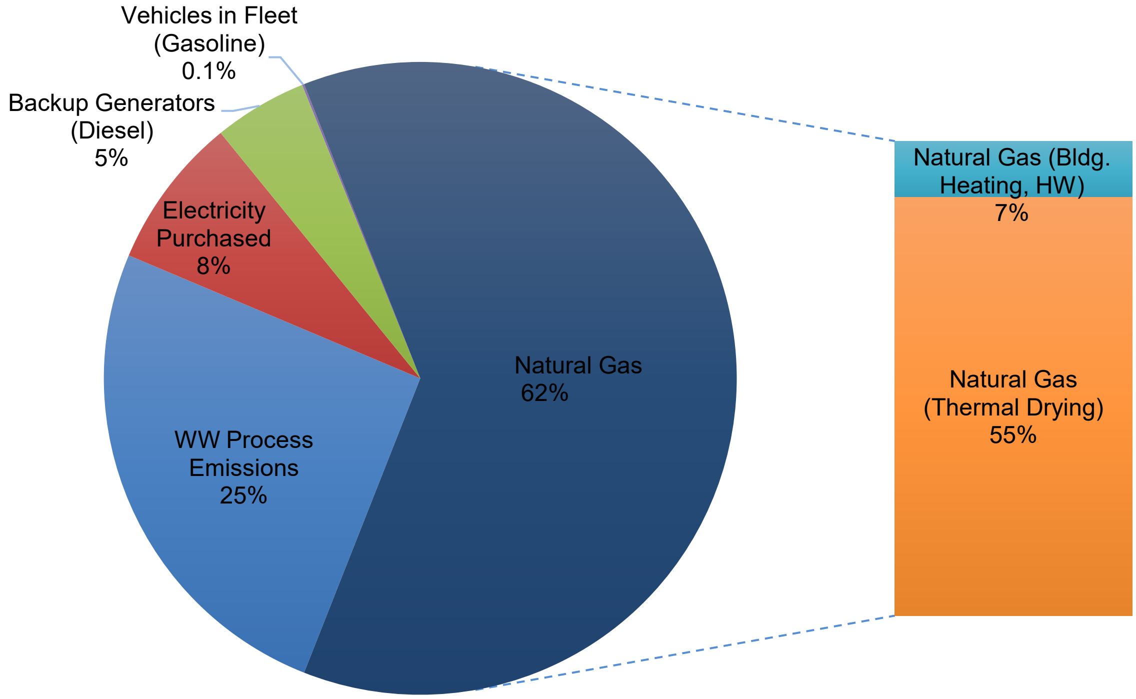

Figure 2.11: Proportion of GHG's Emitted at LRWRP and WBPF Based on Source

Note: (HW = Hot Water)

2.6.2 Little River Pollution Control Plant and WBPF

The proportion of GHG emissions emitted from each source from the LRPCP and WBPF facility is shown in **Table 2.22**. The total quantity of GHG emitted from LRPCP and WBPF is 2,219 tonnes CO_2e in 2018. WWTP's in Ontario that report GHG emissions in the most recent year of reporting reported between 0.1 – 0.3 tonnes CO_2e / ML (for plants with similar treatment process as LRPCP). The LRPC had a GHG intensity of 0.13 tonnes CO_2e / ML in 2018, which is within the range of plants with similar process treatment trains in Ontario.

Table 2.22: GHG Emissions from the LRPCP and WBPF (Annually)

IPCC Scope	Description	Fuel Source / Description	GHG Emissions (tonnes CO_2e)
1 (direct emissions from WWTP operation)	Process emissions	Process specific	458
	Fuel Oil Burning Equipment LRPCP WBPF Total	Natural Gas	223 + 1,117 1,343
	Vehicles in Fleet	Gasoline	5
	Backup Generator Power	Diesel	108
2 (indirect emissions from purchased electricity)	Electricity LRPCP WBPF Total	Biofuel or Natural Gas	180 + 14 194
3 (indirect emissions from other purchased materials)	Chemicals	Production & Transportation	111
Total GHG Emissions (excluding Biogenic)			**2,220**

Figure 2.12 shows the proportion of GHG's emitted from each source at the LRWRP. The figure shows that the majority (60%) of GHG's were emitted from combusting natural gas. The majority of the natural gas emissions were from the thermal drying process at WBPF (83%). The remainder of natural gas is primarily used for building heating. GHG's emitted from purchased electricity (9%), and process emissions (26%) were the other two most signficant sources.

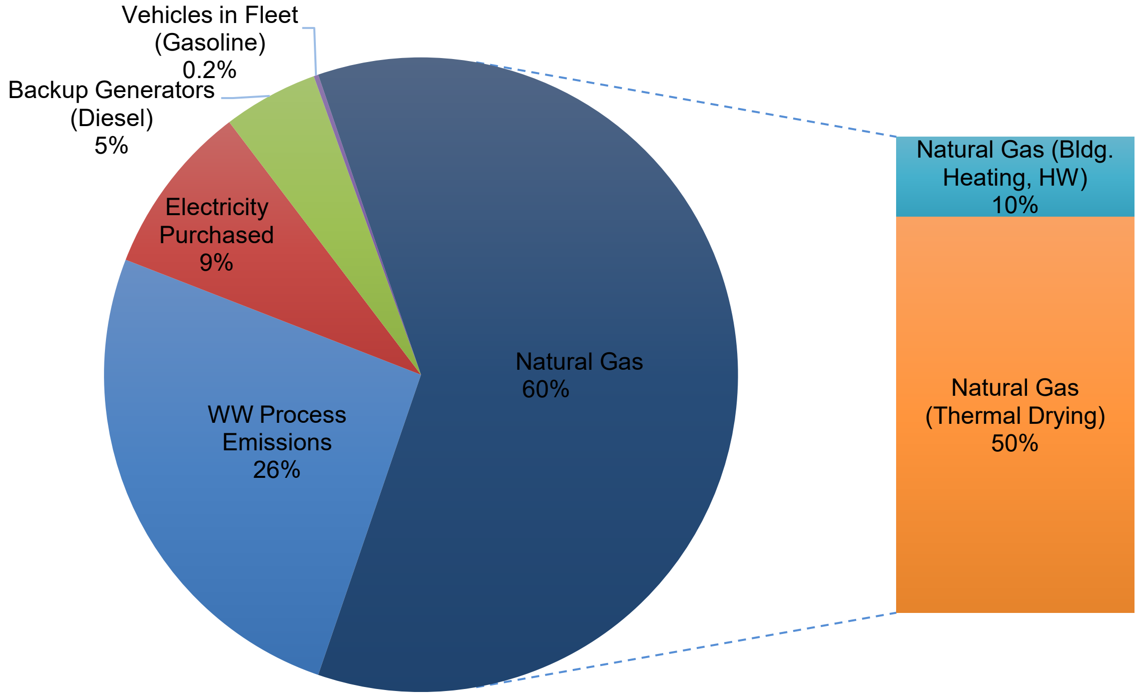

Figure 2.12: Proportion of GHG's emitted at LRPCP and WBPF Based on Source

Note: (HW = Hot Water)

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3.0 STUDY AREA CONDITIONS

The following sections provide an overview of background information and a description of existing conditions within the study area as a basis for comparison. Alternative design solutions and concepts must be evaluated based on their potential impact to existing natural, cultural, social, and economic environments.

3.1 GENERAL DESCRIPTION OF THE STUDY AREA

The City of Windsor is located in Southwestern Ontario on the south shore of the Detroit River and Lake St. Clair directly across from the City of Detroit, Michigan. The population of Windsor is approximately 230,000 with a total land area of approximately 145.3 square kilometers (12,063 hectares). Settlement in the Windsor area dates back to the 1700's with a population of 200 being reported in 1836 and 2,500 in 1892. Development generally started along the riverfront and progressed southerly away from the river as the population increased. More recently, the Canadian Census Program shows the population of the City increased from 217,188 in 2016 to 229,660 in 2021. The Windsor Census Metropolitan Area (which includes the Towns of Amherstburg, LaSalle, Lakeshore, and Tecumseh) is the 14th largest metropolitan area in Canada.

The riverfront area of the City extends from Lake St. Clair approximately 22.5 km downstream to the west limit of the City. The long-term average discharge of the Detroit River is 5,200 m^3/s with mid-channel surface currents of 1 to 1.2 m/s at the Ambassador Bridge. Flow travel time along the riverfront study area from Lake St. Clair to the western City limit is approximately 8 to 9 hours. There are numerous existing uses of the Detroit River as described in the "Detroit River Remedial Action Plan, Stage 1" dated 1991.

- The river supports over sixty species of resident and migratory fish with an associated strong sport fishery.
- The river provides habitat for many resident and migratory birds.
- The river is heavily used for commercial navigation as part of the Great Lakes-St. Lawrence Seaway system with Detroit being the busiest port on the Great Lakes.
- The river is used as a source of cooling water supply for several industries.
- There are five municipal drinking water intakes in the river including the City of Windsor intake in the study area and the Town of Amherstburg intake in the lower reaches of the river near Lake Erie.
- The river serves as a receiving water for municipal and industrial discharges.
- The Detroit River is an important recreational resource used for activities such as swimming, water skiing, jet skiing, scuba diving, fishing, boating, waterfowl viewing and waterfowl hunting.

- The two bathing beaches on the Canadian shore are located upstream of the study area (Sand Point Beach and Stop 26).
- There are extensive park areas in the City of Windsor bordering on the river.

3.2 LAND USE PLANNING AND POLICY

The Provincial Policy Statement (PPS) is a consolidated statement of the government's policies on land use planning. The PPS was issued in 2020 under the *Planning Act* and as such all decisions affecting planning matters shall be consistent with the Provincial Policy Statement. The PPS has policies across five themes: increasing housing supply and mix, protecting the environment and public safety, reducing barriers and costs, supporting rural, northern, and Indigenous communities, and supporting certainty and economic growth. The PPS is a key consideration for identifying land-use planning objectives and evaluating alternative design concepts in Phase 2 and 3 of the Class EA process.

In combination with Municipal Official Plans, the PPS outlines a framework for comprehensive planning that allows Ontario to sustain strong communities, a clean and healthy environment, and economic growth. The key approach for implementing the PPS is through Municipal Official Plans which identify provincial interests and present appropriate land use designations and policies for the local community. It is important that Municipal Official Plans are kept up to date with the PPS to protect provincial interests and ensure that development takes place in suitable areas. This proposed project is consistent with the City of Windsor's Official Plan.

3.3 NATURAL ENVIRONMENT

3.3.1 Climate

The climate in Essex County is classified as modified humid continental, which has hot and humid summers with mild winters and adequate precipitation. In comparison with the other areas in the Province, Essex County's southerly latitude and proximity to the lower Great Lakes provides for warmer summer and winter temperatures with a longer growing season. Because the area is also on one of the major continental storm tracks, it experiences wide variations in day-to-day weather including severe summer thunderstorms. The normal minimum and maximum temperatures are –9 ^{0}C and +28 ^{0}C respectively and the mean daily temperature is above 6 ^{0}C, which tends to increase temperatures in surface waters.

3.3.2 Geology and Physiography

The City of Windsor is located in the physiographic region of Southwestern Ontario known as the St. Clair Clay Plains. As the name suggests the area is covered with extensive clay plains. The topography of the area is extremely flat with elevations ranging from 175 to 204 meters above sea level.

Most of the bedrock under the region is sedimentary limestone of the Devonian age which has a high calcium and magnesium content. The bedrock in the majority of Essex County is covered by glacial drift with a thickness ranging from 3 m to 45 m from west to east. The parent soil material is a heavy ground moraine and lacustrine deposition containing a considerable amount of limestone, appreciable amounts of shale and some igneous rock.

3.3.3 Soils and Subsurface Conditions

Soils within the County of Essex were formed from heavy ground moraine, which has been altered by glacial lake wave action and lacustrine deposition. The majority of the area is part of a smooth clay plain and the predominant soil types are Perth and Brookston clays and their associated clay loams. Developed from dolomitic limestone intermixed with shale, the imperfectly drained member is the Perth clays, and the poorly drained member is the Brookston clays. The clay deposits found in the majority of the Windsor area consist of a stiff silty clay to clayey silt deposited without significant stratification and possessing a distinctively till-like structure with a small fraction of sand and gravel sized particles distributed randomly throughout. In the west end of Windsor, this till-like deposit is overlain by a lacustrine deposit of soft to firm, layered silty clay. This deposit was laid down in the glacial lakes in front of the ice sheet during their retreat in the post glacial period, when the level of Lake Erie was considerably higher than it is at present. These layered strata, of varying thicknesses and strengths, are known to exist up to 30 meters in total depth.

3.3.4 Natural Vegetation

The City lies completely within the Niagara section of the Deciduous Forest Region of Ontario. Favourable soil and climatic conditions have allowed for the extension of many species of Carolinian and prairie flora which makes the region unique in Canada.

The study area (sites near the LRWRP and WBPF) consist mainly of industrial properties. Stantec completed a site investigation, to document existing natural heritage conditions in the study area. Surveys included Ecological Land Classification (ELC) of vegetation communities, a Species at Risk (SAR) habitat assessment of terrestrial features, and a fish habitat assessment. The natural heritage features that were identified through the background review were confirmed during the field surveying. The natural heritage impact assessment report is included in **Appendix C**.

Potential impacts associated with the proposed construction of the biosolids management faciltiy include soil compaction, siltation, and spills of deleterious substances, noise disturbance, and encounters with wildlife. The impacts are considered short term, localized to the construction area during construction activities, and will be mitigated through the application of appropriate construction techniques and mitigation measures.

3.3.5 Terrestrial Life

The land uses in the study area support a limited number of small animals such as squirrels and rabbits that have adapted to human activity. Installation of the biosolids management facility will not result in an impact on vegetation communities. No permanent impact to breeding birds, reptiles and other wildlife is expected as a result of the installation of the biosolids management facility provided appropriate mitigation measures are followed.

3.4 CULTURAL HERITAGE ENVIRONMENT

Cultural heritage resources include archaeological resources, built heritage resources and cultural heritage landscapes.

3.4.1 Archeological Resources

Windsor is an area rich in cultural heritage resources and diversified cultural traditions. Many of the areas along the Detroit River retain cultural and historical significance. **Figure 7.2** (below) shows a map, taken from the City's Archeological Master Plan (2005), identifying areas with archeological potential, which typically require archeological assessments. The map identifies the lands surrounding the LRWRP and WBPF as an area retaining archeological potential.

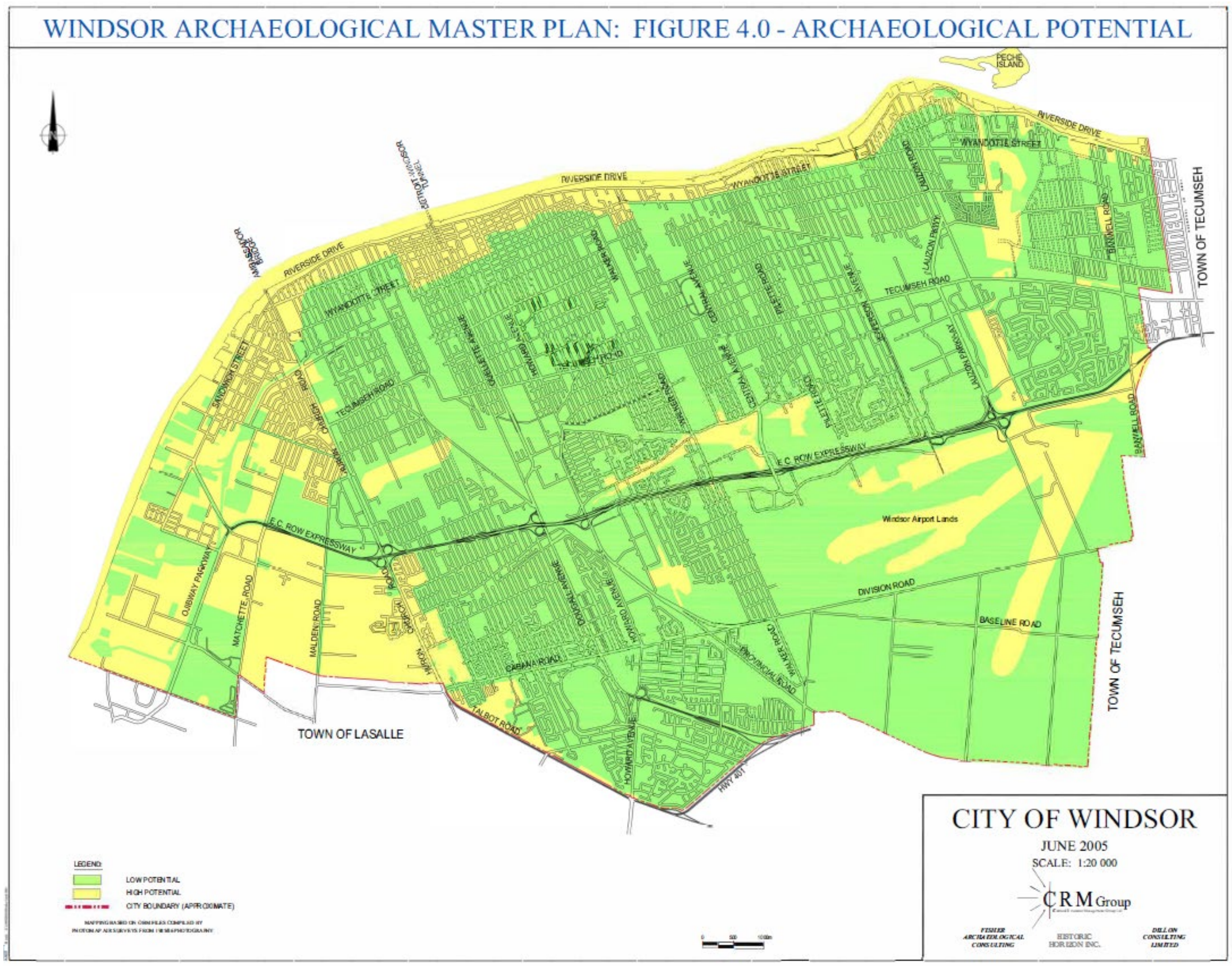

Figure 7.1: Archaeological Potential in the City of Windsor Area

A Stage 1 Archaeological Assessment (AA) was undertaken by Stantec Consulting Ltd. (Stantec) of the LRWRP and WBPF lands (under Project Information Form [PIF] number P422-0031-2023). A Stage 1 AA provides information about a study area's geography, history, previous AAs, and includes a property inspection by a licensed archaeologist to assist in the evaluation of a study area's archaeological potential. Its purpose is to identify areas of archaeological potential and recommend further AA as necessary (i.e., Stage 2). A property inspection was completed by Stantec archaeologists on March 17, 2023. For the LRWRP lands, the study area was identified as being subject to previous and extensive land disturbance and it is anticipated that no further archaeological work will be recommended. The WBPF lands were identified as being subject to previous AA in 2006 and 2007 as part of the Detroit River International Crossing project. No archaeological resources were identified during the 2006 and 2007 AAs and no further archaeological work was recommended for the WBPF lands (ASI 2010).

In summary, no further AA is anticipated to be recommended for the LRWRP or WBPF lands. The Stage 1 AA Report is included in **Appendix C**.

3.4.2 Built Heritage Resources and Cultural Heritage Landscapes

The screening checklist, Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes, developed by the MTCS (now Ministry of Citizenship and Multiculturalism (MCM)), was completed as part of the project file. The heritage resources around the proposed work area (site next to WBPF) were identified based on the Windsor Municipal Heritage Register provided by the City of Windsor. The City of Windsor's Planning and Building Services Department was also consulted to determine the location and details of Built Heritage and Cultural Heritage Landscapes. The completed checklist is included in **Appendix C**. The study area was determined to have low potential for built heritage resources and cultural heritage landscapes. Therefore, no technical cultural heritage studies have been undertaken as part of this Class EA.

4.0 PROBLEM STATEMENT

The City of Windsor owns and operates two wastewater treatment facilities, the LRWRP and the LRPCP, which produce approximately 8,500 and 2,500 dry tonnes of biosolids each year, respectively. The dewatered biosolids, which have a dry solids content of approximately 30%, are heat dried and pelletized at the City-owned Windsor Biosolids Processing Facility (WBPF). The finished pellets are used as a Class A fertilizer and soil amendment throughout Southwestern Ontario. The servicing contract and upgrade requirements for the WBPF will be revisited by 2029 as the capacity of existing biosolids management facility is unable to accommodate projected wastewater biosolids or community growth. Based on the biosolids projections for the two WWTPs, the proposed solution should have the capacity to treat upwards of 24,000 dry tonnes of biosolids each year (20 – year projection) and 34,500 dry tonnes of biosolids each year (ultimate projection).

To address current and future biosolids management needs at the two wastewater treatment plants, the City initiated this study to identify the preferred means of processing wastewater sludge into biosolids. A primary goal of this study was to prioritize solutions which would move the two wastewater treatment plants towards a 'net-zero' energy future and improve upon energy conservation commitments outlined in the City of Windsor Corporate Energy Management Plan and Community Energy Plan. To achieve this goal, the biosolids management strategy will consider biosolids management solutions that improve energy efficiency, plan for effective land use, reduce energy consumption, limit greenhouse gas (GHG) emissions, and promote smart / green energy solutions.

The objective of this Class EA study is to investigate and report alternative methods for addressing biosolids management needs in the City of Windsor. This study will explore the opportunities for processing wastewater biosolids for improved energy recovery, biogas production, and energy savings. Further, the study will identify the preferred design solution and concepts recommended to manage and process the wastewater biosolids with consideration for potential addition of SSO wastes in the future. The SSO waste materials which may potentially be accepted at this facility include municipal food and organic waste, ICI food and organic waste, agricultural organic waste, and high strength organic waste such as food processing waste, dairy waste, and fats, oils, and grease.

5.0 ALTERNATIVE DESIGN SOLUTIONS AND RECOMMENDATIONS

This section presents an overview of the work undertaken for Phase 2 of the Class EA process. Phase 2 involves the identification and evaluation of various design solutions with the objective of determining which alternative best addresses the problem statement. In Ontario, the Municipal Engineers Association defines the Municipal Class EA process and outlines that this phase should include the development of a reasonable range of alternatives. This includes a 'Do Nothing' option as a basis for comparison.

5.1 INTRODUCTION

In this section of the report, alternative design solutions will be identified and evaluated leading to the selection of the recommended design. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Do Nothing
Alternative No. 2: Process Improvements at the Existing WBPF
Alternative No. 3: Incineration
Alternative No. 4: Compost
Alternative No. 5: Anaerobic Digestion and Biogas Utilization

The five alternative solutions were evaluated based on a variety of social, natural environmental, economic, and technical criteria. These evaluation criteria were developed based on biosolids management needs at the two wastewater treatment plants, applicable municipal plans / commitments, design principles, and past industrial experience. The evaluation criteria are as follows:

Technical Criteria:

- Ability to meet biosolids management needs
- Constructability, implementation timeline, and reliability
- Flexibility to meet future needs or climate change predictions
- Ease of operation and maintenance

Social Criteria:

- Impact to archaeological sites or areas of archaeological potential
- Impact to known or potential built heritage resources and cultural heritage landscapes
- Noise, vibration, odour, or air pollution emissions
- Permanent changes or impacts to society including acceptability to the public

- Development policies and agreements

Environmental Criteria:

- Impacts to natural environment including air, climate, vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, surface drainage and groundwater, and soil / geology.
- Regulatory compliances and applicable development / planning policies
- Conservation and optimization of resources including energy recovery, reduction of energy consumption, reductions in GHG emissions, nutrients recovery (where applicable)

Economic Criteria:

- Capital, operational, and maintenance (lifecycle) costs
- Energy savings
- Potential for federal and provincial grant programs

5.2 ALTERNATIVE NO. 1: DO NOTHING

5.2.1 Overview

The "Do Nothing" option sets a benchmark for the evaluation and is a required component of the Municipal Class EA process. This option assumes that nothing is done to address the stated problem and the existing WBPF would continue to be used for biosolids management needs in the City of Windsor. Although this may be an acceptable short-term solution for the remainder of the servicing contract, this is not considered a viable long-term solution (6+ years).

5.2.2 Screening Result

The WBPF is approaching the end of its current servicing contract and would require upgrades to have capacity for future biosolids processing needs. If nothing is done to plan for these future needs, the WBPF will not be able to accommodate the biosolids produced at the City of Windsor's two WWTPs. Further, if nothing is done, there would be no improvements to energy efficiency, energy consumption, GHG emissions, or other energy conservation commitments outlined in the City of Windsor Corporate Energy Management Plan and Community Energy Plan. For these reasons, Alternative No. 1 – Do Nothing was not considered a viable alternative for the long-term Biosolids Management Strategy and was not carried forward for detailed evaluation.

5.3 ALTERNATIVE NO. 2: PROCESS IMPROVEMENTS AT THE EXISTING WINDSOR BIOSOLIDS PROCESSING FACILITY

5.3.1 Overview

Under this strategy, sludge cake from the LRPCP and LRWRP would continue to be processed at the Windsor Biosolids Processing Facility using the existing biosolids management process outlined in **Section 2.3.2**. To meet future sludge handling requirements, the WBPF would need to be capable of processing 90,000 tonnes of wet dewatered sludge per year (20-year design capacity) with consideration for future expansion or phasing to 130,000 tonnes of wet dewatered sludge per year (ultimate design capacity).

The biosolids treatment capacity at the existing WBPF is primarily limited by the operational schedule and evaporation capacity of the rotary drum dryer. The existing rotary drum dryer has an average retention time of 20 minutes and an evaporation capacity of 6,000 kg water/hr. The processing rate is dependent on the moisture content of incoming wet dewatered sludge cake and is typically in the range of 180 to 200 tonnes of sludge per operating day. It is standard for the WBPF to operate 24 hours per day from Monday to Friday with maintenance occurring on Saturday and Sunday. Based on the current sludge production, operational schedule, and evaporation capacity the WBPF processes approximately 47,000 to 52,000 tonnes of wet dewatered sludge each year.

5.3.2 Evaluation

Technical Feasibility

To provide flexibility and meet future needs the capacity of the existing plant would need to significantly increase (nearly three times the current processing volume). Assuming ideal operating conditions and longer operating times (increasing operation to 24 hours per day for 6 days per week), the WPBF would only be capable of processing 62,400 tonnes of wet dewatered sludge each year. This means that the required increase in capacity at the WBPF would not be achievable through operational changes and would only be accomplished through considerable process improvements and expansion of the existing WBPF. Although the thermal drying technology is proven and reliable for the current servicing needs, the WBPF is nearing the end of its design service life and there are considerable process improvements that would be required to maintain operations. The operation and maintenance costs for the drying process at the WBPF are high due to the need to buy large quantities of natural gas and, in turn, burning the natural gas releases excessive amounts of greenhouse gases to the atmosphere. There are a variety of new and proven technologies which could be employed for this application and for these reasons upgrading and expanding the existing WPBF would not be seen as the most technically suitable long-term solution.

Social Impacts

A Stage 1 AA was completed for the lands next to the WBPF and determined, the expansion of the WBPF is not anticipated to have significant impacts on archaeological sites or areas of archaeological potential. The MCM Checklist, Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage

Landscapes, was completed and the proposed work area was determined to have low potential for built heritage resources and cultural heritage landscapes.

The neighbourhood surrounding the existing WBPF is zoned as an industrial district with business parks and heavy industrial complexes. There are no residential properties within the immediate or general vicinity of the WBPF; therefore, permanent changes or impacts to the society are anticipated to be minimal.

<u>Natural Environmental Impacts</u>

The expansion of the WPBF is anticipated to have minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. Potential impacts associated with the expansion would include soil compaction, spills of deleterious substances, noise disturbance, and encounters with wildlife. However, these impacts are considered short term and are localized to the construction area during construction activities. The land uses in the area surrounding the WBPF support a limited number of terrestrial species and vegetation. No permanent impact to breeding birds, reptiles, or other wildlife is expected as a result of the construction provided appropriate mitigation measures and construction techniques are followed.

Further to the considerations from construction activities, it is important to consider the natural environmental impacts in terms of the (i) local development and planning policies and (ii) ability to reduce energy consumption and GHG emissions. Upgrading and expanding the existing WBPF is inconsistent with the City of Windsor Community Energy Plan which focuses on improving energy efficiency, effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. This alternative does not promote the use of green energy solutions for the efficient reuse of wastewater residuals, nor does it allow for a sustainable long-term solution. Although the process upgrades would improve the energy efficiency of the WBPF and reduce the overall energy consumption, the thermal drying process is energy intensive and does not provide the opportunity for significant energy savings or reduction in GHG emissions.

<u>Economic Impacts</u>

The required improvements and cost of land for potential expansion would come at a significant capital cost to the City of Windsor. Further to this capital cost investment, the thermal drying process employed at the WBPF would have higher operation and maintenance costs when compared to other technologies. Historical operation of the WPBF includes thorough equipment replacement, which results from considerable equipment wear and tear and increases the overall cost for maintenance and operations.

5.3.3 Screening Result

The WBPF is approaching the end of its current servicing contract and would require significant process upgrades and expansion to meet future biosolids processing needs. In consideration of the technical, social, natural environmental, and economic factors discussed above, Alternative No. 2 – Process Improvements at the Existing WBPF is not considered a viable alternative for the long-term Biosolids Management Strategy. Although upgrading and expanding the WBPF is not considered a viable long-term solution, this facility has potential to (i) be reutilized for material storage, (ii) provide interim solution, (iii) provide engineering redundancy, or (iv) be reutilized in combination with alternative technologies.

5.4 ALTERNATIVE NO. 3: INCINERATION

5.4.1 Overview

Under this strategy, the biosolids produced in the City's two WWTPs would be dewatered by centrifuge onsite and then transferred to a centralized incineration facility. At the incineration facility the sludge would be combusted, and remaining ash material would be trucked to landfill. The simple process schematic for an incineration facility is shown in **Figure 5.1**.

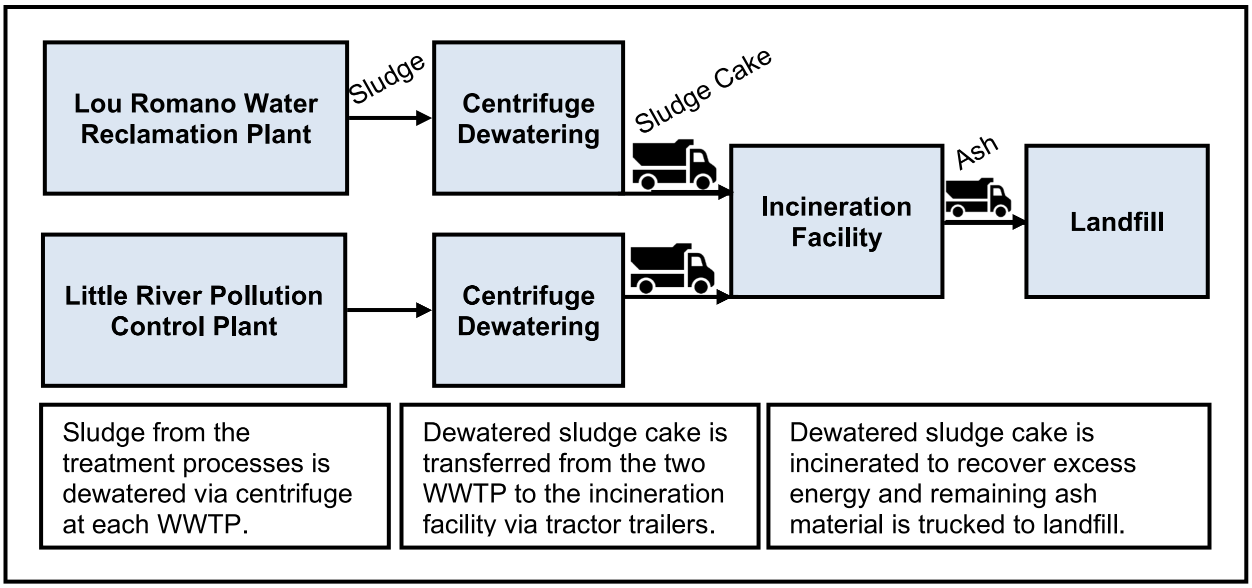

Figure 5.1: Process Schematic for the Incineration Facility

Incineration is a type of thermal treatment technology which may be used to treat residential, commercial, industrial, or institutional wastes. Incineration facilities operating in Canada include waste-to-energy facilities, municipal wastewater sludge incinerators, hazardous waste incinerators, and biomedical incinerators. The industry standard and most commonly applied technology for incineration of municipal sludge are fluidized bed incinerators with comprehensive air pollution control measures. At these facilities, wastewater sludge is burned in a combustion chamber to recover excess energy in the form of heat and/or electricity. Fluidized bed incinerators employ a fluidized bed of granular material at a minimum temperature of 850°C to transfer heat directly to the sludge. Energy from the incineration occurring in the combustion chamber is converted into steam and further into electricity by use of a turbine generator. The electricity recovered from this process can be used to power the incineration facility or sold to the provincial electrical grid. With the exception of the initial start-up period, the process does not require the input of additional heat or energy. Incineration facilities have the capability to reduce the volume of solid waste by up to 90%.

Following combustion, propellers remove the remaining materials from the chamber where they are further separated for material reuse. The granular bed material is separated via sieves and returned to the combustion chamber and metals are removed via magnets to be recycled. The remaining material, ash, is collected, stored, and reutilized or landfilled offsite. There is potential for a portion of the ash material to be beneficially reused to offset raw inputs in cement manufacturing, gypsum material production or other similar industrial applications as available in the region. The incineration facility would provide short-term storage of ash and that which is not reused would be periodically trucked to landfill.

5.4.2 Evaluation

Technical Feasibility

The incineration facility would be designed to have the capability to meet current and future biosolids management needs. Fluidized bed incinerators are a proven and reliable incineration technology for the processing of municipal wastewater sludge. Ideally, the incineration facility would be in operation prior to the end of the existing WBPF servicing contract expiration in 2029. However, the increased complexity for the design, construction, and testing/operation of the facility due to restrictive permitting requirements discussed below may delay the overall implementation timeline. In this scenario, the existing WBPF would be utilized until the incineration facility is in operation and then decommissioned as there is no opportunity for beneficial reuse in combination with the incineration facility.

Social Impacts

The exact location of the proposed facility could not be determined at this stage; however, it is expected that the site would be selected such that the facility is located in an area zoned for heavy industrial complexes. The construction of an incineration facility is not anticipated to have significant impacts to archaeological sites or areas of archaeological potential, built heritage resources, or cultural heritage landscapes given the site for the facility is appropriately selected and assessed for such resources.

Noise, vibration, odour, and air pollution emissions from the incineration facility are anticipated to be minimal as the facility would be designed in accordance with stringent emission requirements and regulations of the Ontario Ministry of Environment Conservation and Parks (MECP). These regulations ensure the facility is designed accordingly and appropriate mitigation measures are in place to minimize emissions to any surrounding properties. More specifically, Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Treatment applies to incinerator systems designed and operated within Ontario under O. Reg. 419/05 of the *Environmental Protection Act*. This guideline controls the installation of air pollution systems; sets air emission limits for particulate matter, acid gases, heavy metals, and polychlorinated dioxins and furans; and establishes requirements for the control, monitoring, and performance testing of incineration systems. Modern incinerators employ air pollution control measures which can remove approximately 99% of pollutants emitted from the incineration process. Although these stringent regulations and monitoring programs would be in place for the facility it is anticipated that the incineration of sewage sludge would not be favorable amongst Windsor residents.

Natural Environmental Impacts

The construction of this incineration facility is anticipated to have minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. The site for the incineration facility would be selected such that no permanent impact to breeding birds, reptiles, or other wildlife is expected as a result of construction provided appropriate mitigation measures and construction techniques are followed.

Further to the considerations from construction activities, incineration facilities are becoming increasingly less common in Ontario and throughout Canada due to stringent environmental regulations, mitigation controls, and monitoring programs. The rigorous environmental permitting requirements and need for comprehensive air pollution controls make incineration less favorable in comparison to land disposal alternatives. Socio-environmental considerations including concerns for anthropogenic climate change and global warming have also led to the decrease in the use of incineration facilities. Further, the use of an incineration facility is inconsistent with the City of Windsor Community Energy Plan which focuses on improving energy efficiency, effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. This alternative does not promote the use of green energy solutions and results in a large quantity of ash material being disposed of in landfills. Although this facility would recover excess energy in the form of electricity, the incineration process would not result in a significant reduction of GHG emissions in comparison to the existing process at the WBPF.

Economic Impacts

The cost of land and construction for the incineration facility would come at a significant capital cost to the City of Windsor. Further to this capital cost investment, the facility would have considerable operation and maintenance costs associated with the incineration, air pollution control, and ash disposal.

5.4.3 Screening Result

The implementation of an incineration facility would provide flexibility to meet current and future biosolids management needs within the City of Windsor. However, from a social, natural environmental, and economic perspective this would not be considered a preferable solution. Negative socio-environmental factors which would limit the use of incineration include rigorous environmental permitting requirements; strict air pollution control and monitoring requirements; GHG emissions and anthropogenic climate change concerns; and the ultimate disposal / landfilling of ash materials. Negative economic impacts include a significant capital cost for implementation, operation, and maintenance of the incineration facility. In consideration of these factors, Alternative No. 3 – Incineration is not considered a viable alternative for the long-term Biosolids Management Strategy.

5.5 ALTERNATIVE NO. 4: COMPOST

5.5.1 Overview

Under this strategy, the biosolids produced in the City’s two WWTPs would be dewatered by centrifuge onsite and then transferred to a centralized composting facility. The composting facility would utilize aerated static pile processing and be fully enclosed with comprehensive odour control systems. At the composting facility the sludge would be processed, stored onsite, and then sold as a fertilizer product for land application throughout Southwestern Ontario. The simple process schematic for the composting facility is shown in **Figure 5.2**.

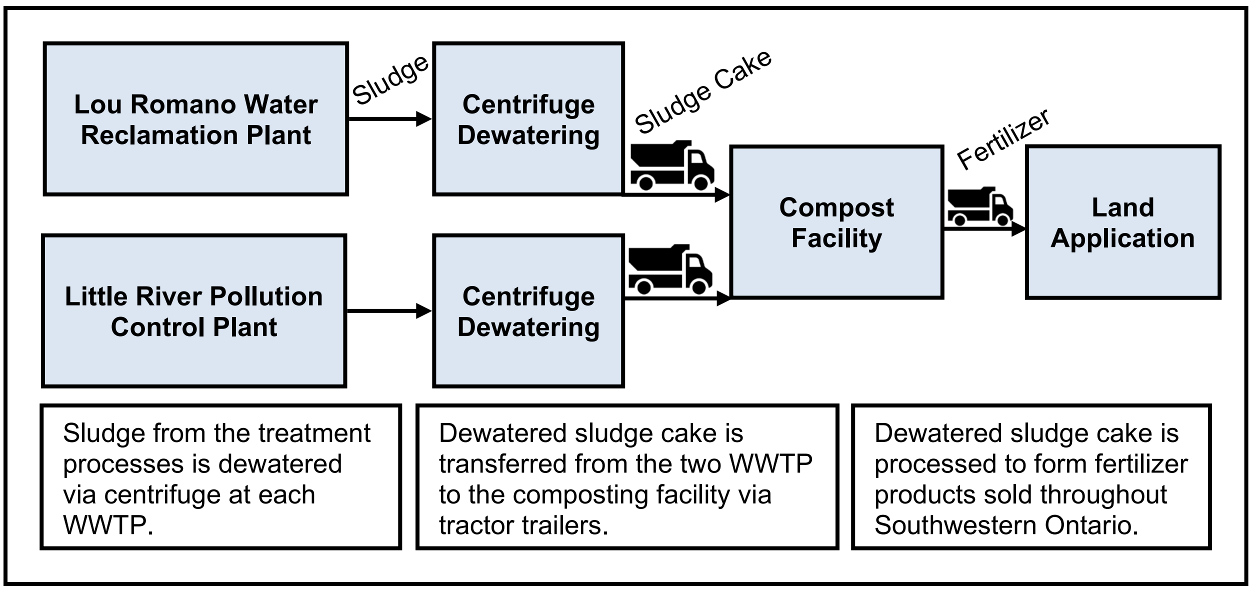

Figure 5.2: Process Schematic for the Compost Facility

Composting is a solids stabilization process which biologically decomposes organic material and destroys pathogens from the solids stream. This process results in a stabilized compost product that can be used as mulch, soil conditioner, or a soil amendment depending on the incoming material. Composting may be used to process a variety of wastes including yard waste, food, paper, municipal solid waste, and sewage sludge. The industry standard for composting municipal sludge is enclosed negatively aerated static pile composting which is a well proven and successful technology used throughout Canada. This technology is beneficial as the final product is a Class A fertilizer which can be effectively stored during winter months and sold for revenue.

At these facilities dewatered sludge is mixed with a bulking agent such as wood chips, municipal solid waste, or SSO waste prior to composting. This mixed composting material is formed into freestanding piles on top of perforated piping or stored in three-walled bunkers that are lined with perforated piping. These piping systems are connected to a blower that push (positive aeration) or pull (negative aeration) air through the pile and control the decomposition process. The use of negative aeration is advantageous as biofilters can be installed in the blower assembly to treat the process air, remove particulate, and eliminate odours prior to venting. The perforated aeration pipes are covered with a layer of wood chips to facilitate air distribution, absorb moisture, and ensure uniform aeration. In addition, a layer of wood chips or recycled compost is used to cover the pile for insulation and improved odour control.

The main parameters that must be controlled to ensure optimum conditions for material decomposition are the oxygen concentration, temperature, and moisture content. The oxygen concentration in the compost pile must be controlled to maintain aerobic decomposition and effectively eliminate odours. The temperature and moisture content in the compost pile must be maintained to provide effective composting, ensure destruction of pathogens, and monitor progression of the decomposition. These parameters should be monitored and can be controlled by increasing or decreasing the aeration rate through the compost pile.

The active composting period is typically 3 to 4 weeks and is followed by a curing period of approximately 4 to 12 weeks. Following the active composting period, material is removed from their existing piles and reformed into curing piles, typically located outdoors. The curing period is essential to further dry, stabilize, and deodorize the material prior to screening and final storage.

There are five (5) major considerations for the design and implementation of a composting facility: (1) tipping / receiving area, (2) active composting area, (3) curing area, (4) product storage, and (5) odour control systems. The tipping and receiving area would be an enclosed building that provides initial storage and pre-processing (if applicable) of wastewater sludge and bulking materials. It is essential that the doors to the building remain closed as much as possible and the building is sized appropriately based on the type of trucks/trailers used for material collection. The receiving building will have frequent air exchanges and a slight negative pressure to reduce odour issues at the facility. If SSO waste is to be processed at this facility, pre-processing with a shredder or other technology would be required and would be located in the receiving area. The active composting area would be an enclosed building that can provide adequate capacity for four weeks of active negative aeration within three-walled bunkers. The curing area would be outdoors and provide adequate capacity for twelve weeks of curing. Following the curing process, the material would be screened and stored onsite until it is sold. The product storage area would provide allowance for storage during the winter months (October to April).

The odour control system at the facility would likely include a biofilter in combination with the negative aeration blowers. The use of a biofilter is common in composting facilities because they are an effective and budget-friendly means of achieving odour control, and the equipment and materials to maintain them are readily available at compost facilities. Biofilters consist of moist organic material curated to adsorb and biologically degrade odorous compounds including ammonia and various volatile organic compounds.

5.5.2 Evaluation

Technical Feasibility

The composting facility would be designed to have the capability to meet current and future biosolids management needs. Negative aerated static pile composting is a proven and reliable technology for the processing of municipal wastewater sludge. Ideally the composting facility would be in operation prior to the end of the existing WBPF servicing contract expiration in 2029. The design, construction, and testing/operation of the facility may be completed within the desired implementation timeline. In this scenario, the existing WBPF would be utilized until the composting facility is in operation and then decommissioned as there is minimal opportunity for beneficial reuse in combination with the composting facility.

The composting facility would be composed of one main building, one curing storage yard, one final product storage yard, and one odour management facility. The composting facility would be sized to accommodate the 20-year sludge projection (24,000 dry tonnes / yr) with consideration for future expansion or phasing to the ultimate sludge projection (34,500 dry tonnes / yr). The site for the composting facility would be selected based on the size requirements for the ultimate sludge projection scenario. The main building will include the receiving area, initial storage, and the active composting area with an initial area of approximately 20,000 m^2 and consideration for expansion to 40,000 m^2. The curing area and storage yard will have an initial area of approximately 20,000 m^2 and consideration for expansion to 40,000 m^2. The odour management facility will have an area of approximately 5,000 m^2 and consideration for expansion to 10,000 m^2. The total size requirements for the site under ultimate design is approximately 130,000 m^2 (13 hectares) with an allowance for interior roadways and clearances (+25%) and mandatory separation along site perimeter (+15 %). This is a large land area requirement for the given project and approximately 8 times larger than that required for an anerobic digestion facility. Due to the size and separation requirements, it is anticipated that the composting facility would be located outside of the City limits. The selected site would need to be zoned or re-zoned for heavy industrial complexes.

<u>Social Impacts</u>

The exact location of the proposed facility could not be determined at this stage; however, it is expected that the site would be selected such that the facility is located in an area zoned for heavy industrial complexes. The construction of a composting facility is not anticipated to have significant impacts to archaeological sites or areas of archaeological potential, built heritage resources, or cultural heritage landscapes given the site for the facility is appropriately selected and assessed for such resources. Although this site would be located outside of the City limits and away from residential properties, additional considerations would be required to ensure the prevention and control of off-site impacts. This will include mitigation and/or control of noise and vibration; air pollutants; odour; leachate; and vermin / vectors.

- Noise and vibration emissions from the composting facility are anticipated to be minimal as the facility would be designed in accordance with stringent emission requirements and regulations of the Ontario Ministry of Environment Conservation and Parks (MECP). These regulations ensure the facility is designed accordingly and appropriate mitigation measures are in place to minimize emissions to any surrounding properties.
- Air pollution studies have shown that bioaerosols (particularly the fungus Aspergillus fumigatus) are commonly present indoor and outdoor at composting facilities. The concentration of these bioaerosols is variable with higher concentrations occurring in the spring and summer. Literature indicates that the off-site concentration of these bioaerosols is typically below the level believed to cause health effects. Moreover, health risk can be reduced through the careful siting of the

composting facility and operational control measures. All components of the composting operation should be located away from sensitive receptors such as residential dwellings, institutional facilities, and other outdoor public areas. The separation distance at each site varies based on geographic conditions (topography, vegetation, elevation, prevailing wind speed, and direction) and the standard distance for facility approval is between 250 and 1000 metres.

- Ontario Regulation 419/05, Air Pollution – Local Air Quality of the *Environmental Protection Act*, establishes contaminant-specific concentration limits for some odorous contaminants. As a part of the environmental compliance approval process, composting facilities will be required to develop an Odour Prevention and Control Plan. Further compliance with O.Reg. 419/05 includes an Odour Impact Assessment and Emission Summary and Dispersion Modelling (ESDM) Report. These assessments involve a summary of total air emissions for individual contaminants from a property which are converted to off-property concentrations using mathematical air dispersion models. Follow-up assessments will also be required to reflect actual operating conditions.

- Water that has come into contact with waste materials at the composting facility, known as leachate, may possess characteristics and contain compounds that can degrade the quality of surface and groundwater if discharged without treatment. Composting facilities can generate significant amounts of leachate. The *Ontario Water Resources Act*, regulates discharges to surface and groundwater, including stormwater and leachate from composting facilities, to ensure that water resources are protected. As a part of the approval process for the composting facilities, studies of the physical, geological, hydrological, and hydrogeological conditions on the site must be conducted. These studies should depict the anticipated quality and quantities of leachate or run-off on site and identify appropriate management options. If leachate is directly discharged to a receiving water body, directly to the ground, or into the subsurface, approval under section 53 of this Act is required.

- Compost material and raw waste at the facility may attract a variety of vermin and vectors including insects, rodents, birds, and other wildlife. If established these vermin and vectors can be difficult to remove and may pose a public health problem. Measures that can be used to control vermin and vectors at a site include prompt processing of organic wastes; maintaining aerobic compost conditions; controlling odour emissions; ensuring regular mixing of curing materials to discourage nesting; and using pest control and traps as necessary.

Although these stringent regulations and monitoring programs ensure that the off-site impacts of the composting process are mitigated it is anticipated that the composting of sewage sludge would not be favorable amongst local residents.

<u>Natural Environmental Impacts</u>

The construction of this composting facility is anticipated to have minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. The site for the composting facility would be selected such that no permanent impact to breeding birds, reptiles, or other wildlife is expected as a result of construction. In addition, appropriate mitigation measures and construction techniques are to be followed for the composting facility.

Further to the considerations from construction activities, the use of a composting facility is inconsistent with the City of Windsor Community Energy Plan which focuses on effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. The implementation of this composting facility would require the acquisition of a large plot of land away from residential and other sensitive receptors. The required amount of land is not readily available within the City limits and would severely alter of hinder long-term land use plans outlined in the Official Plan. Based on this the facility would have to be located outside of the City limits and would need to be incorporated into land use plans for the County of Essex. In terms of reducing energy consumption and limiting GHG emissions, the aeration and curing processes used at the composting facility would be better than the thermal drying process used at the existing WBPF. However, the composting facility would likely be located in the County which significantly increases the energy consumption and GHG emissions associated with transporting the wastewater sludge from the WWTP's to the processing facility. Further, this alternative does not promote the use of green energy solutions, nor does it provide an opportunity for energy recover from wastewater sludge in the form of heat or electricity. Energy recovery from wastewater sludge can be used to significantly reduce or offset electricity consumption, improve the process sustainability, and move wastewater treatment plants towards net-zero energy. Many municipalities throughout North America are implementing alternative technologies which include energy recovering processes as an opportunity for environmental, social, and economic benefits.

Economic Impacts

The opinion of probable cost for a composting facility is summarized in **Table 5.1**. The following is a summary of the key assumptions applied for the OPC assessments presented in this section of the report:

- The Probable Costs are presented in 2023 dollars.
- The capital cost is estimated from equipment cost plus 50% installation cost. Equipment costs are based on vendor supplied price quotations and historical pricing of similar equipment.
- The level of accuracy in projecting costs at this stage of development of a project is typically plus or minus 30% or greater and can be refined as the project develops to a level of plus or minus 10% just prior to tendering. However, the level of accuracy cannot be guaranteed, and the actual final cost of the project will only be determined through the tendering and construction process.
- The preliminary cost analysis does not include an estimate for property acquisition because it is tied to the current real estate market and may vary depending on location. Therefore, it is not possible to produce an accurate estimate of these costs at this stage of the project.

Table 5.1: Opinion of Probable Capital Cost for Composting Facility

Item	Description	Quantity	Unit	Unit Cost ($/Unit)	Cost
1	Property / Land Acquisition	13	ha	Unknown	Not Included
2	Tipping / Compost Building	20,000	m^2	2,500	$ 50,000,000

Item	Description	Quantity	Unit	Unit Cost ($/Unit)	Cost
3	Aeration Equipment	1	LS	10,000,000	$ 10,000,000
4	Air Pollution Control (Biofilter)	5,000	m^2	2,500	$ 12,500,000
5	Process Mechanical, Electrical, Instrumentation and Control	1	LS	5,500,000	$ 5,500,000
6	Mobile Equipment (Front End Loaders, Screen, Compost Turner, Dump Truck)	1	LS	2,000,000	$ 2,000,000
Subtotal					**$80,000,000**
Contingency Allowance (30%)					$ 24,000,000
Engineering Allowance (15%)					$ 12,000,000
Total Capital Cost					**$ 116,000,000**

There are no known government rebate programs available for the implementation of a composting facility for the purpose of processing wastewater sludge. There are government rebate programs available to help municipalities implement waste diversion programs and adopt technologies that generate clean affordable energy. Therefore, the total anticipated capital cost for the implementation of a composting facility is approximately $ 116,000,000 plus the cost for property / land acquisition.

The annual budget for operation and maintenance of the composting facility is summarized in **Table 5.2**. The operation and maintenance costs for the facility include operator and administrative staff labour, trucking, general equipment operation and maintenance, electricity consumption, biofilter media replacement, mechanical equipment maintenance, and laboratory analysis. Since the proposed composting facility is located away from the existing WWTP's there is no opportunity to share operating staff between the facilities.

The aeration blowers and odour control equipment at the composting facility will be operated 24 hours per day 7 days per week to ensure appropriate aeration and odour management. The biofilter media in the odour control system is required to be refreshed annually which would include replacing one third of the media each year. General mechanical maintenance and part replacement will be expected annually for the mobile trucking equipment and on-site mobile equipment.

The O&M cost for the composting facility would be offset with revenue from the sale of the final fertilizer product. The potential annual revenue from selling compost is approximately $1,850,000. This is based on the anticipated compost production of 370,000 m^3 (20-year sludge projection) sold at a unit price of $5.00 per m^3.

Table 5.2: Opinion of Probable Cost for Annual O&M of Composting Facility

Item	Description	Quantity	Unit	Unit Cost ($/Unit)	Cost
1	Labour	27,000	hrs	40	• $ 1,080,000

Item	Description	Quantity	Unit	Unit Cost ($/Unit)	Cost
2	General Equipment O&M	24,000	dry tonnes	120	• $ 2,880,000
3	Biofilter Media Replacement	1	LS	100,000	• $ 100,000
4	Fertilizer Revenue	370,000	m^3	5	+ $ 1,850,000
Total					• $2,210,000

The operation and maintenance cost for a composting facility to service the City of Windsor with consideration for fertilizer revenue is approximately $ 2,210,000 / year.

5.5.3 Screening Result

The implementation of a composting facility would provide flexibility to meet current and future biosolids management needs within the City of Windsor. In consideration of the factors discussed in **Section 5.5.2**, Alternative No. 4 – Composting was carried forward for further evaluation in **Section 5.7**.

5.6 ALTERNATIVE NO. 5: ANAEROBIC DIGESTION AND BIOGAS UTILIZATION

5.6.1 Overview

Under this strategy, it is assumed the biosolids produced in the City's two WWTPs would be processed at a centralized anaerobic digestion facility. Sludge from the LRPCP would be dewatered by centrifuge on-site and then trucked as sludge cake to the anaerobic digestion facility. This sludge cake from the LRPCP would be mixed with liquid waste sludge from the LRWRP and then fed to the anaerobic digestion facility. At the anaerobic digestion facility sludge would be processed (digested), dewatered via centrifuge, stored, and then sold as a fertilizer product for land application throughout Southwestern Ontario. There are opportunities to reduce the biosolids volume, improve the performance of the digesters, and increase biogas production through various pretreatment technologies. Further, there are opportunities to reduce the volume of digestate through further treatment and drying at the existing WBPF. For the evaluation of alternative design solutions, it will be assumed that the anaerobic digestion facility will follow the simple process schematic shown in **Figure 5.3.** Pretreatment technologies, anaerobic digestion technologies, and post processing options will be further reviewed in the evaluation of alternative design concepts.

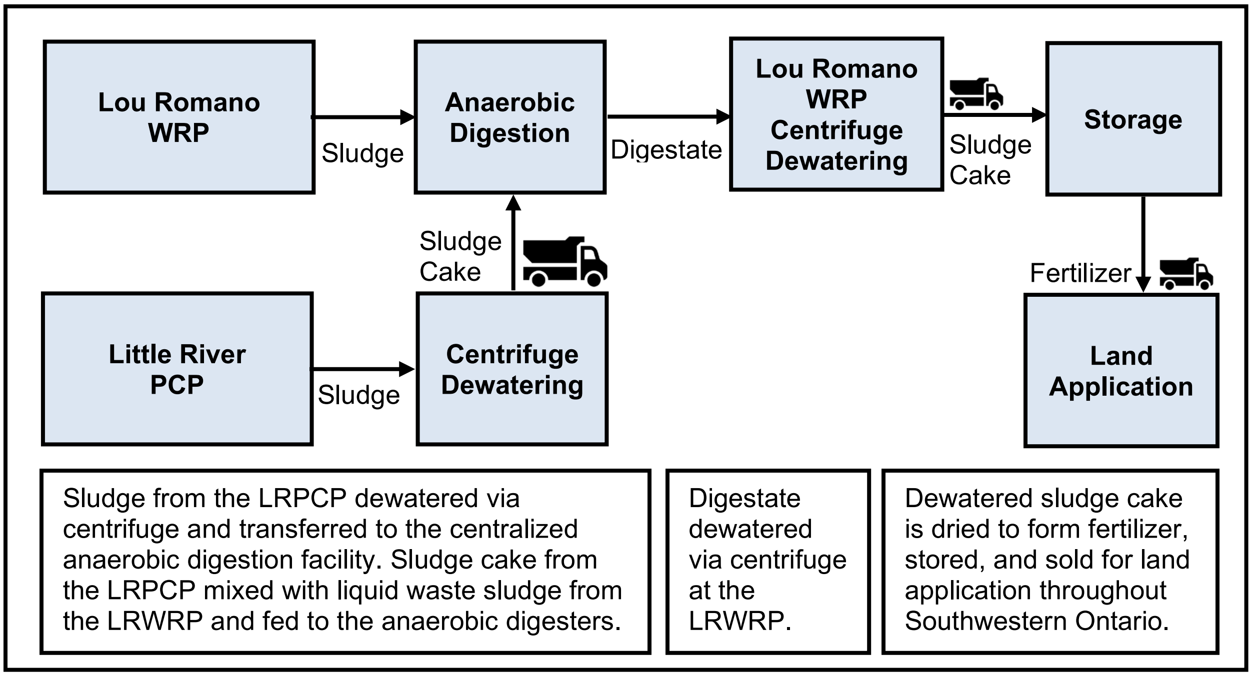

Figure 5.3: Process Schematic for the Anaerobic Digestion Facility

Anaerobic digestion is a solids stabilization process which utilizes microorganisms to decompose organic materials while simultaneously reducing odours and pathogens from the solids stream. This process significantly decreases the volume of biosolids material. The most common digester type for this application is mesophilic anaerobic digesters (MADs) and alternative technologies include thermophilic anaerobic digesters, temperature-phased anaerobic digestion, acid/gas phased digestion, and egg-shaped anaerobic digesters. It is assumed at this stage of the Class EA that MADs will be utilized for the facility, the appropriate anaerobic digester size and type for this facility may be further assessed during the design concept evaluation (**Section 6.0**).

Anaerobic digestion is a biological process which includes four stages: (i) hydrolysis, (ii) acidogenesis, (iii) acetogenesis, and (iv) methanogenesis. In the first stage, hydrolysis, complex organic matter is hydrolyzed to simpler soluble organic compounds. In the subsequent step, acidogenesis, these soluble organic compounds are then fermented to volatile fatty acids (VFAs). In the next step, acetogenesis, VFAs are converted to acetic acid, carbon dioxide, and hydrogen. In the last step, methanogenesis, methanogens convert acetic acid, carbon dioxide, and hydrogen to biogas consisting mainly of methane, carbon dioxide, and some impurities. In this biological process, hydrolysis is considered the rate limiting step.

Enhancing hydrolysis through pretreatment of sludge can improve the performance of MADs and increase biogas production. Typically, pretreatment technologies require an additional input of energy, chemicals, and/or capital cost. The main objective of pretreatment of sludge is to break down biomass cell walls, disintegrate large complex organic compounds, and render the inner organic matter more bioavailable. As a result, pretreatment will accelerate sludge hydrolysis and improve the performance of subsequent anaerobic digestion. Pretreatment options will be further explored in the evaluation of alternative design concepts (**Section 6.0**) and may include: biological pretreatment (enzymatic hydrolysis, temperature-phased anaerobic digestion, microbial electrolysis cell); thermal pretreatment (thermal hydrolysis process (THP)); mechanical pretreatment (ultrasonication, microwave irradiation, electrokinetic disintegration, high-pressure homogenization); electrical (focused pulse); chemical (acidic or alkali pretreatment, ozonation, Fenton oxidation, Fe(ii)-activated persulfate oxidation); or any combination of the above methods.

The gas produced from the anaerobic digesters is a form of renewable energy resource commonly referred to as 'biogas' which can be used as a source for the production of heat, electricity, and/or fuel. Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities. A quantitative analysis of the anticipated biogas production, energy savings, and reduction in GHG emissions is presented in **Section 5.8**.

The quantity and quality of the biogas production at a facility is directly related to the quantity and quality of feedstock materials (sludge characteristics) as well as the operating conditions of the digester. The volatile solids loading may be used to characterize digester performance and estimate volume of biogas production. Biogas is collected in the digester headspace prior to biogas pretreatment and use in a biogas-to-energy technology. The digester headspace is typically maintained below 3 kPA and if the biogas demand is exceeded, excess biogas is flared to regulate pressure. Alternative biogas-to-energy technologies or biogas utilization strategies include: (1) generation of heat for the thermal drying process at the WBPF; (2) on-site generation of heat via a boiler; (3) on-site co-generation of combined heat and power (CHP) via reciprocating engines; (4) upgrade to renewable compressed natural gas (R-CNG) and utilize as an alternative fuel in fleet vehicles; and (5) upgrade to renewable natural gas (RNG) and inject to natural gas pipeline. An overview of the anaerobic digestion process and alternative biogas utilization strategies are shown in **Figure 5.4.**

In recent years, many municipalities have implemented integrated organics management programs that involve processing both municipal wastewater sludge and organic wastes (also called supplementary organic feedstock) within one management facility. The organic waste materials which may potentially be accepted at this facility include municipal food and organic waste, ICI food and organic waste, agricultural organic waste, and high strength organic waste (HSW) such as food processing waste, dairy waste, and fats, oils, and grease (FOG). The focus is not only processing the waste materials within the municipality but maximizing the recovery of their remaining value in the form of electricity, thermal energy, and/or fuel to achieve net-zero energy within wastewater treatment plants. The utilization of supplementary organic feedstock materials such as municipal source separated organics may be further assessed during the design concept evaluation (**Section 6.0**).

The anaerobic digestion process results in the production of biosolids in the form of digestate. The digestate would be dewatered and stored on-site or off-site prior to agricultural land application. The size of this storage would need to be adequate for storage during the winter months. Alternatively, pretreatment technologies or post-treatment at the existing WBPF may be utilized to reduce the volume of and upgrade the quality of the biosolids. Retaining the WBPF is beneficial as there is a proven market for pelletized fertilizer as compared to bulk sludge fertilizer and the storage space required is significantly lower.

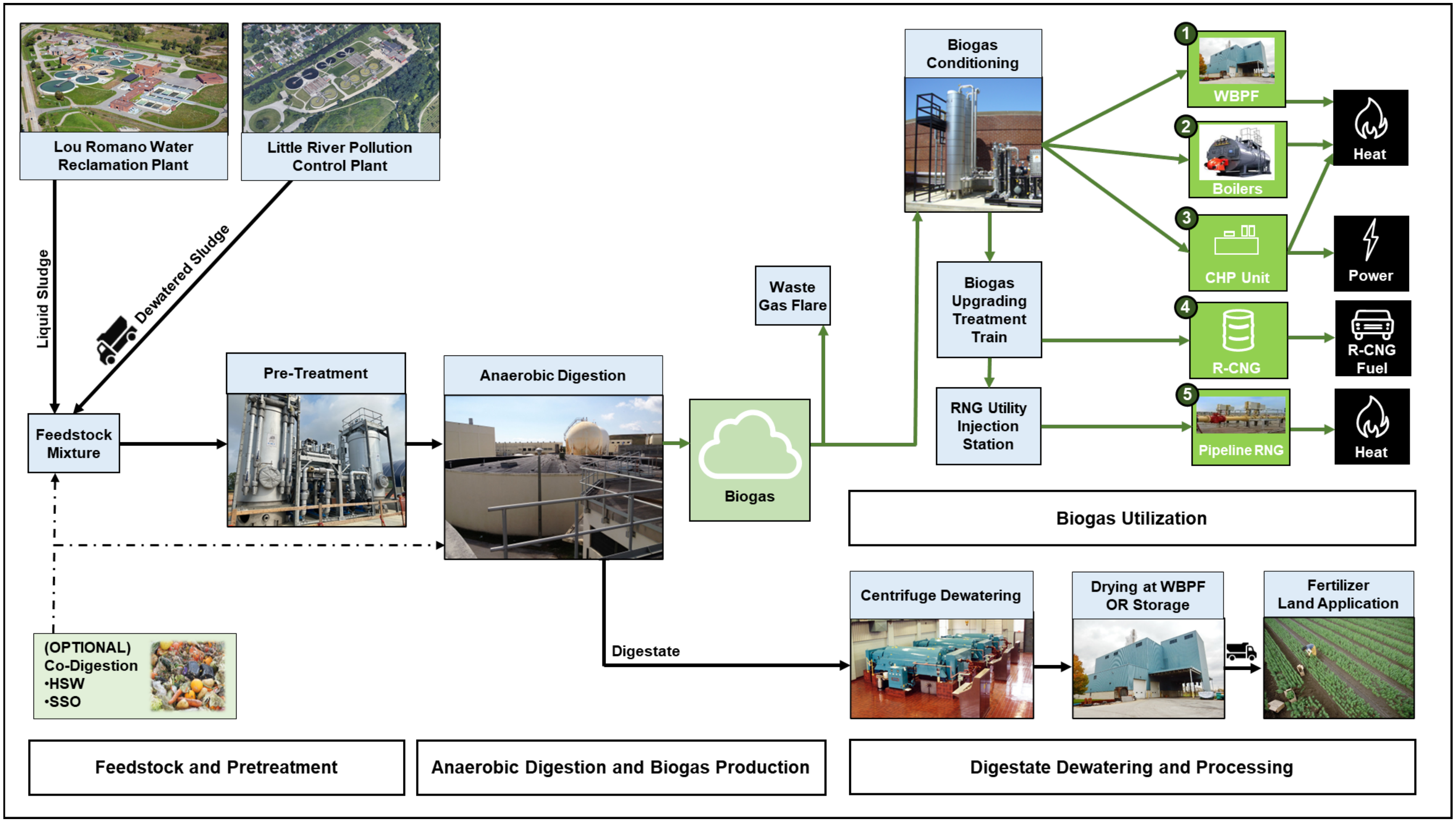

Figure 5.4: Overview of Anaerobic Digestion and Biogas Utilization Alternatives

5.6.2 Evaluation

Technical Feasibility

The anaerobic digestion facility would be designed to have the capability to meet current and future biosolids management needs. Anaerobic digestion is a proven and reliable technology for the processing of municipal wastewater sludge. Ideally, the facility would be in operation prior to the end of the existing WBPF servicing contract expiration in 2029. The design, construction, and testing/operation of the facility may be completed within the desired implementation timeline. In this scenario, the existing WBPF may be utilized after the anaerobic digestion facility is in operation as there is an opportunity for beneficial reuse to provide redundancy or operational flexibility.

The anaerobic digestion facility would be composed of one (1) sludge receiving / temporary storage area, two (2) pretreatment units (one current; one future; if applicable), fourteen (14) digesters (seven current; seven future), one (1) biogas management facility (including biogas conditioning unit), and digestate processing / storage facility. The facility would be sized to accommodate the 20-year sludge projection (24,000 dry tonnes / yr) with consideration for future expansion or phasing to the ultimate sludge projection (34,500 dry tonnes / yr). The site for the anaerobic digestion facility would be selected based on the size requirements for the ultimate sludge projection scenario.

The sludge receiving and temporary storage area would be located near the entrance to the site and require an area of approximately 500 m^2. The pretreatment units will require an area of approximately 100 m^2 (each). The digesters will have an initial area of approximately 3,000 m^2 with consideration for expansion to 6,000 m^2. The biogas management facility will require an area of approximately 600 m^2. The digestate processing and storage facility would require an area of approximately 800 m^2. The total size requirements for the site under ultimate design is approximately 16,000 m^2 (1.6 hectares) with an allowance for interior roadways and clearances (+50%) and mandatory separation along site perimeter (+25 %). Due to the small size and separation requirements, it is anticipated that the facility would be located at the LRWRP or WBPF.

Social Impacts

It is expected that the anaerobic digestion facility would be located at the existing LRWRP or WBPF which are zoned for heavy industrial complexes. A Stage 1 AA was completed for both of these lands and determined, the facility is not anticipated to have significant impacts on archaeological sites or areas of archaeological potential. There are no (i) registered built or cultural heritage resources or (ii) residential properties in the immediate vicinity of the LRWRP or WBPF. The MCM Checklist, Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes, was completed and the proposed work area was determined to have low potential for built heritage resources and cultural heritage landscapes.

It is anticipated that all of the processes employed at the proposed anaerobic digestion facility (receiving building, pretreatment unit, anaerobic digesters, biogas utilization unit, and dewatering facility) would be covered or enclosed with air pollution control devices. Therefore, noise, vibration, odour, and air pollution emitted from this facility are anticipated to be minimal and/or similar to that from the existing wastewater treatment plant and industrial facilities in the area. Based on this and the lack of residential dwellings, recreational facilities, or public outdoor spaces in the area the permanent changes or impacts to the society are anticipated to be minimal.

Further during the implementation phase of this project, throughout detailed design and after the preferred size, layout, and technical specifications for the facility are determined an ESDM Report should be prepared in accordance with Ontario Regulation 419/05. The ESDM Report will outline the potential impact of the proposed facility on local air quality as well as mitigation measures to be followed during the design, construction, and operation of the proposed facility.

Natural Environmental Impacts

The construction of this anaerobic digestion facility is anticipated to have minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. The site for the facility would be selected such that no permanent impact to breeding birds, reptiles, or other wildlife is expected as a result of construction. In addition, appropriate mitigation measures and construction techniques are to be followed for the facility.

Further to the considerations from construction activities, the use of an anaerobic digestion facility is consistent with the City of Windsor Community Energy Plan which focuses on effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. The implementation of this biosolids management facility would not require the acquisition of land and would effectively reuse lands located at the WBPF or LRWRP.

In terms of reducing energy consumption and limiting GHG emissions, the biogas produced from the anaerobic digesters is a form of renewable energy which can be used as a source for the production of heat, electricity, and/or fuel. Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities. A quantitative analysis of the anticipated biogas production, energy savings, and reduction in GHG emissions is presented in **Section 5.8**. Further, this alternative promotes the use of green energy solutions and provides an opportunity for energy recovery from wastewater sludge in the form of heat or electricity. Energy recovery from wastewater sludge can be used to significantly reduce or offset electricity consumption, improve the process sustainability, and move wastewater treatment plants towards net-zero energy. Many municipalities throughout North America are implementing waste-to-energy technologies which include energy recovering processes as an opportunity for environmental, social, and economic benefits.

Economic Impacts

The opinion of probable cost for an anaerobic digestion facility is summarized in **Table 5.3**. The following is a summary of the key assumptions applied for the OPC assessments presented in this section of the report:

- The Probable Costs are presented in 2023 dollars.
- The capital cost is estimated from equipment cost plus 50% installation cost. Equipment costs are based on vendor supplied price quotations and historical pricing of similar equipment.

- The level of accuracy in projecting costs at this stage of development of a project is typically plus or minus 30% or greater and can be refined as the project develops to a level of plus or minus 10% just prior to tendering. However, the level of accuracy cannot be guaranteed, and the actual final cost of the project will only be determined through the tendering and construction process.
- The Opinion of Probable Cost does not include any cost for land acquisition as it is assumed the facility would be located on property which is currently owned by the City of Windsor.

Table 5.3: Opinion of Probable Capital Cost for Anaerobic Digestion Facility

Item	Description	Quantity	Unit	Unit Cost ($/Unit)	Cost
1	Pretreatment Unit	1	Unit	16,000,000	$ 16,000,000
2	Anaerobic Digesters	1	LS	70,000,000	$ 70,000,000
3	Biogas Utilization Facility	1	LS	18,000,000	$ 18,000,000
Subtotal					**$ 104,000,000**
Contingency Allowance (30%)					$ 31,200,000
Engineering Allowance (15%)					$ 15,600,000
Total Capital Cost					**$ 150,800,000**

There are several government rebate programs available which help to facilitate municipalities implementing waste diversion programs and adopting technologies that generate clean affordable energy. Funding programs that may be applicable to this anaerobic digestion facility include the Government of Canada Low Carbon Economy Fund and the Green Municipal Fund with high potential for other programs to open in the future. Therefore, the total anticipated capital cost for the implementation of an anaerobic digestion facility is approximately $ 151,000,000 minus the value of potential government rebates.

The annual budget for operation and maintenance of the anaerobic digestion facility is summarized in **Table 5.2**. The operation and maintenance costs for the facility include operator staff labour, equipment operation, electricity consumption, general equipment maintenance, and laboratory analysis. Administrative staff, maintenance technicians, and a portion of the operating staff may be shared with the existing staff at the WBPF and/or LRWRP.

The O&M cost for the anaerobic digestion facility would be offset with revenue from the sale of the final fertilizer product. The potential annual revenue from selling fertilizer is approximately $1,400,000 based on the anticipated fertilizer production of 280,000 m^3 (20-year sludge projection) sold at a unit price of $5.00 per m^3. In addition, there is potential for the O&M cost to be further offset with cost savings from heat and/or electricity produced from the anaerobic digestion process. The potential annual cost savings from energy savings is approximately $2,000,000 based on the anticipated net electricity production of 16,400,000 kWh (20-year sludge projection) at a unit price of $ 0.12 /kWh.

Table 5.4: Opinion of Probable Cost for Annual O&M of Anaerobic Digestion Facility

Item	Description	Quantity	Unit	Unit Cost ($)	Cost
1	Labour	10,000	hrs	40	• $ 400,000
2	General Equipment O&M	24,000	dry tonnes	40	• $ 1,000,000
3	Fertilizer Revenue	280,000	m^3	5	+ $ 1,400,000
4	Electricity Savings / Revenue	16,400,000	kWh	0.12	+ $ 2,000,000
Total					+ $ 2,000,000

With consideration for fertilizer revenue and electricity savings an anaerobic digestion facility to service the City of Windsor would generate a profit of approximately $2,000,000 / year.

5.6.3 Screening Result

The implementation of an anaerobic digestion facility would provide flexibility to meet current and future biosolids management needs within the City of Windsor. In consideration of the factors discussed in **Section 5.6.2**, Alternative No. 5 – Anaerobic Digestion and Biogas Utilization was carried forward for further evaluation in **Section 5.7**.

5.7 EVALUATION OF ALTERNATIVE SOLUTIONS

In order to objectively compare Alternative No. 4 and 5, an evaluation matrix with a colour rating scale system was utilized. For each of the evaluation criteria the alternatives were assessed and awarded a rating in the colour range of red, yellow, green, or dark green with red being the least desirable and dark green being the most desirable. The description of the colour rating is presented in **Table 5.5**. A summary of the overall scoring is presented in **Table 5.6**.

Table 5.5: Description of Colour Rating for Evaluation Criteria

Colour	Scale	Description
	Poor	Unsuitable or not fit for the desired application; negative impacts; disadvantageous; and/or undesirable given the project timeline, budget, scope, and standards.
	Fair	Acceptable for the desired application; minimal negative impacts; adequate given the project timeline, budget, scope, and standards.
	Good	Suitable or good for the desired application; negligible impacts; and/or agreeable given the project timeline, budget, scope, and standards.
	Very Good	Favourable; positive impacts; advantageous; excellent given the project timeline, budget, scope, and standards.

Table 5.6: Evaluation of Alternative Solutions

<table>
<tr><th>Evaluation Criteria</th><th>Alternative No. 4:
Composting</th><th>Alternative No. 5:
Anaerobic Digestion</th></tr>
<tr><td>Technical Criteria:
Ability to meet biosolids management needs
Constructability, implementation timeline, and reliability
Flexibility to meet future needs or climate change predictions
Ease of operation and maintenance</td><td>Good
Strong ability to meet current biosolids management needs with the ability to process wastewater biosolids in a less energy intensive way for improved energy savings.
Moderately complex construction.
Large land area requirements - the total size requirements for the site under ultimate design is approximately 130,000 m^2 (13 hectares).
It is anticipated that the composting facility would be located outside of the City limits.
The design, construction, and testing/operation of the facility may be completed within the desired implementation timeline.
Proven and reliable biosolids management practice with the ability to produce a marketable final product (Class A fertilizer product).
Flexible to meet future biosolids management needs through the expansion of or addition to active composting building, outdoor curing and product storage area, and odour control systems.
Higher operational requirements - increased labour requirements for moving biosolids / composting materials though the four stages of the composting process.
High maintenance requirements due to the use and upkeep of (i) mechanical components to mix/churn the compost material, (ii) aeration blowers and piping to aerate the compost material, (iii) mechanical / trucking equipment to move compost material, and (iv) biofilter material replacement (annual).</td><td>Very Good
Strong ability to meet current biosolids management needs with the ability to process wastewater biosolids in a less energy intensive way for improved energy recovery, biogas production, and energy savings.
Moderately complex construction.
Smaller land area requirements - the total size requirements for the site under ultimate design is approximately 16,000 m^2 (1.6 hectares).
It is anticipated that the anaerobic digestion facility would be located at the LRWRP or WBPF.
The design, construction, and testing/operation of the facility may be completed within the desired implementation timeline.
Proven and reliable biosolids management practice with the ability to produce a marketable final product (Class B / Class A fertilizer product).
Flexible to meet future biosolids management needs through the addition of pretreatment units or additional digestion units.
Lower operational requirements - highly automated operation procedures with minimal labour requirements for moving solid materials.
Low-moderate maintenance requirements.</td></tr>
<tr><td>Social Criteria:</td><td></td><td></td></tr>
</table>

Evaluation Criteria	Alternative No. 4: Composting	Alternative No. 5: Anaerobic Digestion
• Impact to archaeological sites of areas of archaeological potential • Impacts to known of potential built heritage resources and cultural heritage landscapes • Noise, vibration, odour, or air pollution emissions • Permanent changes or impacts to society including acceptability to the public • Development policies and agreements	Fair • Anticipated to have no significant impact to archaeological sites or areas of archaeological potential given the site for the facility is appropriately selected and assessed for such resources. • Anticipated to have no significant impact to built heritage resources or cultural heritage landscapes given the site for the facility is appropriately selected and assessed for such resources. • Site to be zoned or rezoned heavy industrial complexes. If rezoning is required, this will have a greater impact to society and existing land use planning. • Although this site would be located outside of the City limits and away from residential properties, additional considerations would be required to ensure the prevention and control of off-site impacts. This will include mitigation and/or control of noise and vibration; air pollutants; odour; leachate; and vermin / vectors. Composting facility has a higher potential for these issues due to the outdoor curing and storage yards. • Inconsistent with the City of Windsor Community Energy Plan which focuses on effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. • Greater permanent changes or impacts to the society are anticipated	Very Good • Anticipated to have no significant impact to archaeological sites or areas of archaeological potential (based on Stage 1 AA findings). • Anticipated to have no significant impact to built heritage resources or cultural heritage landscapes (based on screening checklist). • Zoned for heavy industrial complexes. • The noise, vibration, odour, and air pollution emitted from this facility are anticipated to be negligible and/or less than the baseline emissions from the existing wastewater treatment plant and industrial facilities in the area. • Consistent with the City of Windsor Community Energy Plan which focuses on effective land use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. • Permanent changes or impacts to the society are anticipated to be minimal.
Environmental Criteria: • Impacts to natural environment including air, climate, vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas,	● (yellow) Fair • Minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. • Inconsistent with the City of Windsor Community Energy Plan which focuses on effective land use	● (green) Very Good • Minimal impacts to vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, and/or soil. • Consistent with the City of Windsor Community Energy Plan which focuses on effective land

Evaluation Criteria	**Alternative No. 4:** **Composting**	**Alternative No. 5:** **Anaerobic Digestion**
surface drainage and groundwater, and soil / geology. • Regulatory compliances and applicable development / planning policies • Conservation and optimization of resources including energy recovery, reduction of energy consumption, reductions in GHG emissions, nutrients recovery (where applicable)	planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. • Moderate reduction in energy consumption and GHG emissions - composting would be more energy efficient that the thermal drying process used at the existing WBPF. However, the composting facility would likely be located in the County which increases the energy consumption and GHG emissions associated with transporting the wastewater sludge. • Does not promote the use of green energy solutions, nor does it provide an opportunity for energy recover from wastewater sludge in the form of heat or electricity.	use planning, reducing energy consumption, limiting GHG emissions, and promoting smart / green energy solutions. • High reduction in energy consumption and GHG emissions - biogas produced from the anaerobic digesters is a form of renewable energy which can be used as a source to produce heat, electricity, and/or fuel. • Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities.
Economic Criteria: • Capital, operational, and maintenance (lifecycle) costs • Energy savings	Fair • No known government rebate programs available for the implementation of a composting facility for the purpose of processing wastewater sludge. • High capital cost investment - the total anticipated capital cost for the implementation of a composting facility is approximately $ 116,000,000 plus the cost for property / land acquisition. • The operation and maintenance *cost* for a composting facility with consideration for fertilizer revenue is approximately $ 2,210,000 / year.	Good • Several government rebate programs available which help to facilitate municipalities adopting technologies that generate clean affordable energy. Funding programs that may be applicable include the Government of Canada Low Carbon Economy Fund and the Green Municipal Fund with high potential for other programs to open in the future. • High capital cost investment - the total anticipated capital cost for the implementation of an anaerobic digestion facility is approximately $ 151,000,000 minus the value of potential government rebates. • With consideration for fertilizer revenue and electricity savings an anaerobic digestion facility would generate a *profit* of approximately $2,000,000 / year.
Evaluation Results	**Fair**	**Very Good**

5.8 RECOMMENDED SOLUTION

5.8.1 Overview

The above sections present a thorough review and evaluation of alternative design solutions for the management of the City of Windsor biosolids from the LRWRP and LRPCP. This study identified, evaluated, and reported on five (5) alternative design solutions:

Alternative No. 1: Do Nothing
Alternative No. 2: Process Improvements at the Existing WBPF
Alternative No. 3: Incineration
Alternative No. 4: Compost
Alternative No. 5: Anaerobic Digestion and Biogas Utilization

As a part of this Municipal Class EA, these five alternative solutions were evaluated based on a variety of social, natural environmental, economic, and technical criteria. **Section 5.0** summarizes the evaluation criteria, screening of alternatives, detailed evaluation, and outcomes of the analysis. The most preferred alternative and therefore the recommended solution was determined to be Alternative No. 5 – Anaerobic Digestion and Biogas Utilization. Under this strategy, the biosolids produced in the City's two WWTPs would be processed at a centralized anaerobic digestion facility. At the anaerobic digestion facility sludge would be processed (digested), dewatered via centrifuge, stored, and then sold as a fertilizer product for land application throughout Southwestern Ontario. The biogas produced from the anaerobic digesters is a form of renewable energy which can be used as a source to produce heat, electricity, and/or fuel. Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities. A quantitative analysis of the anticipated biogas production, energy savings, and reduction in GHG emissions is shown in the sections below.

5.8.2 Biogas Potential

In recent years, many municipalities have implemented integrated organics management. This involves processing both municipal waste sludge and organic wastes (also called supplementary organic feedstock) within one biosolids management facility. The focus in not only processing the wastes, but also maximizing the recovery of their remaining value in the form of electricity, thermal energy, and/or fuel to achieve net-zero energy within wastewater treatment plants.

Supplementary organic feedstock materials which may be processed at the proposed anaerobic digestion facility include household Source Separated Organic (SSO) waste. SSO's includes food and organic wastes which may be collected through curbside collection programs throughout the City of Windsor or Essex County. In Canada, organic waste can make up to 40% of the total solid waste; however, the mass of SSO accepted at the proposed anaerobic digestion facility is highly dependent on public participation. Therefore, it is considered conservative for this study to evaluate co-digestion assuming 20% of the total solid waste is separated and recovered for potential re-use. The average annual mass of solid waste collected in the City of Windsor from 2012 to 2020, was approximately 51,500 wet tonnes / yr. Therefore, an estimated 10,300 wet tonnes of SSO could be accepted at the proposed facility each year. Additional supplementary feedstock materials that could be utilized at the co-digestion facility include HSW such as commercial or industrial food processing waste, dairy waste, and FOG waste. Co-digesting HSW wastes with sludge is an attractive option because it can significantly increase the biogas/energy yield and create a revenue stream from tipping fees. In the City of Windsor, it is estimated that the HSW and FOG collection station would accept an average of 22.7 m3/day which corresponds to two truckloads of 11.4 m3/day (two truckloads of 3,000 US gallon/day).

Table 5.7 shows the feedstock quantity, volatile solids (VS) loading, and biogas production for each feedstock material based on the historic sludge loading at the LRWRP and LRPCP. The biogas production from digesting sludge from the two wastewater treatment plants is estimated to be 2,050 m^3 biogas/day and 6,950 m^3 biogas/day for LRPCP and LRWRP, respectively. Co-digestion could potentially increase the total biogas production by approximately 50% with 1,350 m^3 biogas/day from digesting liquid HSW and 3,600 m^3 biogas/day from digesting SSO. The total biogas production from anaerobic digestion based on the historic sludge loading is 14,000 m^3 biogas/day.

Table 5.7: Loading and Biogas Production from Anaerobic Digestion (Current – Historic Sludge Load)

Feedstock	Feedstock Quantity	VS Loading (kg/day)	Biogas Production (m^3 biogas/day)
LRPCP Sludge (1)	9,200 wet tonnes /yr	5,100	2,050
LRWRP Sludge (1)	31,200 wet tonnes/yr	17,300	6,950
HSW (2)	22.7 m^3/day	1,000	1,400
SSO (3)	10,300 wet tonnes/yr	4,800	3,600
Total	-	28,200	14,000

(1) Biogas Production Rate = 0.8m^3 biogas/kg VSR; VS/TS = 0.75; VSR = 50%; 27% solids
(2) Biogas Production Rate = 1.5m^3 biogas/kg VSR; VS/TS = 0.95; VSR = 90%; 5% solids
(3) Biogas Production Rate = 1.0m^3 biogas/kg VSR; VS/TS = 0.85; VSR = 75%; 20% solids

Table 5.8 shows the feedstock quantity, volatile solids (VS) loading, and biogas production for each feedstock material based on the anticipated 20-year sludge projection. The biogas production from digesting sludge from the two wastewater treatment plants is estimated to be 6,700 m^3 biogas/day and 13,300 m^3 biogas/day for LRPCP and LRWRP, respectively. The total biogas production from anaerobic digestion based on the projected sludge loading is 25,000 m^3 biogas/day.

Table 5.8: Loading and Biogas Production from Anaerobic Digestion (20-Year Sludge Projection)

Feedstock	Feedstock Quantity	VS Loading (kg/day)	Biogas Production (m^3 biogas/day)
LRPCP Sludge (1)	30,000 wet tonnes /yr	16,700	6,700
LRWRP Sludge (1)	60,000 wet tonnes/yr	33,300	13,300
HSW (2)	22.7 m^3/day	1,000	1,400
SSO (3)	10,300 wet tonnes/yr	4,800	3,600
Total	-	55,800	25,000

(1) Biogas Production Rate = 0.8m^3 biogas/kg VSR; VS/TS = 0.75; VSR = 50%; 27% solids
(2) Biogas Production Rate = 1.5m^3 biogas/kg VSR; VS/TS = 0.95; VSR = 90%; 5% solids
(3) Biogas Production Rate = 1.0m^3 biogas/kg VSR; VS/TS = 0.85; VSR = 75%; 20% solids

5.8.3 Energy Savings Potential

Table 5.9 shows the energy balance for the LRWRP and LRPCP with the projected energy production from anaerobic digestion and biogas utilization in the form of combined heat and power. The energy consumption presented incorporates the historic energy consumption at the LRWRP and LRPCP and projected energy consumption required for sludge thickening, anaerobic digestion, and digestate dewatering. The energy produced from anaerobic digestion of sludge would amount to 40% of the energy required to operate LRWRP and LRPCP. Co-digestion with HSW and SSO could potentially produce an additional energy that amounts to 62% of the total energy required to operate both plants.

Table 5.9: Energy Balance of the LRWRP and LRPCP with Energy Production from Anaerobic Digestion (Current – Historic Sludge Loading)

Feedstock	Energy Consumption (-)		Net Energy Production (+) Anaerobic Digestion and CHP	
	Electricity (MWh/yr)	Total Energy (eMWh/yr)	Electricity (MWh/yr)	Total Energy (eMWh/yr)
LRPCP Sludge	6,000	9,500	1,700	3,600
LRWRP Sludge	17,800	28,000	5,700	12,300
HSW		300	1,100	2,400
SSO	300	1,900	3,000	6,400
Total	24,100	39,700	11,500	24,700

5.8.4 Potential Reduction in GHG Emissions

Table 5.10 shows the effect that anaerobic digestion and biogas utilization in the form of CHP had on GHG emissions for LRWRP and LRPCP. Anaerobic digestion of sludge reduced GHG emissions by 1,400 tonnes CO_{2e}/year and 400 tonnes CO_{2e}/year at the LRWRP and LRPCP, respectively. Co-digestion with HSW and SSO could potentially reduce GHG emissions further to 5,900 tonnes CO_{2e} /year, which corresponds to approximately 35 % reduction in GHG emissions.

Table 5.10: Energy Balance of the LRWRP and LRPCP with Energy Production from Anaerobic Digestion (Current – Historic Sludge Loading)

Feedstock	Existing Conditions (tonne CO_2e/yr)	Anaerobic Digestion with CHP (tonne CO_2e/yr)	
	GHG Emissions (A)	GHG Emissions (B)	GHG Reductions (A – B)
LRPCP Sludge	2,200	1,800	(400)
LRWRP Sludge	7,000	5,600	(1,400)
HSW	-	(200)	(200)
SSO	-	(1,300)	(1300)
Total	9,200	5,900	(3,300)

6.0 ALTERNATIVE DESIGN CONCEPTS AND RECOMMENDATIONS

6.1 INTRODUCTION

This section presents an overview of the work undertaken for Phase 3 of the Class EA process. Phase 3 involves the identification of alternative design concepts (technical alternatives) for the preferred solution, and evaluation of various design concepts with the objective of determining which alternative best addresses the preferred solution. As such, the following sections describe alternative anaerobic digestion and biogas utilization technologies that might be considered for achieving net zero and significantly reducing GHG emissions with wastewater treatment.

In this section of the report, alternative design concepts for an anaerobic digestion facility will be identified and evaluated leading to the selection of the recommended design. The following sections will outline and evaluate design concept alternatives within the following categories:

1. **Sludge Handling**
   - Trucking LRPCP Sludge Cake
   - Pumping LRPCP Liquid Sludge
2. **Sludge Pretreatment**
   - Biological
   - Thermal
   - Mechanical / Electrical
   - Chemical
3. **Type of Anaerobic Digestion**
   - Mesophilic Anaerobic Digesters
   - Thermophilic Anaerobic Digesters
   - Temperature Phased Anaerobic Digesters
   - Acid / Gas Phased Anaerobic Digesters
4. **Site Selection**
   - LRWRP
   - WBPF
5. **Digestate Handling**
   - WBPF
   - Storage and Land Application
6. **Biogas Utilization**
   - Heat (via boiler)
   - Combined Heat and Power
   - Renewable Compressed Natural Gas
   - Renewable Natural Gas

The alternative design concepts were evaluated based on a variety of social, natural environmental, economic, and technical criteria. These evaluation criteria were developed based on biosolids management needs at the two wastewater treatment plants, applicable municipal plans / commitments, design principles, and past industrial experience. The evaluation criteria are as follows:

Technical Criteria:

- Ability to meet biosolids management needs
- Constructability, implementation timeline, and reliability
- Flexibility to meet future needs or climate change predictions
- Ease of operation and maintenance

Social Criteria:

- Impact to archaeological sites or areas of archaeological potential
- Impact to known or potential built heritage resources and cultural heritage landscapes
- Noise, vibration, odour, or air pollution emissions
- Permanent changes or impacts to society including acceptability to the public
- Development policies and agreements

Environmental Criteria:

- Impacts to natural environment including air, climate, vegetation, fish and wildlife, areas of natural and scientific interest, environmentally sensitive areas, surface drainage and groundwater, and soil / geology.
- Regulatory compliances and applicable development / planning policies
- Conservation and optimization of resources including energy recovery, reduction of energy consumption, reductions in GHG emissions, nutrients recovery (where applicable)

Economic Criteria:

- Capital, operational, and maintenance (lifecycle) costs
- Energy savings
- Potential for federal and provincial grant programs

6.2 SLUDGE HANDLING

In this section of the report, alternative design concepts for the handling of sludge from the LRWRP and LRPCP will be identified and evaluated leading to the selection of the recommended design. Currently, sludge at the LRWRP and LRPCP is removed from the treatment process and dewatered on-site by centrifuge. Following the centrifuge process, the dewatered sludge cake has a dry solids content in the range of 25 to 30 % (typically 27 %). Dewatered sludge cake from both of the wastewater treatment facilities is then transferred to the WBPF by tractor trailer for further processing.

With the implementation of an anaerobic digestion facility alternative methods must be assessed to determine the preferred sludge handling and transportation method. Sludge from the LRWRP and LRPCP will need to be transported to the proposed anaerobic digestion facility using one of two methods: (i) sludge dewatering via centrifuge with transferring via tractor trailer or (ii) pumping of dilute liquid sludge. The method used for sludge handling will influence the sludge feedstock characteristics and solids content which directly impacts the ability to meet technical requirements for anaerobic digestion. The anaerobic digestion facility will be located close to the LRWRP; therefore, it is anticipated that the sludge will be handled using the second method, pumping dilute liquid sludge. Employing this method for the LRWRP sludge will not require a significant capital cost investment and will have minimal social and natural environmental impacts. Whereas the anaerobic digestion facility will be located far from the LRPCP; therefore, it is necessary to evaluate each sludge handling method to determine the preferred strategy. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Trucking LRPCP Sludge Cake and Pumping LRWRP Liquid Sludge

Alternative No. 2: Pumping LRPCP Liquid Sludge and Pumping LRWRP Liquid Sludge

6.2.1 Alternative No. 1 – Trucking LRPCP Sludge Cake

Under this strategy the liquid sludge from the LRPCP would be centrifuged onsite to a dry solids content of approximately 27 %. Next, the dewatered sludge cake would be trucked via tractor trailer to a sludge holding tank at the anaerobic digestion facility. The liquid sludge from LRWRP would be removed from the treatment process with a solids content of approximately 5 % and pumped to the nearby anaerobic digestion facility sludge holding tank. The liquid sludge from the LRWRP would be mixed with sludge cake from LRPRP in the sludge holding tank, diluted/thickened (as necessary), input to the pretreatment process (if applicable), and then fed to anaerobic digestion. The simple process schematic for this alternative is shown in **Figure 6.1**.

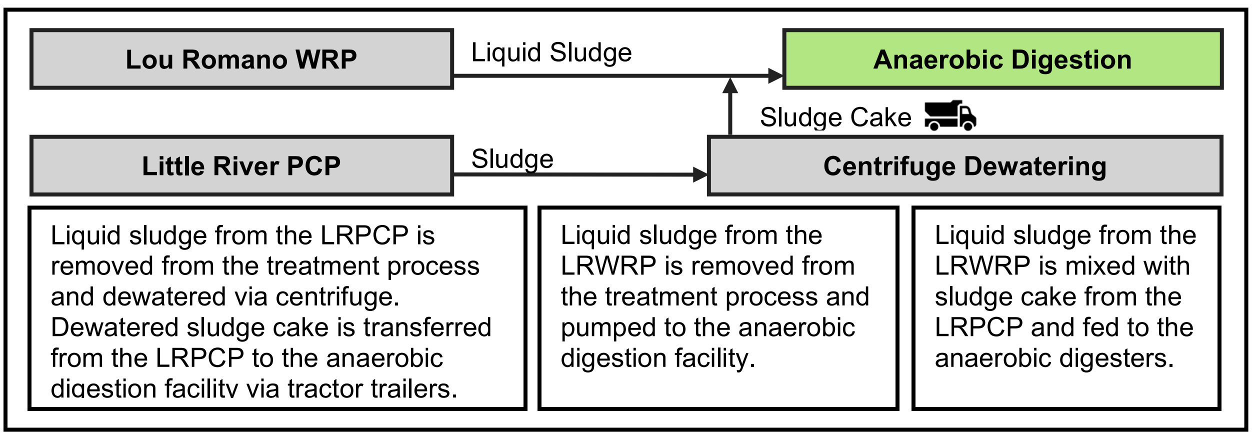

Figure 6.1: Process Schematic for Trucking LRPCP Sludge Cake

Benefits of this sludge handling method include a higher level of control over the solids concentration and loading to the anaerobic digesters. With this method the mixing of liquid sludge from LRWRP and dewatered sludge from LRPCP may be controlled to provide a suitable solids content for anaerobic digestion. If a sludge pretreatment technology is employed prior to anaerobic digestion, sludge thickening may be required. In comparison to the other sludge handling alternative, the solids content in the mixed sludge is significantly higher and closer to the desired value for pretreatment. This is beneficial at it will require less energy and/or resources to be input for the sludge thickening process.

In addition, the number of tractor trailer loads may be easily scaled up or down based on the sludge production at the LRPCP. This will provide flexibility to meet current and future sludge handling needs without the requirement for addition funding. This transfer method is consistent with the current sludge handling protocol at the LRPCP which will allow the City of Windsor to follow existing practices and protocols. Since the City of Windsor operating staff is familiar with this method there will be simple and continuous operation of sludge transfer from the LRPCP. For this sludge handling strategy, there are some level of social and environmental impacts due to the transportation and emissions from transferring the sludge by tractor trailer across the City. However, these impacts are equivalent to the existing sludge handling strategy and are not anticipated to increase due to the implementation of the anaerobic digestion facility. The energy recovered from the sludge at the anaerobic digestion facility in the form of biogas would offset the transportation emissions associated with transferring this sludge.

6.2.2 Alternative No. 2 – Pumping LRPCP Liquid Sludge

Under this strategy the liquid sludge from the LRPCP would be removed from treatment process and diluted (as necessary) to a solids content of approximately 2 %. Next, this liquid sludge would be pumped via a new pipeline to a sludge holding tank at the anaerobic digestion facility. The liquid sludge from LRWRP would be removed from the treatment process with a solids content of approximately 5 % and pumped to the nearby anaerobic digestion facility sludge holding tank. The liquid sludge from the LRWRP and LRPCP would be mixed, thickened (as necessary), input to the pretreatment process (if applicable), and then fed to anaerobic digestion at approximately 4 % dry solids. The simple process schematic for this alternative is shown in **Figure 6.2**.

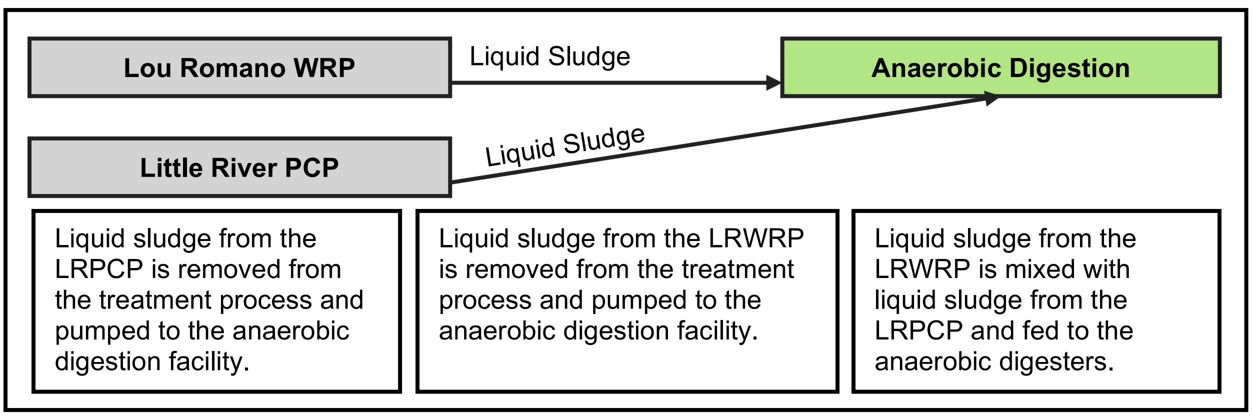

Figure 6.2: Process Schematic for Piping LRPCP Liquid Sludge

Benefits of this sludge handling method include eliminating the need to operate the dewatering facility at the LRPCP and the partial automation of sludge transfer from the LRPCP to the anaerobic digestion facility. The operation of the dewatering centrifuges at a wastewater treatment facility account for a portion of the overall energy usage and operation and maintenance requirements. With this strategy the dewatering facility at LRPCP may be decommissioned which would lower the overall operations and maintenance requirements for the facility.

Drawbacks of this sludge handling method include a lower level of control over the solids concentration and loading to the anaerobic digesters. With this method there is less control over the mixing of liquid sludge from LRWRP and dilute liquid sludge from LRPCP and some processing may be required to provide a suitable solids content for anaerobic digestion. If a sludge pretreatment technology is employed prior to anaerobic digestion, sludge thickening will be required. In comparison to the other sludge handling alternative, the solids content in the mixed sludge is significantly lower and more energy and/or resources will be required for the sludge thickening process.

The implementation of this solids management strategy would require approximately 20 km of forcemain piping across the City of Windsor as well as multiple pumping stations. This would come at a significant capital cost investment from the City of Windsor. This piping system would have complex construction, operations, and maintenance requirements with the need for multiple property acquisitions and regulatory approvals. This construction would have major social and environmental impacts along the route of the piping system and is not likely to be favourable to the community as a whole. This alternative would have significantly higher potential for impact to archaeological sites or areas of archaeological potential as well as impacts to known or potential built heritage resources and cultural heritage landscapes.

In addition, there is limited ability to scale this process up or down based on the sludge production at the LRPCP. In order to meet future needs the pipeline which connects the two facilities may need to be upgraded or twinned. This will have a significant social-environmental impact and require additional capital cost investments which limits flexibility to meet current and future sludge handling needs. This transfer method is different from the current sludge handling protocols at the LRPCP which will require some retraining and updates to the existing practices and protocols. Since the City of Windsor operating staff is familiar with the current method there may be some disruptions to the operation of sludge transfer from the LRPCP.

6.2.3 Evaluation of Sludge Handling Alternatives

The evaluation of the alternative sludge handling concepts is shown in **Table 6.1**.

Table 6.1: Evaluation of Alternative Sludge Handling Concepts

Evaluation Criteria	Alternative No. 1 – Trucking LRPCP Sludge Cake	Alternative No. 2 – Pumping LRPCP Liquid Sludge
Technical Suitability	Very Good • More suitable solids content for anaerobic digestion or sludge pretreatment technologies • High level of control over solids concentration fed to anaerobic digestion • Flexible to meet future needs • No construction • Simple O&M	Poor • Sludge thickening would be required to reach suitable solids content for anaerobic digestion or pretreatment • Lower level of control over solids concentration fed to anaerobic digestion • Less flexible to meet future needs • Complex construction • Moderately complex O&M
Social & Natural Environment	Good	Fair

Evaluation Criteria	Alternative No. 1 – Trucking LRPCP Sludge Cake	Alternative No. 2 – Pumping LRPCP Liquid Sludge
	• Emissions from transportation across the City (equivalent to existing management strategy) • Lower potential for impact to archaeological sites or areas of archaeological potential • Lower potential for impact to known or potential built heritage resources and cultural heritage landscapes	• High social and environmental impact from installation of approximately 20 km of forcemain piping and multiple pumping stations • Higher potential for impact to archaeological sites or areas of archaeological potential • Higher potential for impact to known or potential built heritage resources and cultural heritage landscapes
Economic	Good • No capital cost • Moderate O&M	Fair • High capital cost • Low-moderate O&M cost
Overall	Good	Fair

Based on this analysis, trucking LRPCP sludge cake and pumping LRWRP liquid sludge to the anaerobic digestion facility appears to be preferred. Benefits of this alternative include the increased control over the solid's concentration fed to the pretreatment unit or anaerobic digesters, lower capital cost, and flexibility to meet future needs. Further, this alternative would avoid the negative social, economic, and natural environmental impacts of installing a long forcemain from the LRPCP to the LRWRP which would likely require multiple pumping stations across the City of Windsor. The option to pipe sludge from the LRPRP to the anaerobic digestion facility should be reconsidered during future LRPCP expansion studies or when major upgrades of the LRPCP centrifuges are anticipated.

6.3 SLUDGE PRETREATMENT

In the biological process of anaerobic digestion, hydrolysis is considered the rate limiting step. During hydrolysis, complex organic matter reacts in the presence of water to form simpler soluble organic compounds. Enhancing hydrolysis through pretreatment of sludge can improve the performance of anaerobic digestion and increase biogas production. Pretreatment technologies commonly require an additional input of energy, chemicals, and/or capital cost. The main objective of pretreatment of sludge is to break down biomass cell walls, disintegrate large complex organic compounds, and render the inner organic matter more bioavailable. As a result, pretreatment will accelerate sludge hydrolysis and improve the performance of subsequent anaerobic digestion including increasing volatile solids reduction (VSR) and improving biogas production. Pretreatment options may include: biological pretreatment (enzymatic hydrolysis, temperature-phased anaerobic digestion, microbial electrolysis cell); thermal pretreatment (thermal hydrolysis process (THP)); mechanical pretreatment (ultrasonication, microwave irradiation, electrokinetic disintegration, high-pressure homogenization); electrical (focused pulse); chemical (acidic or alkali pretreatment, ozonation, Fenton oxidation, Fe(ii)-activated persulfate oxidation); or any combination of the above methods.

In this section of the report, alternative design concepts for the pretreatment of sludge will be identified and evaluated leading to the selection of the recommended design. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Biological Pretreatment

Alternative No. 2: Thermal Pretreatment

Alternative No. 3: Mechanical / Electrical Pretreatment

Alternative No. 4: Chemical Pretreatment

6.3.1 Alternative No. 1: Biological Pretreatment

Biological pretreatment methods employ microorganisms to breakdown the biomass rendering it more bioavailable for anaerobic digestion thus improving biogas production. Microorganisms utilized for this pretreatment method include fungal or bacterial strains, microbial consortia, or enzymes. Biological pretreatment methods include enzymatic hydrolysis and microbial electrolysis cells. The chosen application varies depending on the chemical composition of the substrate material, structural/facility requirements, and economic factors; however, enzymatic hydrolysis is more common for the treatment of wastewater sludge. Enzymatic hydrolysis typically involves the construction of up to six (6) enzymatic hydrolysis tanks in series upstream of the anaerobic digesters. The goal is to shift the reactor kinetics away from complete mixed reaction to a plug flow condition in which temperature, enzyme type, and concentration can be controlled to improve VSR and digestion capacity as well as reduce the production of inhibitory substances and sterilizes waste eliminating pathogens. Advantages of biological pretreatments in comparison to other pretreatment methods are the low energy and chemical requirements within a compact footprint for improved biogas potential and thus energy savings. However, there are limited full scale applications for the pretreatment of wastewater sludge with conflicting findings in scientific papers related to full-scale biological pretreatment.

6.3.2 Alternative No. 2: Thermal Pretreatment

Thermal pretreatment methods employ heat and pressure to breakdown biomass rendering it more bioavailable for anaerobic digestion. The main thermal pretreatment method used for wastewater sludge is Thermal Hydrolysis Process (THP) which is a pre-digestion conditioning process which treats solids in a batch reaction at elevated temperature and pressure. THP consists of three main phases:

- (Phase 1) Preheating
- (Phase 2) Heating and Batch Reaction
- (Phase 3) Depressurizing

The preheating phase occurs in the pulper where pre-thickened sludge at a solid's concentration of approximately 14 to 16 % is heated using steam recycled from the flash tanks. The heating and batch reaction phase occurs in the reactor where the feedstock is heated to 165 °C at a high pressure of approximately 8 to 9 bar gauge. From the reactor, hydrolyzed sludge at a solid’s concentration of approximately 10 % is transferred to the flash tank. The depressurizing phase occurs in the flash tank where it is rapidly depressurized and diluted further to approximately 8% to 12% total solids. Following this stage, the pretreated sludge temperature is reduced to approximately 40°C before it is fed to the digesters.

This process enhances digestion rate resulting in shorter retention time, smaller digesters’ footprint, more biogas production, sludge disinfection, enhanced dewaterability, and Class A biosolids production. This technology is a proven and reliable with full-scale applications in operation throughout North America. The main provider of THP systems for pretreatment of wastewater sludge is Cambi.

6.3.3 Alternative No. 3: Mechanical / Electrical Pretreatment

Mechanical and electrical pretreatment work to break apart sludge flocs and denature complex biological molecules making biomass more bioavailable for anaerobic digestion. Mechanical and electrical pretreatment methods include:

- Ultrasonification –involves the irradiation of feedstock material with ultrasonic waves (>20 kHz) resulting in agitation of rigid sludge flocs and cellular walls. Ultrasound waves generate microbubbles that violently collapse within a few microseconds after reaching a critical size, inducing cavitation. The sudden and violent collapse leads to extreme temperatures (~5000 °K) and pressure (~500 bars) initiating powerful hydro-mechanical shear forces and highly reactive radicals. Both the hydro-mechanical shear forces and the oxidizing effect of the radicals contribute to the break-up of sludge flocs and the liberation of intercellular material. This disruption to feedstock material alters the biomass making it more bioavailable for anaerobic digestion. Ultrasonication is a well-established mechanical technology for sludge disintegration in Europe.
- Microwave Irradiation – involves the application of short oscillation frequency microwaves (typically close to 900 MHz or 2,450 MHz) to feedstock material resulting in damage to sludge cells making it more bioavailable for anaerobic digestion. Microwave irradiations may be applied in one of two processes: (1) thermal or (2) athermal. The thermal effect process occurs through the mechanism of heat generation by the effect of polarization. Thermal effect that is generated through its the rotation of dipoles under oscillating electromagnetic fields, which heats the intracellular liquor to boiling point and brings out the break-up of bacterial cell. Athermal effect is not correlated with temperature changes. Athermal effect is induced by changing the dipole orientation of polar molecules, giving rise to the possible breakage of hydrogen bonds, and unfolding and denaturing of complex biological molecules, which kills microorganisms at lower temperatures.
- Electrokinetic Disintegration – also known as pulsed electric field involves applying high-voltage electric fields to the feedstock material to induce a sudden disruption of rigid sludge flocs and cellular walls. This disruption to feedstock material alters the biomass making it more bioavailable for anaerobic digestion.
- High-Pressure Homogenization – relies on abrupt pressure gradient, high turbulence, cavitation as well as strong shearing forces, which are aroused under strong depressurization of highly compressed sludge suspensions (up to 900 bar). During this process, sludge flocs break and cell

membrane ruptures releasing the intracellular substances and making the feedstock more bioavailable for anaerobic digestion.

The chosen application varies depending on the chemical composition of the substrate material, structural/facility requirements, and economic factors. These processes may be used to enhance the digestion rate allowing for higher VSR loading rate, increased digestion capacity, biogas production, and Class A biosolids production. However, there are limited full-scale installations in North America and typically these technologies require higher energy demands, increased replacement costs, and more complex operation and maintenance.

6.3.4 Alternative No. 4: Chemical Pretreatment

Chemical pretreatment methods employ strong reagents to deform biomass cell wall rendering it more bioavailable for anaerobic digestion and thus improving the biogas production. The main reagents employed for this application include acid or alkali pretreatment as well as oxidants (including ozonation, Fenton oxidation, and Fe (II)-activated persulfate oxidation). Chemical pretreatment methods include:

- Acidic and Alkali Pretreatment – involves the use of concentrated and diluted acids and/or bases to break the chemical structure of feedstock materials. The most commonly used acids include hydrochloric acid (HCl), sulfuric acid (H_2SO_4), phosphoric acid (H_3PO_4), and nitric acid (HNO_3). The most commonly used bases include sodium hydroxide (NaOH), potassium hydroxide (KOH), calcium hydroxide ($Ca(OH)_2$), magnesium hydroxide ($Mg(OH)_2$), calcium oxide (CaO), and ammonia (NH_3). The application of acid or base avoids the need for use of high temperatures and thus can be operated at ambient or moderate temperatures. The effectiveness of acidic or alkali pretreatment may vary with the types and characteristics of feed sludge because of their distinct affinity to organic components. Besides, this method may induce the formation of toxic by-products that negatively impact the anaerobic digestion process. Other drawbacks include great toxicity, strong corrosivity, necessity of treated sludge neutralization, and increased mineral content of digested sludge.

- Ozonation – involves the infusion of ozone (O_3) into the feedstock material to effectively disintegrate biomass cell wall and enhance sludge digestion. The efficiency of the ozonation process is closely related to characteristics of sludge; mass transfer rate; and slow kinetic rates of ozonation reaction with sludge. In addition, sludge ozonation is an energy-intensive process. High energy input is required for ozone production, transfer to sludge, and energy consumption to produce liquid oxygen. Microbubble ozonation can be applied to accelerate the formation of hydroxyl radicals and speed up sludge solubilization, thus reducing the impact of high capital requirements.

- Fenton Oxidation - involves reactions of hydrogen peroxide (H_2O_2) with catalyst iron ions (Fe^{2+}) to produce highly active hydroxyl radicals (•OH). Hydroxyl radicals have a higher oxidation potential and are particularly effective for the disintegration of sludge resulting in the release of both intracellular materials and bound water. The effectiveness of this process depends on several variables including reagents concentrations, Fe_{2+}/H_2O_2 ratio, reaction time, initial pH, and temperature. A major drawback for Fenton oxidation process is the low pH requirements (< 4.0) to prevent Fe^{3+} precipitation and the subsequent neutralization step required before digestion.

- Fe (II)-Activated Persulfate Oxidation - is an emerging sludge pretreatment technology to condition and enhance waste sludge dewatering. Persulfate ($S_2O_8^{2-}$) can be activated by heat, UV light, or transition metals to generate sulfate free radicals (SO_4^{-}•) which are extremely strong oxidants. This method is effective in disintegrating sludge cell wall resulting in the release of intracellular materials and subsequent enhancement of digestion and dewaterability. Compared to hydroxyl radicals, sulfate radicals own higher oxidation potentials at a wider pH range (3.0 – 8.5) and are more selective for oxidation at acidic conditions. Therefore, it can be more cost-effective than using hydroxyl radicals.

The chosen application varies depending on the chemical composition of the substrate material, structural/facility requirements, and economic factors. These processes may be used to enhance the digestion rate allowing for higher VSR, increased digestion capacity, biogas production, and Class A biosolids production. However, there are limited full-scale installations in North America and typically these technologies require higher energy demands, high capital costs, high chemical cost, and more complex operation and maintenance related to neutralization requirements.

6.3.5 Evaluation of Sludge Pretreatment Alternatives

The evaluation of the alternative pretreatment concepts is shown in **Table 6.2**.

Table 6.2: Evaluation of Alternative Pretreatment Concepts

Evaluation Criteria	Alternative No. 1: Biological Pretreatment	Alternative No. 2: Thermal Pretreatment	Alternative No. 3: Mechanical / Electrical Pretreatment	Alternative No. 4: Chemical Pretreatment
Technical Suitability	Poor • Limited full-scale applications • Moderately robust and resilient • Complex O&M • Class A Fertilizer	Very Good • Proven and reliable full-scale applications • Highly robust and resilient • Complex O&M • Reduces biosolids volume for improved anaerobic digester capacity • Class A Fertilizer	Fair • Limited full-scale applications • Highly robust and resilient • Complex O&M • Class A Fertilizer	Fair • Limited full-scale applications • Highly robust and resilient • Complex O&M • Class A Fertilizer
Social & Natural Environment	Very Good • Small footprint • No chemical use	Very Good • Small footprint • No chemical use	Very Good • Small footprint • No chemical use	Fair • Moderate footprint • Chemical use
Economic	Good • High capital cost • High O&M cost • Improved biogas production and energy savings	Good • High capital cost • High O&M Cost • Improved biogas production and energy savings	Fair • High capital cost • High O&M costs • Higher energy cost • Improved biogas production and energy savings	Fair • High capital cost • High O& M costs • Chemical cost • Improved biogas production and energy savings
Overall	Good	Very Good	Good	Fair

Based on this analysis, thermal pretreatment using THP appears to be preferred. Benefits of this alternative include its ability to accelerate sludge hydrolysis and improve the performance of subsequent anaerobic digestion. This process enhances digestion rate resulting in shorter retention time, smaller digesters' footprint, more biogas production, sludge disinfection, enhanced dewaterability, and Class A biosolids production. This technology is a proven and reliable with full-scale applications in operation throughout North America. These applications have been proven to be highly robust and resilient in comparison to alternative pretreatment technologies.

Implementation of a pretreatment unit for the anaerobic digestion site may be limited by the available budget for this project. If there are budgetary restrictions, it would be recommended to implement the anaerobic digestion facility without pretreatment as an interim solution. When budgetary funding becomes available or during the detailed design process it is recommended that pretreatment options be further explored. Implementation of pretreatment technologies may also be considered when major upgrades of the WBPF are required or when capacity expansion of the anaerobic digestion facility is required.

6.4 TYPE OF ANAEROBIC DIGESTION

In this section of the report, alternative design concepts for the type of anaerobic digesters to be used at the facility will be identified and evaluated leading to the selection of the recommended design. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Mesophilic Anaerobic Digesters

Alternative No. 2: Thermophilic Anaerobic Digesters

Alternative No. 3: Temperature Phased Anaerobic Digesters

Alternative No. 4: Acid / Gas Phased Anaerobic Digesters

6.4.1 Alternative No. 1: Mesophilic Anaerobic Digesters

Mesophilic Anaerobic Digesters (MAD) employ mesophilic microorganisms that live and thrive in moderate temperature ranges between 30 °C and 38 °C. MADs are usually operated at a consistent temperature of 37 °C in order to avoid reduction in microbial activity (below 35 °C) and production of inhibitory compounds (above 40 °C). MADs are generally more stable and reliable than thermophilic anaerobic digesters because there is a wider diversity of microbial organisms that grow in the mesophilic temperature range. In addition, mesophilic organisms are generally more robust and adaptable to changes in operating conditions such as temperature shifts or feedstock variations. MADs are a proven and reliable technology which make up a majority, more than 90%, of anaerobic digestion processes employed at WWTPs. This process is fully enclosed which mitigate potential noise and odour concerns. Digestate produced from MAD may be classified as a Class B quality biosolids when the tie and temperature criteria specified by the regulating body are satisfied. This biosolids quality would be increased to Class A if pretreatment via THP was included.

6.4.2 Alternative No. 2: Thermophilic Anaerobic Digesters

Thermophilic Anaerobic Digesters (TAD) employ thermophilic microorganisms that live and thrive in moderate temperature ranges between 50 °C to 57 °C. TADs are usually operated at a consistent temperature of 57 °C. In the anaerobic digestion process, temperature of operation is a key driver in the activity of microbial organisms that influences the overall rate of anaerobic digestion. At higher temperatures hydrolysis, the breakdown of complex organic molecules occurs at an improved rate which can theoretically increase the biogas yield. TAD offers advantages over MAD as operating at higher temperatures accelerates and increases the VSR and allows for higher loading rates or decreased retention times in the digesters. In addition, the higher temperatures utilized in TAD allows for improved pathogen reduction. Digestate produced from TAD may be classified as a Class A quality biosolids when the tie and temperature criteria specified by the regulating body are satisfied. Digestate material produced from TADs are typically more odourous than that from MAD.

Although TAD are generally more efficient for the production of biogas, most anaerobic digestion facilities are operated at mesophilic digestion temperatures. There are limited full-scale municipal applications in North America. Drawbacks of TADs include higher maintenance and operations costs associated with maintaining the digesters at higher operating temperatures. In addition, TADs have a lower process stability that make them less reliable in comparison to MADs. The operating temperature and influent substrate characteristics are important parameters to be monitored and controlled for efficient operation and stability of TADs. Variations in these parameters, particularly the temperature, significantly impact anaerobic digestion because there is a lower diversity of microbial organisms that grow in the thermophilic temperature range. Further, the formation of inhibitory compounds is more likely in the thermophilic temperature range. These inhibitors can slow down or interrupt the anaerobic digestion process resulting in decreased biogas yield.

6.4.3 Alternative No. 3: Temperature Phased Anaerobic Digesters

Temperature Phased Anaerobic Digestion (TPAD) incorporates both thermophilic and mesophilic reactors connected in series. This technology combines the advantages of thermophilic digestion with the advantages of mesophilic digestion to improve the overall performance of the anaerobic digestion facility. TPAD employs digesters in series where the first stage, consisting of first stage digester, operated at thermophilic temperatures and the second stage, consisting of multiple digesters, is operated at mesophilic temperatures. In stage one, the thermophilic digesters improve VSR, increases biogas production, and increases pathogen destruction rates. In stage two, the mesophilic digesters improve the process stability and destroy odourous compounds produced during the thermophilic stage. Digestate produced from TPAD may be classified as a Class A quality biosolids when the tie and temperature criteria specified by the regulating body are satisfied.

TPAD are not nearly as common as MADs. Further, there are limited full-scale applications of this technology in North America. Thermal pretreatment technologies such as THP provides similar advantages to TPAD and is increasingly more common worldwide.

6.4.4 Alternative No. 4: Acid / Gas Phased Anaerobic Digesters

Acid / Gas Phased Anaerobic Digesters involves the physical separation of the acid-forming steps (hydrolysis and fermentation) and gas-forming steps (acetogenesis and methanogenesis) of the anaerobic digestion process. These two stages are conducted in separate digestion tanks and operated at ideal conditions for the corresponding biological process. In theory, this would allow for improved control of operating conditions during each stage of the anaerobic digestion process and optimization of biogas production.

In the first stage, the primary digester is heated to optimize performance of hydrolytic and acidogenic microorganisms. These digesters are maintained at a pH of 6 or less for a short retention period that is conducive to the production of VFAs. In the second stage, the secondary digesters are self-heated due to the exothermic (heat-producing) nature of the methanogenesis process. These digesters are maintained at a neutral pH for a longer retention period that is conducive to the methanogenesis process and maximizes biogas production. Although this process offers many advantages in theory, there are limited full-scale applications with conflicting findings in scientific papers related to acid / gas phased anaerobic digesters.

6.4.5 Evaluation of Type of Anaerobic Digestion Alternatives

The evaluation of the alternative types of anaerobic digestion is shown in **Table 6.3**.

Table 6.3: Evaluation of Alternative Anaerobic Digestion Concepts

Evaluation Criteria	Alternative No. 1: Mesophilic Anaerobic Digesters	Alternative No. 2: Thermophilic Anaerobic Digesters	Alternative No. 3: Temperature Phased Anaerobic Digesters	Alternative No. 4: Acid / Gas Phased Anaerobic Digesters
Technical Suitability	Very Good • Proven and reliable • Class B biosolids (without pretreatment) • High stability • Less complex O&M • High biogas potential	Poor • Limited municipal applications • Potential for Class A biosolids (without pretreatment) • Lower stability • Complex O&M • High biogas potential	Fair • Limited full-scale applications • Potential for Class A biosolids (without pretreatment) • Moderate stability • More complex O&M • High biogas potential	Poor • Limited full-scale applications with poor process reliability • Potential for Class A biosolids (without pretreatment) • Moderate stability • More complex O&M • High biogas potential
Social & Natural Environment	Very Good • Moderate footprint • Less odour potential in digestate material	Good • Small footprint • Higher odour potential in digestate material	Very Good • Moderate footprint • Less odour potential in digestate material	Very Good • Moderate footprint • Less odour potential in digestate material
Economic	Very Good • Moderate O&M cost • Moderate capital cost	Fair • Higher O&M cost • Higher capital cost • Higher energy requirements	Fair • Higher O&M cost • Higher capital cost • Higher energy requirements	Fair • Higher O&M cost • Higher capital cost
Overall	Very Good	Fair	Good	Fair

Based on this analysis, Mesophilic Anaerobic Digesters (MAD) appears to be preferred. MAD is a highly proven and reliable technology which makes up vast majority, approximately 90 %, of anaerobic digestion processes employed for the digestion of wastewater sludge from municipal WWTPs. Benefits of this alternative include that it is a proven and reliable technology with high process stability and less complex operations and maintenance requirements. Further, this alternative has a moderate footprint and capital cost requirement when compared to the alternatives with less odour potential in the digestate material.

6.5 SITE SELECTION

In this section of the report, alternative locations for the facility will be identified and evaluated leading to the selection of the recommended design. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Lou Romano Water Reclamation Plant

Alternative No. 2: Windsor Biosolids Processing Facility

The preliminary layouts shown in the Figures below are for display purposes only. The requirements for the various components of the anaerobic digestion facility as well as their exact location and layout are to be determined during the detailed design phase.

6.5.1 Alternative No. 1: Lou Romano Water Reclamation Plant

Under this strategy the anaerobic digestion facility would be located at the LRWRP site to the northeast of the existing dewatering facility as shown in **Figure 6.3**. This land is currently owned by the City of Windsor; therefore, no land acquisition would be required. At this site the anaerobic digestion facility would be composed of the receiving area, pretreatment, anaerobic digesters, and a biogas processing area. The remaining solids from the anaerobic digesters, digestate, would be transferred to the existing dewatering facility at the LRWRP; therefore, a new dewatering facility is not included in the preliminary site layout. Benefits of this location include that the facility would be close to the existing sludge holding tank and dewatering facility allowing for beneficial reuse and easy transfer of sludge and digestate. However, there is limited space at this location and there is potential for increased construction complexity due to underground utilities.

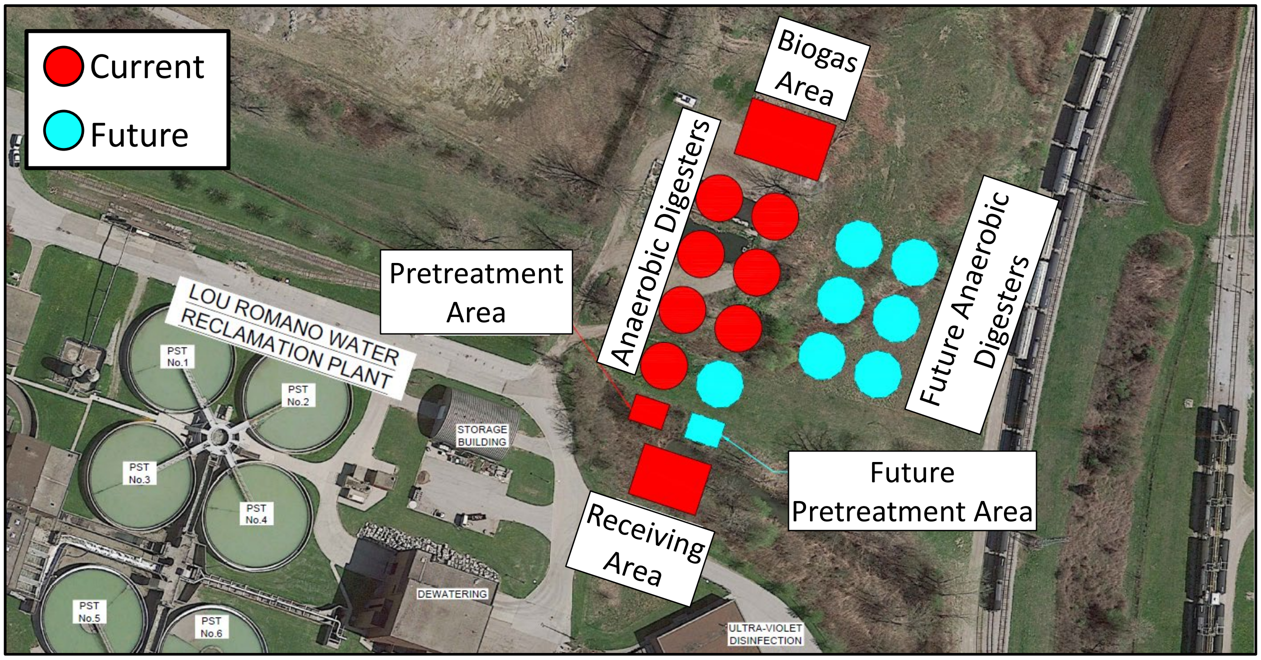

Figure 6.3: Potential Site Layout at the Lou Romano Water Reclamation Plant

6.5.2 Alternative No. 2: Windsor Biosolids Processing Facility

Under this strategy the anaerobic digestion facility would be located at the WBPF site to the southeast of the existing facility as shown in **Figure 6.3**. This land is currently owned by the City of Windsor; therefore, no land acquisition would be required. At this site the anaerobic digestion facility would be composed of the receiving area, pretreatment (if applicable), anaerobic digesters, biogas processing area, and dewatering facility. The remaining solids from the anaerobic digesters would be transferred to a new dewatering facility Transferring the digestate to the LRWRP for dewatering and then transferring the dewatered digestate back to the WBPF for storage is not seen as a cost-effective solution. Benefits of this location include that the site has adequate space for current and future processing needs with no construction concerns regarding underground utilities.

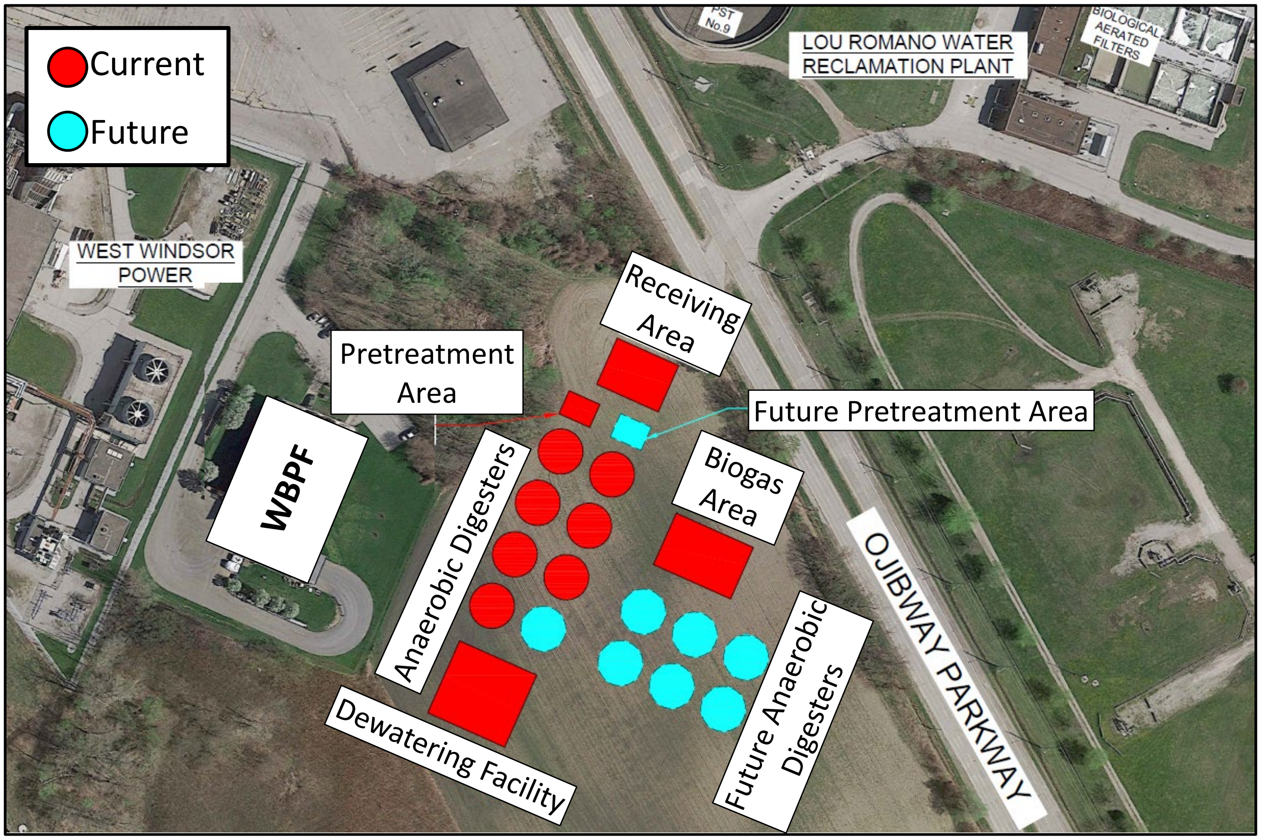

Figure 6.4: Potential Site Layout at the Windsor Biosolids Processing Facility

6.5.3 Evaluation of Site Alternatives

The evaluation of the alternative site location concepts is shown in **Table 6.4**Table 6.1**.**

Table 6.4: Evaluation of Alternative Site Location Concepts

Evaluation Criteria	Alternative No. 1: Lou Romano Water Reclamation Plant	Alternative No. 2: Windsor Biosolids Processing Facility
Technical Suitability	Poor • Limited space • Additional space for digestate storage would be required with option to be located at the WBPF site • Close to the existing sludge holding tank and dewatering facility allowing for beneficial reuse and easy transfer of sludge and digestate	Good • Adequate space • Adequate space for digestate storage • Farther from the existing sludge holding tank and dewatering facility

Evaluation Criteria	Alternative No. 1: Lou Romano Water Reclamation Plant	Alternative No. 2: Windsor Biosolids Processing Facility
	• Increased construction complexity and site restrictions due to underground utilities	
Social & Natural Environment	Very Good • Land zoned for heavy industrial use • Far from residential areas • Anticipated to have no significant impact to archaeological sites or areas of archaeological potential (based on Stage 1 AA findings). • Anticipated to have no significant impact to built heritage resources or cultural heritage landscapes (based on screening checklist).	Very Good • Land zoned for heavy industrial use • Far from residential areas • Anticipated to have no significant impact to archaeological sites or areas of archaeological potential (based on Stage 1 AA findings). • Anticipated to have no significant impact to built heritage resources or cultural heritage landscapes (based on screening checklist).
Economic	Very Good • Similar capital cost • Similar O&M cost	Very Good • Similar capital cost • Similar O&M cost
Overall	Good	Very Good

Based on this analysis, the Windsor Biosolids Processing Facility Site appears to be preferred. Benefits of this alternative include that there is adequate space for the anaerobic digestion facility and digestate storage to service current and future biosolids processing needs. Although the LRWRP site provides the opportunity to reutilize the existing sludge holding tank and dewatering facility there are limitations to the site use due to underground utilities.

6.6 DIGESTATE HANDLING

In this section of the report, alternative design concepts for the handling of digestate from the anaerobic digestion facility will be identified and evaluated leading to the selection of the recommended design. With the implementation of an anaerobic digestion facility alternative methods must be assessed to determine the preferred digestate handling, transportation, solids disposal, and liquid treatment method.

The following sections will outline and evaluate alternatives for the management of digestate:

Alternative No. 1: Windsor Biosolids Processing Facility

Alternative No. 2: Storage and Land Application

The liquid fraction of digestate, also known as supernatant, has a high concentration of nitrogen which must be treated prior to ultimate disposal. Typically, this supernatant is separated from the digestate by centrifuge and then can be transferred to the headworks of a WWTP for treatment. In some cases, the high nitrogen content of the supernatant may strain the plants secondary treatment process and sidestream treatment must be considered before it is directed to the headworks. Alternatives which may be used for this sidestream treatment include (i) physiochemical options i.e., air stripping, membrane contactor, ion exchange, breakpoint chlorination, or precipitation, and (i) biological options i.e., full nitrification (with or without denitrification, partial nitrification (with or without denitrification), or deammonification. Advanced oxidation processes such as ozonation, hydrogen peroxide, and/or UV light are not considered viable methods for sidestream treatment. Based on the anticipated concentration of nitrogen in the supernatant and the average daily flow at the LRWRP sidestream treatment is not recommended at this time and should be further evaluated during the detailed design process.

6.6.1 Alternative No. 1: Windsor Biosolids Processing Facility

Under this strategy, the remaining material from the anaerobic digesters would be dewatered via centrifuge and then transferred to the existing WBPF to be further processed. At the WBPF, the digestate would be heat dried and pelletized to remove moisture, stabilize the sludge, and produce a Class A fertilizer product. The fertilizer may be stored at the existing WBPF and then sold throughout Southwestern Ontario. The simple process schematic for this alternative is shown in

Figure 6.5.

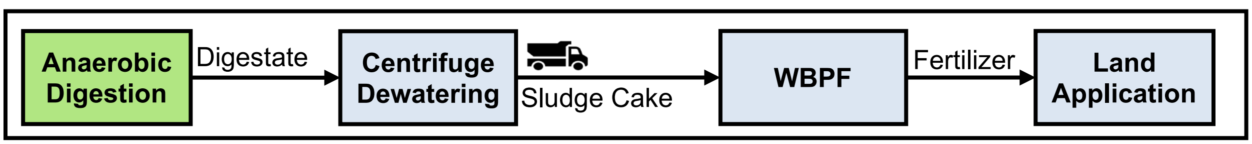

Figure 6.5: Process Schematic for Digestate Handling at the WBPF

Benefits of this digestate handling strategy include the ability to produce a Class A fertilizer product without the need for sludge pretreatment. This strategy can be implemented within a small footprint and at low to no capital cost. The capital cost of this option may increase if optional improvements are implemented at the WBPF to improve the energy efficiency of the drying process. In addition, the WBPF will continue to produce revenue from the sale of the fertilizer product. Retaining the pelletizing process at the WBPF is beneficial as there is a proven market for pelletized fertilizer as compared to bulk sludge fertilizer and the storage space required is significantly lower. The pelletized fertilizer product contains very little moisture, is easy to handle and transport and requires much less storage space than dewatered sludge.

Currently, there are higher energy requirements and costs for the processing of digestate at the WBPF due to the need to buy large quantities of natural gas for the heat drying process. In turn, burning the natural gas releases excessive amounts of GHGs to the atmosphere. If biogas from the anaerobic digestion process was used to heat/power the drying process at the WBPF this would greatly offset the energy requirements, reduce the operating costs, and minimize GHG emissions.

Drawbacks of this digestate handling strategy include that it has more complex operation and maintenance requirements. Significant upgrades, such as the replacement of the rotary drum dryer, may be required in the future to improve the energy efficiency of the drying process. The WBPF was built in 1999 (approximately 24-years old) and is operated by Synagro under a service contract expiring in 2029.

Generally speaking, the WBPF has been well maintained throughout its service life and may remain operational for some additional time after the expiration of the servicing contract. The processes utilized at the WBPF are aging and are maintenance intensive; therefore, this facility may be taken out of service in the long-term. The WBPF can continue to be used for the remainder of its useful life and the decommissioning of this facility should be reconsidered as process failures occur or significant upgrades are required.

6.6.2 Alternative No. 2: Storage and Land Application

Under this strategy the remaining material from the anaerobic digesters would be dewatered via centrifuge and then stored prior to land application. If pretreatment is not employed at the anaerobic digestion facility the dried material would be classified as a Class B fertilizer which may be land applied or stored at the anaerobic digestion facility when land application is not possible. Storage of Class B material may be required when land application is not possible such as during the winter months, inclement weather, unsuitable soil conditions, and/or other adverse conditions. Class B fertilizer materials may be temporarily stored for less than one week at the application site prior to land application. If pretreatment is employed at the anaerobic digestion facility the dried material would be classified as a Class A fertilizer which may be land applied or stored at the anaerobic digestion facility or at the application site prior to land application. The fertilizer may be stored on-site (Class B) or off-site (Class A) and sold throughout Southwestern Ontario. The simple process schematic for this alternative is shown in

Figure 6.6**.**

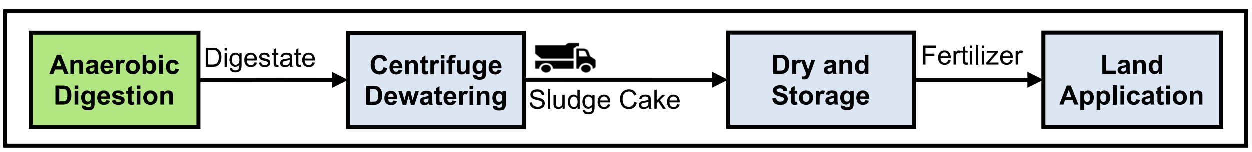

Figure 6.6: Process Schematic for Digestate Storage and Land Application

Benefits of this strategy include that it is a viable long-term solution for digestate handling requirements. This process has minimal construction requirements and may be implemented within a moderate footprint. In addition, this strategy would have simple operation and maintenance requirements with low energy input demands. The sales of fertilizer product will produce revenue for the City of Windsor.

Drawbacks of this digestate handling strategy include that sludge pretreatment is required to produce a Class A fertilizer. Without pretreatment the fertilizer would be classified as Class B which is not as marketable as Class A fertilizers. Developing a market for the dewatered sludge product may face some difficulty due to the more complex and costly systems for handling, transportation, and application of the product. Due to the requirement for a pretreatment unit, this strategy would require a larger capital cost investment.

6.6.3 Evaluation of Digestate Handling Alternatives – Solids Disposal

The evaluation of the alternative digestate handling concepts is shown in **Table 6.5**.

Table 6.5: Evaluation of Alternative Solids Disposal Concepts

Evaluation Criteria	Alternative No. 1: Windsor Biosolids Processing Facility	Alternative No. 2: Storage and Land Application
Technical Suitability	Good • Production of Class A fertilizer product • Highly marketable fertilizer product with proven sales record • More complex O&M • Short to medium-term solution • Upgrades may be required to improve the energy efficiency of the WBPF	Very Good • Production of Class B fertilizer product • Potential for Class A fertilizer with sludge pretreatment • Less marketable fertilizer product • Simple O&M • Long-term solution • Minimal construction requirements
Social & Natural Environment	Fair • Higher energy requirements • Small footprint	Very Good • Low energy requirements • Moderate to small footprint
Economic	Good • Low capital cost (some upgrades may be required to if the City would like to improve energy efficiency) • Moderate O&M cost • Revenue from fertilizer	Good • Moderate capital cost (pretreatment unit required to produce Class A fertilizer) • Low O&M cost • Revenue from fertilizer
Overall	Good	Very Good

Storage and land application of the digestate material appears to be the most preferred because it is a viable long-term solution with simple operation and maintenance requirements, low energy demand, and minimal construction requirements. Implementation of a pretreatment unit (which is necessary for the storage and land application of digestate) may be limited by the available budget for this project. If there are budgetary restrictions, it would be recommended to continue to use the WBPF as an interim solution. The long-term solution for the management of digestate material should be further explored during the detailed design period or as additional funding becomes available.

6.7 BIOGAS ULTILIZATION

In this section of the report, alternative design concepts for biogas-to-energy technologies or biogas utilization strategies will be identified and evaluated leading to the selection of the recommended design. The gas produced from the anaerobic digesters is a form of renewable energy resource commonly referred to as 'biogas' which can be used as a source for the production of heat, electricity, and/or fuel. Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities. A quantitative analysis of the anticipated biogas production, energy savings, and reduction in GHG emissions is presented in **Section 5.8**.

The quantity and quality of the biogas production at a facility is directly related to the quantity and quality of feedstock materials (sludge characteristics) as well as the operating conditions of the digester. The volatile solids loading may be used to characterize digester performance and estimate volume of biogas production. Biogas is collected in the digester headspace prior to biogas pretreatment and use in a biogas-to-energy technology. The digester headspace is typically maintained below 3 kPA and if the biogas demand is exceeded, excess biogas is flared to regulate pressure. Alternative biogas-to-energy technologies or biogas utilization strategies include: (1) on-site generation of heat via a boiler; (2) on-site co-generation of combined heat and power via reciprocating engines; (3) upgrade to renewable compressed natural gas and utilize as an alternative fuel in fleet vehicles; and (4) upgrade to renewable natural gas and inject to natural gas pipeline. An overview of the anaerobic digestion process and alternative biogas utilization strategies are shown in Figure 4.4.

With the implementation of an anaerobic digestion facility, alternative methods must be assessed to determine the preferred method for processing, conditioning, and utilizing biogas efficiently. The following sections will outline and evaluate the following alternative solutions:

Alternative No. 1: Heat (via boiler)

Alternative No. 2: Combined Heat and Power

Alternative No. 3: Renewable Compressed Natural Gas

Alternative No. 4: Renewable Natural Gas

6.7.1 Alternative No. 1: Heat (via boiler)

Biogas produced by the anaerobic digesters can be utilized with little to no processing by being burned on-site to power boilers. Under this strategy, conditioned biogas from the anaerobic digesters may be used for direct combustion via a boiler to produce heat. This heat may be used to maintain the operation of the anaerobic digesters at approximately 37 °C and excess gas may be used to supply heat to buildings at the WBPF and LRWRP during the colder months. If the heating requirements for the facility are significantly less than the heat produced from the anaerobic digestion, excess biogas must be flared to maintain operating conditions. This would result in poor biogas utilization and negates the environmental and economic benefits of implementing the anaerobic digesters. The biogas yield for this facility is anticipated to exceed the heating requirements at the anaerobic digestion facility and LRWRP; therefore, this would not be a favourable option.

Benefits of utilizing biogas in boilers include that it is a simple, proven, and reliable technology with minimal operations and maintenance requirements. Further, this alternative may be supplied within a small footprint at a low capital cost. Boilers would provide an opportunity for energy savings during the winter months (when heating demand is higher) and offset the GHG emissions by displacing grid power during this time.

However, a major drawback of this technology is the poor biogas utilization which counteracts the benefits listed above.

6.7.2 Alternative No. 2: Combined Heat and Power

Combined Heat and Power (CHP), also known as cogeneration, is a process for the concurrent production of electrical energy and thermal energy (heating and/or cooling) from a single fuel source. Heat is produced as a by-product of electricity generation from the combustion of the selected fuel source, in this case biogas. In the power conversion process, it is typical for the thermal energy (heat) produced to be equal to or greater than the electrical power generated. The recovery and beneficial use of thermal energy via CHP is what makes this process highly energy efficient. CHP has been successfully implemented in many wastewater treatment plants with anaerobic digestion and biogas utilization. Under this strategy, conditioned biogas from the anaerobic digesters may be used for direct combustion via reciprocating engines or turbines to produce heat and electricity. This heat may be used to maintain the operation of the anaerobic digesters at approximately 37 °C, heat the drying process at the WBPF, and supply heat to buildings at the WBPF and LRWRP during the colder months. In addition, the electricity produced in this process may be used to support anaerobic digestion and other processes at the WBPF or LRWRP.

Benefits of CHP are that it is a proven and reliable technology which has widescale applications in North America. This system has less complex operation and maintenance requirements when compared to the renewable natural gas alternatives. CHP can be implemented at the anaerobic digestion facility within a small to moderate footprint and at a moderate capital cost. The main benefit of CHP is that it produces more useful energy (in the form of electricity) than if biogas was used solely for heat demands for anaerobic digestion, WBPF, and LRWRP processes. This improves biogas utilization and enhances the heat and power reliability of the facility. CHP can provide energy and cost savings by displacing electricity or fuels purchased for the LRWRP and WBPF. This displacement of purchased energy reduces the carbon footprint of the City of Windsor corporation and reduces the emissions of GHGs and other air pollutants.

6.7.3 Alternative No. 3: Renewable Compressed Natural Gas

Biogas which has been conditioned and upgraded to remove carbon dioxide, water vapor, and other trace gases such that it meets natural gas quality and compressed is known as Renewable Compressed Natural Gas (R-CNG). R-CNG can be utilized for fleet vehicles as a renewable alternative to traditional fossil fuels in heavy or light duty vehicles. This process is beneficial when the cost of petroleum-based fuels is significantly more than that for R-CNG. To further improve the economics of this strategy, R-CNG is best suited for use in fleet vehicles that return to a single location of refueling. This will allow for the construction and maintenance of a single R-CNG fueling station. Under this strategy, biogas from the anaerobic digesters would undergo conditioning and upgrading to RNG. Next this RNG would be compressed, stored, and dispensed for use as an alternative fuel source for City of Windsor fleet vehicles.

The implementation of R-CNG will include consideration for compression requirements; onsite storage; construction of a central dispensing station; purchasing or upgrading fleet vehicles with engines design for R-CNG; and maintenance garage. Additional considerations for the construction and operation of a dispensing station include safety considerations for onsite storage of a compressed explosive gas (tank sizing, weatherizing, etc.); operating staff and security; increased truck traffic to and from the dispensing facility; and permitting, zoning, bylaws, regulations, certifications, etc.

Benefits of R-CNG include that it is a proven and reliable technology with full-scale applications in Ontario (Hamilton, Ontario). This strategy can be implemented within a moderate footprint at the anaerobic digestion facility. R-CNG allows for improved biogas utilization and enhances the fuel reliability for the City of Windsor. R-CNG can provide energy and cost savings by displacing fuels purchased by the City. This displacement of traditional fossil fuels also reduces the carbon footprint of the City of Windsor corporation and reduces the emissions of GHGs and other air pollutants.

Drawbacks of R-CNG include that it has more complex operation and maintenance requirements when compared with boilers or CHP. In addition, this alternative would require a higher capital cost investment due to the need to construct a biogas conditioning and upgrading station as well as the cost for the R-CNG storage / fueling station and the upgrading or purchasing of C-RNG compatible fleet vehicles. The biogas conditioning and upgrading unit as well as the fueling station would require specialized operating and maintenance staff.

6.7.4 Alternative No. 4: Renewable Natural Gas

Biogas which has been conditioned and upgraded to remove carbon dioxide, water vapor, and other trace gases such that it meets natural gas quality is known as Renewable Natural Gas (RNG). RNG, also referred to as biomethane, can be injected into existing natural gas grids and used as a renewable alternative to conventional natural gas. Under this strategy, biogas from the anaerobic digesters would undergo conditioning and upgrading to RNG and would be injected to the nearest natural gas pipeline. In Ontario, 100% of RNG production is sold to the pipeline and then repurchased at a discounted price to heat and/or power the treatment processes at the LRWRP, WBPF, and anaerobic digestion facility. Utility providers across Canada have been showing increasing interest in RNG and have set goals to include a five percent blend of RNG in natural gas grids by the year 2025 and ten percent by 2030.

The implementation of RNG will include consideration for onsite storage; connection and distance to natural gas grid; and construction of an injection station. Additional considerations for the construction and operation of an injection station include safety considerations for onsite storage of an explosive gas (tank sizing, weatherizing, etc.); operating staff and security; and permitting, zoning, bylaws, regulations, certifications, etc.

Benefits of RNG include that it is a proven and reliable technology with full-scale applications in Ontario (Hamilton, Ontario). This strategy can be implemented within a moderate footprint at the anaerobic digestion facility. RNG allows for improved biogas utilization and enhances the heat and power reliability of the anaerobic digestion facility, LRWRP, and WBPF. RNG can provide energy and cost savings by displacing electricity and fuels purchased for the LRWRP and WBPF. This displacement of purchased energy reduces the carbon footprint of the City of Windsor corporation and reduces the emissions of GHGs and other air pollutants.

Drawbacks of RNG include that it has more complex operation and maintenance requirements when compared with boilers or CHP. In addition, this alternative would require a higher capital cost investment due to the need to construct a biogas conditioning and upgrading station as well as the cost for the RNG storage and injection station. The biogas conditioning and upgrading unit as well as the injection station would require specialized operating and maintenance staff.

6.7.5 Evaluation of Biogas Utilization Alternatives

The evaluation of the alternative biogas utilization concepts is shown in **Table 6.6.**

Table 6.6: Evaluation of Alternative Biogas Utilization Concepts

Evaluation Criteria	Alternative No. 1: Heat (via boiler)	Alternative No. 2: Combined Heat and Power	Alternative No. 3: Renewable Compressed Natural Gas	Alternative No. 4: Renewable Natural Gas
Technical Suitability	Fair • Proven and reliable • Less complex O&M • Poor biogas utilization if heat requirements are significantly less than heat production	Very Good • Proven and reliable • Less complex O&M • Improved biogas utilization	Fair • Proven and reliable • Complex O&M • Improved biogas utilization • Requires specialized staff • Requires construction and O&M of biogas upgrading unit and R-CNG fueling station	Fair • Proven and reliable • Complex O&M • Improved biogas utilization • Requires specialized staff • Requires construction and O&M of biogas upgrading unit and RNG injection station
Social & Natural Environment	Good • Small footprint • Enhances heating reliability • Less reduction in emissions of GHG and other air pollutants due to poor biogas utilization	Very Good • Moderate footprint • Enhances heating and power reliability • Reduces emissions of GHG and other air pollutants by displacing grid power	Good • Moderate footprint • Enhances fuel reliability • Reduces emissions of GHG and other air pollutants by displacing fossil fuel • Complex permitting requirements	Good • Moderate footprint • Enhances power reliability Reduces emissions of GHG and other air pollutants by displacing grid power • Complex permitting requirements
Economic	Good • Low capital cost • Low O&M cost • Low energy cost savings	Good • Moderate capital cost • Moderate O&M cost • Energy cost savings	Poor • High capital cost • Moderate O&M cost • Fuel cost savings	Poor • High capital cost • Moderate O&M cost • High energy cost savings
Overall	Good	Very Good	Fair	Fair

Combined heat and power appear to be the most preferred because it is a proven and reliable technology with potential for improved biogas utilization, energy savings, and reduction in GHG emissions. CHP can be implemented at the anaerobic digestion facility within a small to moderate footprint and at a moderate capital cost.

Alternative No. 3 and 4, are considered viable options for the biogas utilization; however, the capital cost requirements for implementing these solutions were considered a major limiting factor. Should Governmental Funding Programs or Industrial Partnerships (for example, Enbrige Gas Inc.) become available to offset the capital cost requirements these solutions may be considered as favourably as combined heat and power.

7.0 PREFERRED DESIGN

7.1 OVERVIEW OF PREFERRED DESIGN

The recommended design concepts that form the overall recommended design are summarized in **Table 7.1. Section 6.0** identified, evaluated, and reported on: (1) Sludge Handling Strategies, (2) Sludge Pretreatment Technologies, (3) Type of Anaerobic Digestion, (4) Site Selection, (5) Digestate Handling Strategies, and (6) Biogas Utilization Technologies. The recommended design meets the sludge handling requirements determined in **Section 2.4** of this ESR. The anaerobic digestion facility will be design with an initial capacity of 24,000 tDS/yr and potential for future expansion to 35,000 tDS/yr. The current biosolids loads is 11,000 tDS/yr; therefore, the proposed facility will have interim capacity for the co-digestion with supplementary feedstocks.

Table 7.1: Overview of Preferred Design Concepts

No.	Design Concept	Recommendation
1	**Sludge Handling**	**Trucking LRPCP Sludge Cake** Benefits Include: • More suitable solids content with the increased control over the solid's concentration fed to the pretreatment unit or anaerobic digesters; • Improved flexibility to meet current and future solids handling needs; • No construction requirements and no capital cost investment; and • Avoids negative social, economic, and natural environmental impacts of installing a long forcemain from the LRPCP to the LRWRP.
2	**Sludge Pretreatment**	**Thermal Sludge Pretreatment** Benefits Include: • Accelerated sludge hydrolysis and improved performance of subsequent anaerobic digestion; • Enhanced digestion rate resulting in shorter retention time, smaller digesters' footprint, more biogas production, sludge disinfection, enhanced dewaterability, and Class A biosolids production; • Proven and reliable technology with full-scale applications in operation throughout North America; and • Highly robust and resilient treatment technology. If there are budgetary restrictions, it would be recommended to implement the anaerobic digestion facility without pretreatment as an interim solution.
3	**Type of Anaerobic Digestion**	**Mesophilic Anaerobic Digesters** Benefits Include: • Highly proven and reliable technology which makes up vast majority, approximately 90 %, of anaerobic digestion processes employed for the digestion of wastewater sludge from municipal WWTPs; • High process stability with less complex operations and maintenance requirements; • Moderate process footprint requirements; • Lower capital and O&M cost in comparison to the alternatives; and

		• More socially favourable with less odour potential in the digestate material.
4	**Site Selection**	**WBPF Site** Benefits Include: • Adequate space for current and future processing needs; • Land zoned for heavy industrial use and located far from residential areas; and • No construction concerns regarding underground utilities.
5	**Digestate Handling**	**Solids Disposal - Storage and Land Application** Benefits Include: • Viable long-term solution for digestate handling requirements; • Minimal construction requirements which may be implemented within a moderate footprint; • Simple operation and maintenance requirements; and • Low energy input requirements. If there are budgetary restrictions, it would be recommended to continue to use the WBPF as an interim solution until sludge pretreatment can be implemented. The long-term solution for the management of digestate material should be further explored during the detailed design period or as additional funding becomes available.
6	**Biogas Utilization**	**Combined Heat and Power** Benefits Include: • Proven and reliable technology; • Less complex operation and maintenance requirements (in comparison to RNG and R-CNG); • Simple construction within a small to moderate footprint; • Moderate capital cost; • Improved biogas utilization that enhances heat and power reliability of the facility; and • Displaced electricity and/or fuel purchased for the LRWRP and WBPF leading to energy savings, cost savings, and reduction of GHG emissions.

The simple process schematic for the preferred design is shown in **Figure 7.1**. The proposed biosolids management strategy would operate with the following sludge handling protocol. Liquid sludge from the LRPCP would be centrifuged onsite and then trucked via tractor trailer to a sludge holding tank at the anaerobic digestion facility. Whereas the liquid sludge from LRWRP would be removed from the treatment process and directly pumped to the nearby anaerobic digestion facility. The liquid sludge from the LRWRP would be mixed with sludge cake from LRPRP in the sludge holding tank, diluted/thickened (as necessary), input to the pretreatment process, and then fed to anaerobic digestion. Under this strategy the anaerobic digestion facility would be located in the lot next to the existing WBPF.

The sludge pretreatment method selected for the anaerobic digestion facility is thermal pretreatment via the thermal hydrolysis process. After the preheating, heating and batch reaction, and depressurizing phases of THP, pretreated sludge will be fed to the mesophilic anaerobic digesters. From the anaerobic digestion process the (i) residual solids, digestate, must be processed for final disposal and (ii) biogas must be processed for utilization. Implementation of a pretreatment unit for the anaerobic digestion site may be limited by the available budget for this project. If there are budgetary restrictions, it would be recommended to implement the anaerobic digestion facility without pretreatment as an interim solution. When budgetary funding becomes available or during the detailed design process it is recommended that pretreatment options be further explored.

In terms of the digestate handling, in the short to medium-term, material would be dewatered at a new dewatering facility at the anaerobic digestion site (via centrifuge) and then transferred to the existing WBPF to be further processed. No sidestream treatment is required for the liquid fraction of digestate material, supernatant. As such this liquid fraction may be directed to the headworks of the LRWRP for treatment. At the WBPF the digestate would be heat dried and pelletized to remove moisture, stabilize the sludge, and produce a Class A fertilizer product. The fertilizer may be stored at the existing WBPF and then sold throughout Southwestern Ontario. In the long term, pretreatment of sludge would be employed to upgrade the biosolids classification from Class B to Class A. With this strategy digestate would be dewatered and the resulting fertilizer may be (i) immediately land applied, (ii) stored at the anaerobic digestion facility, or (iii) stored at the application site prior to land application. The long-term solution for the management of digestate material should be further explored during the detailed design period or as additional funding becomes available.

Conditioned biogas from the anaerobic digesters may be used for direct combustion via reciprocating engines or turbines to produce heat and electricity. This heat may be used to maintain the operation of the anaerobic digesters at approximately 37 °C, heat the WBPF rotary drum dryer, and supply heat to buildings at the WBPF and LRWRP during the colder months. In addition, the electricity produced in via this process may be used to support anaerobic digestion and other processes at the LRWRP.

Based on the MECP Guideline D-2 ‘Compatibility between Sewage Treatment and Sensitive Land Use’ and the capacity of the LRWRP (greater than 25,000 m^3/d) a separation distance greater than 150 meters may be required from sensitive land uses. Sensitive land uses may be generally defined as a building, amenity area, or outdoor space where routine or normal activities occurring at reasonably expected times would experience 1 or more 'adverse effect(s)' from contaminant discharges generated by a nearby 'facility’. This includes:

- Residences or facilities where people sleep (e.g., single and multi-unit dwellings, nursing homes, hospitals, trailer parks, camping grounds, etc.).
- Institutions (e.g., schools, churches, community centers, day care centers).
- Certain outdoor recreational uses deemed by a level of government to be sensitive (e.g., trailer park, picnic area, etc.).
- Certain agricultural operations (e.g., cattle raising, mink farming, cash crops and orchards).
- Bird/wildlife habitats or sanctuaries.

The nearest sensitive land use receptor to the proposed facility is greater than 800 meters away. Therefore, the facility will be located at an adequate separation distance. The high-level conceptual layout for the facility and a 150 meter buffer zone is shown in **Figure 7.2**.

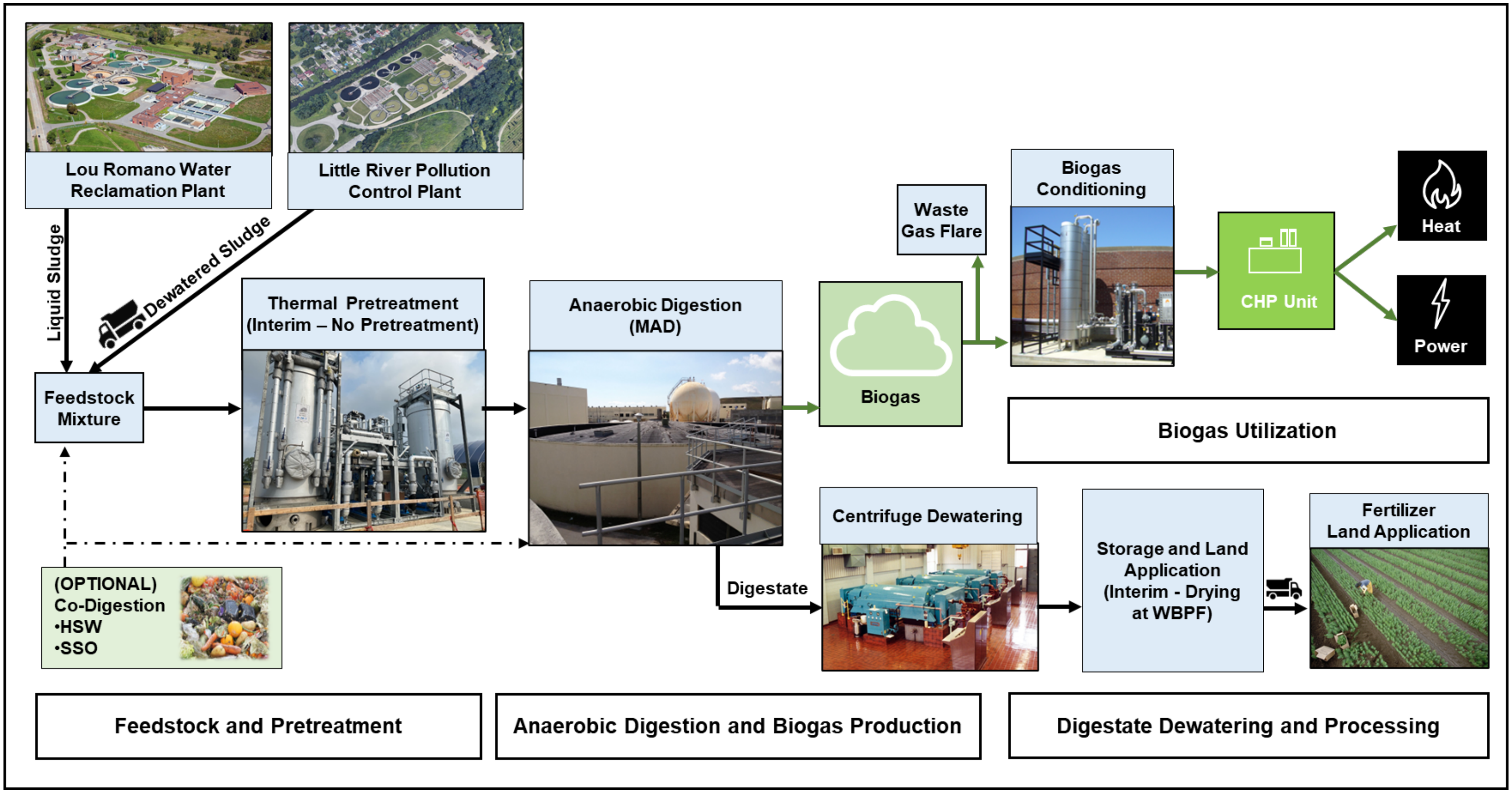

Figure 7.1: Process Schematic for the Preferred Design

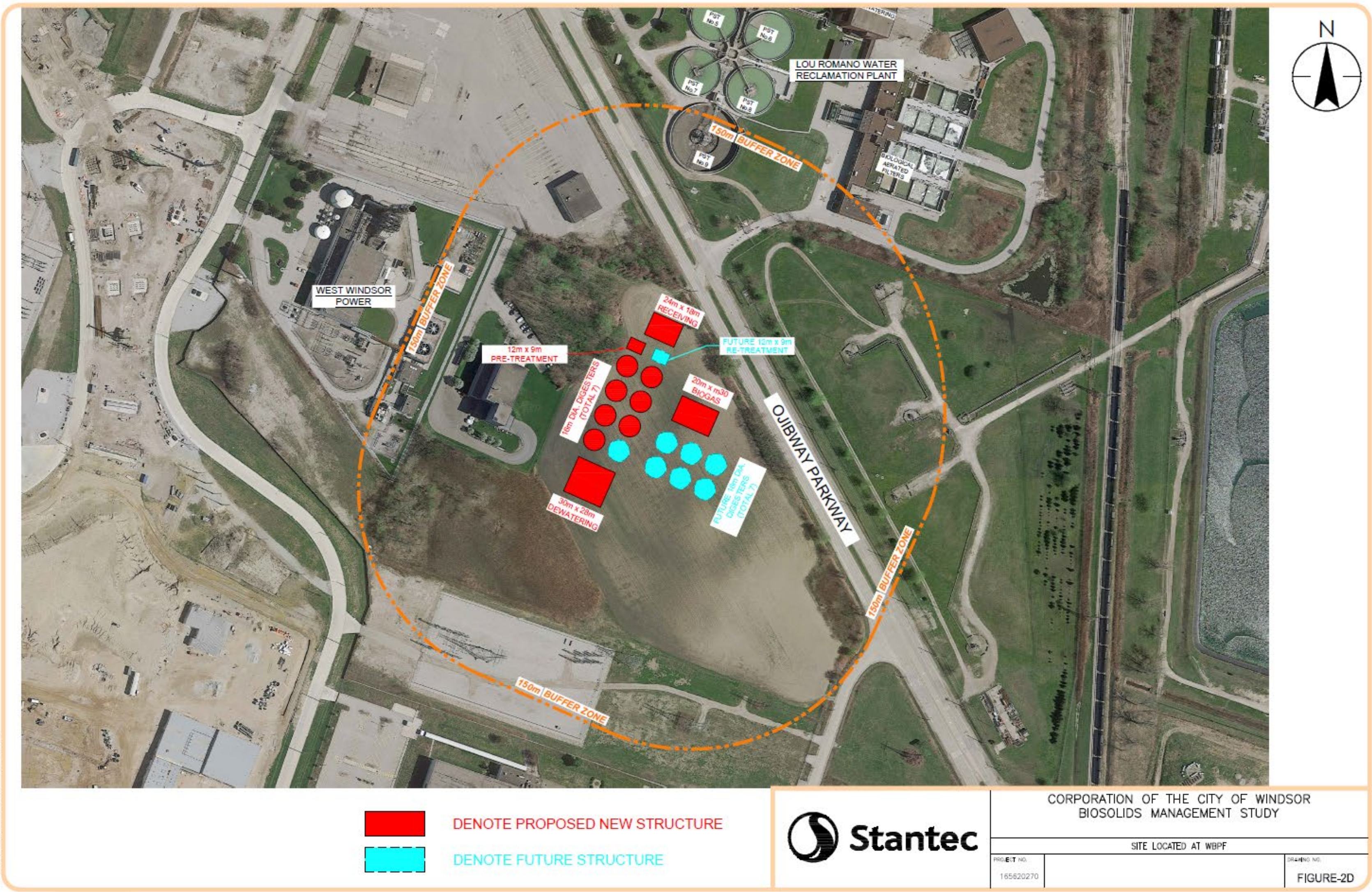

Figure 7.2: Conceptual Layout for the Preferred Design with Buffer Zone

7.2 CO-DIGESTION OF BIOSOLIDS AND SSO

In recent years, many municipalities have implemented integrated organics management. This involves processing both municipal waste sludge and organic wastes within one biosolids management facility. The focus in not only processing the wastes, but also maximizing the recovery of their remaining value in the form of electricity, thermal energy, and/or fuel. Based on the evaluation presented in **Section 5.8**, significant energy savings and GHG reductions can be achieved through anaerobic co-digestion of wastewater biosolids and supplementary organic feedstock materials (i.e., SSO waste). The co-digestion process would move the LRWRP and LRPCP towards a net-zero energy future, provide energy savings to the City of Windsor, and reduce GHG emissions. It is strongly encouraged for the City of Windsor to accept municipal and ICI supplementary feedstock materials at this facility.

The proposed anaerobic digestion facility would be designed to have the capability to meet current and future biosolids management needs. The anaerobic digestion facility will be design with an initial capacity of 24,000 tDS/yr and potential for future expansion to 35,000 tDS/yr. The current biosolids load (historic average) is 11,000 tDS/yr; therefore, the proposed facility will have interim capacity for co-digestion with supplementary feedstocks. Pretreatment of supplementary materials will be required prior to being fed to the anaerobic digesters and is not included in the layout or opinion of probable cost for the anaerobic digestion facility. Prior to detailed design of the anaerobic digestion facility, the inclusion of supplementary feedstock materials should be confirmed.

7.3 PROJECT DELIVERY METHOD

Standard project delivery methods which may be utilized for the implementation of the anaerobic digestion facility are outlined in **Table 7.2**.

Table 7.2: Common Project Delivery Methods

Project Delivery Method	Description
Design-Bid-Build	Traditional project delivery method that involves a design team and a general contractor working directly for the owner under separate contracts. • Advantages of this method include that it is common/familiar to most construction professionals, owners retain a high level of control over design, and often result in lower project cost (due to competitive nature of bidding). • Disadvantages include that the contractor is not involved in the design process often resulting in discrepancies, change orders, and disagreements between parties.
Design-Build	Project delivery method that employs a single firm to handle the design and construction aspects of a project for the owner under a single contract. • Advantages of this method include that the process may be more efficient due to collaboration between the design and construction teams. • Disadvantages include that it is less familiar to most construction professionals as well as potential conflicts of interest between parties. Namely the contractor who would like to minimize cost and the owner who would like a high-quality solution.

Public-Private Partnership	Project delivery method that involves a private company and a government entity to collaborate on a project. • Advantages of this method include private-sector expertise in the desired construction as well as potential for outside funding. • Disadvantages include that projects may be delayed or impacted by changes in priorities of the funding source.
Integrated Project Delivery	Project delivery metho that involves multiple stakeholders performing work under a single predetermined contract. Risk and responsibility are divided equally amongst the stakeholders. • Advantages of this method include improved collaboration amongst all stakeholders and sharing of risk amongst all parties. • Disadvantages include that this is a relatively new method which may not be familiar to construction and design professionals. In addition, selection of a qualified designer and contractor is essential to project success.

Generally speaking, Design-Bid-Build is considered the traditional or standard method for project delivery. For the implementation of the proposed anaerobic digestion facility, additional project delivery methods may be considered by the City of Windsor. Alternative project delivery methods may be considered more desirable if there is an opportunity for external funding.

7.4 IMPLEMENTATION SCHEDULE

The WBPF was built in 1999 (approximately 24-years old) and is operated by Synagro under a service contract expiring in 2029. Generally speaking, the WBPF has be well maintained throughout its service life and may remain operational for some additional time after the expiration of the servicing contract. The processes utilized at the WBPF are aging, require high energy and resource input, and are maintenance intensive; therefore, this facility will be taken out of service in the long-term. The WBPF can continue to be used for the remainder of its useful life and the decommissioning of this facility should be reconsidered as process failures occur or as significant upgrades become required.

Ideally, the proposed anaerobic digestion facility would be in operation prior to the expiration of the existing WBPF servicing contract (2029). In order to meet this deadline, it is recommended to proceed directly with the implementation of the anaerobic digestion facility. The design, construction, and testing/operation of the facility may be completed within the desired implementation timeline.

7.5 OPINION OF PROBABLE COST

This section discusses an opinion of probable cost for the recommended design solution. The opinion of probable cost is an estimate of the future contract price for the engineering and construction work, which is not yet fully defined and may be subject to changes in scope, design, and market conditions.

7.5.1 Level of Accuracy

Opinions of probable cost are commonly provided throughout various stages of a project lifecycle and there are a number of classifications for these estimates that identify the level of accuracy. These classifications can vary based on the industry, but all are based on the fact that the level of accuracy is directly proportional to the level of detail available at each stage of the project.

The level of accuracy for the opinion of probable cost increases as the project moves from the planning stage to the preliminary design and final design. A wide range of accuracy is expected at the planning stage of a project because a number of details remain unknown. As the project moves closer to completion and final design, the estimate would become more accurate due to the increased level of detail and the reduced number of unknowns.

Table 7.3 includes a summary of typical estimate classifications used throughout a project's development including a description of the project stage and range of accuracy. The opinions of probable cost in this study are estimated at the study stage (Class 2) and the corresponding level of accuracy could range from –15% to +30% from the opinion presented in the report.

Table 7.3: Classification of Cost Estimates

Class	Description	Level of Accuracy	Stage of Project Lifecycle
1	Conceptual Estimate	+50% to -30%	Screening of alternatives.
2	Study Estimate	+30% to -15%	Planning and/or environmental assessment report.
3	Preliminary Estimate	+25% to -10%	Preliminary design report.
4	Detailed Estimate	+15% to -5%	Final design report and specifications.
5	Tender Estimate	+10% to -3%	Estimate received from the contractor in response to the Tender.

7.5.2 Opinion of Probable Cost for Preferred Solution

A capital budget estimate (in 2023 dollars) is summarized in **Table 7.4**. In addition to the level of accuracy discussed, the opinion of probable cost was prepared taking into consideration the following factors.

- All estimates are 2023 Canadian dollars based on an Engineering News Record (ENR) Construction Cost Index of 1200.
- It is assumed that the Contractor will have unrestricted access to the site and will complete the work during normal working hours from 7:00 am to 6:00 pm Monday to Friday. There is no allowance for premium time included. Labour costs are based on union labour rates for the Windsor area. Bulk material and equipment rental costs used are typical for the Windsor area.
- An allowance is included for mobilization and demobilization and the Contractor's overhead and profit.
- Equipment costs are based on vendor supplied price quotations and historical pricing of similar equipment.
- The estimate does not include the cost of application or permit fees. No allowance is included for interim financing costs or legal costs. No allowance is included for escalation beyond the date of this report.
- Allowances for engineering and contingency allowances (approximately 30% and 15%, respectively) are included in the estimate.

- It is not known whether contaminated soil conditions or presence of archaeological resources may be encountered in the areas proposed for the facilities. The potential impact cannot reasonably be determined at this point and no allowance is included in the estimate.
- Does not include any cost for pretreatment of supplementary feedstock materials (if they are chosen to be accepted at this facility).

Table 7.4: Opinion of Probable Capital Cost for Preferred Solution

Item	Description	Probable Cost
1	Anaerobic Digestion Facility	$ 70,000,000
2	Biogas Utilization Unit	$ 18,000,000
SUBTOTAL		**$ 88,000,000**
Contingency Allowance (30%)		$ 26,400,000
Engineering Allowance (15%)		$ 13,200,000
TOTAL CAPITAL COST (excluding taxes)		**$ 127,600,000**
HST (13%)		$ 16,600,000
TOTAL ANTICIPATED CAPITAL COST (including taxes)		**$ 144,200,000**
Note: **If capital funding is available thermal pretreatment via THP is recommended. The opinion of probable cost for this pretreatment unit is approximately $16,000,000 (which does not include contingency allowance, engineering allowance, or HST).**		

8.0 ENVIRONMENTAL IMPACTS AND MITIGATING MEASURES

8.1 OVERVIEW

Table 8.1 provides a summary of potential environmental impacts and proposed mitigating measures for the preferred design. In general, the construction and operation of the recommended design will have a limited effect on the environment. The implementation of the pumping station will be the most disruptive phase of the project due to construction activities. **Table 6.1** identifies potential environmental impacts during construction and corresponding mitigation methods. It is anticipated that the recommended work will not have a significant effect on the natural environment such as wildlife, vegetation, or the habitat characteristics of any particular species.

With respect to other socio-economic impacts, it is anticipated that the preferred alternative will not have any serious lasting impact on existing land uses, cultural activities, heritage resources or any other community program. During the construction phase of this project, it is anticipated that all site locations would result in some level of temporary disruption to the community and nearby residents. The impacts on these impacts will be mitigated through standard construction procedures and mitigation measures outlined below.

Table 8.1 Environmental Effects and Mitigating Measures

OPERATION	EFFECT	MITIGATING MEASURES
Cutting, digging, or trimming ground covers, shrubs, and trees	Reduced terrestrial wildlife habitat quality (i.e., diversity, area, function) and increased fragmentation of habitat.	➢ This is not a concern as there is no significant existing terrestrial wildlife habitat in the proposed area of construction
	Loss of unique or otherwise valued vegetation features	➢ There are no known unique vegetation features in the area that may be disturbed by construction activities. ➢ Where possible, existing vegetation features will be restored to a preconstruction condition.
Trenching / tunnelling for sludge pumping; Excavation and construction for anaerobic digestion facility	Soil erosion and sediment transport to adjacent water bodies causing sedimentation and turbidity of adjacent water bodies and drainage ditches	➢ Use of erosion control measures (i.e., sediment traps, silt fences, etc.) ➢ Collect contaminated runoff ➢ Restore vegetation growth quickly ➢ Stage construction activities to minimize potential of adverse impacts
	Reduced water quality and clarity due to increased erosion and sedimentation, and transport of debris.	➢ Apply wet weather restrictions to construction activity. ➢ Comply with any local regulations, policies and guidelines that stipulate a minimum acceptable buffer width (the allowable distance from a water body). Maximum buffer widths are desirable. ➢ If possible, direct surface drainage away from working areas and areas of exposed soils. To the maximum extent possible, promote overland sheet flow to well vegetated areas. ➢ Install and maintain silt curtains, sedimentation ponds, check dams, cofferdams or drainage swales, and silt fences around soil storage sites and elsewhere, as required.

OPERATION	EFFECT	MITIGATING MEASURES
	Loss of vegetation and topsoil and mixing topsoil and subsoil	➢ Restore site by replacing topsoil and reinstate vegetation to prevent erosion
	Removal and/or disturbance of trees and ground flora	➢ Avoid treed areas where possible ➢ Employ tree protection measures ➢ Replace trees and provide site landscaping
	Temporary disruption and inconvenience during construction to adjacent properties, buildings, and inhabitants	➢ Notify public agencies and neighbouring owners of construction activities ➢ Prepare program for reporting and resolving problems ➢ Ensure access is provided for emergency vehicles and personnel ➢ Apply noise and vibration control measures ➢ Apply dust control measures ➢ Control emissions from construction equipment and vehicles ➢ Use silencers to reduce noise ➢ Require compliance with municipal noise by-laws
	Possible need to remove contaminated excavated material.	➢ Sample material. ➢ Handle and dispose of contaminated material in an acceptable manner
	Decreased ambient air quality due to dust and other particulate matter.	➢ Avoid site preparation or construction during windy and prolonged dry periods. ➢ Cover and contain fine particulate materials during transportation to and from the site. ➢ Instruct workers and equipment operators on dust control methods. ➢ Spray water to minimize dust off paved areas or exposed soils. ➢ Stabilize high traffic areas with a clean gravel surface layer or other suitable cover material. ➢ Cover or otherwise stabilize construction materials, debris and excavated soils against wind erosion.
	Disturbance to microscopic organisms in the soil.	➢ Limit the size of stockpiles to avoid anaerobic conditions. ➢ Protect stockpiled soils from exposure to and sterilization by solar radiation (or stockpile in an uncovered shaded area).
	Reduced soil capability through compaction and rutting and mixing of topsoil and layers below.	➢ Avoid working during wet conditions and/or confine operation to paved or gravel surfaces. ➢ Whenever possible, strip and store topsoil separately from the layers below and return to excavation in sequence.
	Industrial disruption of field/facility access.	➢ All driveways, roadways and field access will be restored to pre-construction condition ➢ Staging of construction and advance notice to property owners prior to disruption of construction to minimize inconvenience
	Disruption of tile and surface drainage systems.	➢ Provide for temporary drainage systems until final restoration is accomplished. ➢ Avoid disturbing drainage systems during critical periods. ➢ All existing culverts, tiles, and drainage systems to be restored to pre-construction conditions following construction.

OPERATION	EFFECT	MITIGATING MEASURES
	Reduced water quality of nearby surface waters having value as wildlife habitat.	➢ Use sediment control techniques for stockpiled materials to minimize degradation of water quality.
	Modifications or removal of aquatic habitat.	➢ Stage construction to minimize potential for adverse impacts.
	Residential impacts.	➢ Construction noise and dust impacts will be controlled through noise by-laws and dust control measures in contract specification. ➢ Inconvenience due to temporary loss of property access will be minimized through proper communication and advance notice of disruption. ➢ Pedestrian safety will be maintained through excavation barricades and construction fencing
	Traffic disruption.	➢ Construction activities will attempt to maintain a minimum of one lane of open traffic at all times with necessary detour signage and flag persons. ➢ If complete closure is required, emergency services will be advised in advance and access will be restored at the end of each working day.
	Recreation.	➢ Maintain access to recreational sites during construction. ➢ Locate water and wastewater infrastructure components to minimize impact.

OPERATION	EFFECT	MITIGATING MEASURES
	Archaeological Resources.	➢ A Stage 1 AA was undertaken by Stantec Consulting Ltd. (Stantec) of the WBPF lands (under Project Information Form [PIF] number P422-0031-2023). A property inspection was completed by Stantec archaeologists on March 17, 2023. The WBPF lands were identified as being subject to previous AA in 2006 and 2007 as part of the Detroit River International Crossing project. No archaeological resources were identified during the 2006 and 2007 AAs and no further archaeological work was recommended for the WBPF lands (ASI 2010). Based on this Stage 1 AA, no further AA is recommended. The Stage 1 AA Report is included in **Appendix C**. ➢ Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out an archaeological assessment, in compliance with Section 48(1) of the *Ontario Heritage Act*. ➢ The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 requires that any person discovering human remains must cease all activities immediately and notify the police or coroner. If the coroner does not suspect foul play in the disposition of the remains, in accordance with Ontario Regulation 30/11 the coroner shall notify the Registrar, Ontario Ministry of Public and Business Service Delivery, which administers provisions of that Act related to burial sites. In situations where human remains are associated with archaeological resources, the Ministry of Citizenship and Multiculturalism should also be notified (at archaeology@ontario.ca) to ensure that the archaeological site is not subject to unlicensed alterations which would be a contravention of the *Ontario Heritage Act*.
	Built Heritage Resources and Cultural Heritage Landscapes	➢ The MCM's "Screening for Impacts to Build Heritage and Cultural Heritage Landscapes" checklist was reviewed. The study area was determined to have low potential for built heritage resources and cultural heritage landscapes.
Use of construction equipment	Contamination of surface waters, drains and public roadways from spills, leaks or equipment refuelling.	➢ Use containment facilities ➢ Inspect equipment regularly for fuel and oil leaks ➢ Clean equipment before it travels off site
	Decreased air quality due to vehicular emissions causing increased concentrations of chemical pollutants.	➢ Minimize operation and idling of vehicles and gas-powered equipment, particularly during local smog advisories. ➢ Use well-maintained equipment and machinery within operating specifications.
	Disruption to wildlife migration and movement patterns, breeding, nesting, or hibernation.	➢ There are no known areas containing sensitive vegetation and wildlife. ➢ There are no known areas where migratory birds are breeding.

OPERATION	EFFECT	MITIGATING MEASURES
	Introduction of non-native vegetation, including opportunistic species.	➢ Clean heavy machinery and equipment prior to transporting to new location.
	Loss of unique or otherwise valued vegetation features	➢ Avoid or minimize trampling vegetation with equipment. ➢ Minimize physical damage to vegetation by avoiding pushouts and avoiding the placement of splash onto living vegetation.
	Reduced water quality and clarity due to increased erosion and sedimentation, and transport of debris.	➢ Operate heavy machinery on the shore above the normal water level. ➢ Where possible, conduct activities in the dry, above the actual water level and above any expected rises in water level that may occur during a rainfall or snowmelt event.
	Reduced water quality due to inputs of contaminants from surface runoff during construction and operation.	➢ Refuel equipment off slopes and well away from water bodies. ➢ Securely contain and store all oils, lubricants, fuels, and chemicals. If necessary, use impermeable pads or berms.

8.2 NATURAL ENVIRONMENT IMPACTS AND MITIGATING MEASURES

8.2.1 Standard Mitigation Measures

The following standard mitigation measures/best practices are provided to reduce potential impacts to natural heritage features during construction:

- Delineate the Project footprint with tree protection fencing prior to construction to reduce impacts to adjacent natural features.
- Wash, refuel and/or service equipment a minimum of 30 m from surface waters to reduce the risk of deleterious substances from entering surface waters. Check machinery regularly for fluid leaks.
- Thoroughly clean construction machinery prior to entering the site to reduce the potential for establishment / spread of invasive species.
- To reduce the potential for spread of insect pests such as the Emerald Ash Borer, trees cut should be disposed of on site (either through spreading of wood chips or trees cut and sawed into logs).
- Develop a Spill Management Plan and have it on site for implementation in the event of an accidental spill. Keep an emergency spill kit on site.
- Stabilize and re-vegetate areas of disturbed/exposed soil, as soon as practicably possible with native seed mixes and woody vegetation.

- Maintain erosion and sediment control measures until the restoration measures have been assessed and determined to be secure and stable.

8.2.2 Wildlife Protection

The installation of silt fencing around the work area will reduce the likelihood of reptiles entering the work area. In addition, a visual search of the construction area (including machinery) is recommended each day to locate and avoid reptiles, amphibians, and other wildlife. If wildlife is encountered, they will be given reasonable time to flee the area on their own. If a wildlife species must be moved, a person knowledgeable in handling techniques may relocate it to a location that is both safe and suitable.

The following mitigation measures are recommended to avoid impacts to wildlife during Project construction:

- A visual search of the work area will be conducted before work commences each day, particularly for the period when most wildlife is active (generally April 1 to October 31). Visual inspections will locate and avoid snakes, turtles, and other ground dwelling wildlife such as small mammals. Visual searches will include inspection of machinery and equipment left in the work area overnight prior to starting equipment.
- If wildlife is encountered, work at that location will stop, and the animal(s) will be permitted reasonable time to leave the work area on their own.
- Any sediment and erosion control measures, such as fencing or blanket, utilized on the site during construction will avoid products with plastic mesh due to risk of entanglement of snakes or other wildlife.
- Eastern Foxsnake are considered arboreal (climbers) and as such, exclusionary fencing is recommended to be 200 cm in height above ground (MNRF 2016). Specifications for reptile exclusion fencing should follow Best Practices Technical Note – Reptile and Amphibian Exclusion Fencing (MNR 2013) and Best Management Practices for Mitigating the Effects of Road Mortality on Amphibian and Reptile Species at Risk in Ontario (MNRF 2016). A terrestrial ecologist should be consulted during exclusionary fencing design.
- Any observations of species at risk or species of conservation concern should be reported to MECP and MNRF within 48 hours. Species at risk should not be handled, harassed, or moved in any way, unless they are in immediate danger.
- If wildlife handling and relocation (e.g., amphibians, reptiles) is anticipated during construction such as vegetation clearing or during in-water work, the Contractor must obtain a Wildlife Scientific Collectors Authorization from the MNRF prior to the commencement of work.

8.2.3 Terrestrial Habitat

The proposed work area may contain natural features that may support habitat of endangered species and threatened species. As per Section 2.1.7 of the Provincial Policy Statement (PPS 2020) – "Development and site alteration shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements." All issues related to the provincial *Endangered Species Act* and its regulations shall be addressed prior to the construction of the proposed work. If the proponent believes that their proposed activities are going to have an impact on Species at Risk or are uncertain about the impacts, they should contact SAROntario@ontario.ca to undergo a formal review under the Endangered Species Act (ESA). It is the responsibility of the proponent to ensure that Species at Risk are not killed, harmed, or harassed, and that their habitat is not damaged or destroyed through the proposed activities to be carried out on the site.

A field investigation was carried out to document existing conditions at the proposed work site. The field investigation consisted of vegetation and wildlife habitat assessments. The number, location, and species of bird nests found in trees or vegetated areas that may be affected by the proposed work were documented in the Natural Heritage Impact Assessment Report which is available in **Appendix C**.

8.2.4 Protection of Migratory Birds

The *Migratory Birds Convention Act*, 1995 (MBCA) provides legal protection of migratory birds and their active nests in Canada. The loss of migratory bird nests, eggs and/or nestlings due to tree cutting or other vegetation clearing can be avoided by limiting clearing of vegetation to outside of the general nesting period for migratory birds in this region (C2) as identified by Environment and Climate Change Canada (ECCC) (i.e., between April 1 and August 31). If work must be performed within this window, a survey for active nests or breeding activity should be conducted by a qualified biologist before work commences and additional mitigation measures (e.g., implementation of avoidance distances during construction) implemented, if required.

8.2.5 Protection of Fish and Fish Habitat

Implementation of the following measures will protect fish and fish habitat during construction if in-water work is required:

- Reduce the duration of in-water work to the extent possible.
- Conduct in-water work during periods of low flow to allow work in water to be isolated from flows.
- Schedule in-water work to occur during the applicable in-water work timing window. Based on the fish species known to occur in McKee Creek, in-water work can occur from July 16 to March 14 (no in-water work from March 15 to July 15) (MNR 2013b).
- If in-water work is required, develop, and implement a project-specific fish relocation plan to relocate fish from within an in-water work area. The Contractor must obtain a Licence to Collect Fish for Scientific Purposes from the MNRF prior to the commencement of in-water work.

- Screen water intake pipes to prevent entrainment or impingement of fish following the measures as outlined in DFO's Interim Code of Practice for End-of-pipe Fish Protection Screens for Small Water Intakes in Freshwater (DFO 2020b).
- Where applicable, manage and treat dewatering discharge to reduce the risk of erosion and/or release of sediment-laden or contaminated water to surface waters.

8.2.6 Erosion and Sediment Control

An erosion and sediment control (ESC) plan should be developed and employed during construction to reduce the risk of erosion and the entry of sediment into surface water and other natural features. Mitigation included in the plan should include the following measures:

- Implement project-specific temporary ESC measures per prior to starting work (e.g. silt fence and/or sediment logs).
- Keep additional ESC materials available on site to provide a contingency supply in the event of an emergency.
- Monitor and maintain erosion and sediment controls, as required. Controls are to be removed only after the soils of the construction area have stabilized and vegetation cover has reestablished.
- Stabilize materials requiring stockpiling (fill, topsoil, etc.) and keep a safe distance (> 30 m) from watercourses.

8.2.7 Excess Soil Materials and Waste

In 2019, the MECP introduced O. Reg. 406/19 entitled 'On-site and Excess Soil Management' under the Environmental Protection Act. All excess soil materials and waste generated during the construction process must be disposed of in accordance with O. Reg. 406/19.

8.2.8 Source Water Protection

For the protection of local municipal drinking water sources, the Essex Region Source Protection Plan (SPP), which has been established under the Clean Water Act, 2006 (Ontario Regulation 287/07), came into effect on October 1, 2015.

The Clean Water Act (2006) refers to four types of Vulnerable Areas, which include:

- Intake Protection Zones
- Wellhead Protection Areas
- Highly Vulnerable Aquifers
- Significant Groundwater Recharge Areas

The types of Vulnerable Areas are addressed further below in relation to this project location.

8.2.8.1 Intake Protection Zones (IPZs)

There is one municipal Water Treatment Plant (WTP) downstream of the proposed anaerobic digestion facility, the Amherstburg Water Treatment Plant. The Amherstburg WTP has an intake in the Detroit River (refer to Map 10 of the Essex Region SPP). Intake Protection Zones are areas of land and water, where run-off from streams or drainage systems, in conjunction with currents in lakes and rivers, could directly impact the source water at the municipal drinking water intakes.

An Intake Protection Zone can be described as a defined area surrounding a surface water body intake. The size and shape of each zone in an IPZ represents either a set distance around the intake pipe, or the length of time it would take water and contaminants to reach the intake:

- IPZ-1 is the area closest to the intake pipe and is a set distance which extends one kilometre upstream and 120 meters onto the shore.
- IPZ-2 includes the on and offshore areas where flowing water and any pollution would reach the intake pipe within two hours.
- IPZ-3 is an area where contaminants could reach the intake pipe during and after a large storm.

The proposed facility is located within the Intake Protection Zone 3 (IPZ-3) of the Amherstburg WTP. As such it is subject to one (1) policy of the Amherstburg IPZ-3:

> *The above grade handling and storage of liquid fuels (containing benzene) in quantities of 3,000,000 L or greater is identified as a Significant Drinking Water Threat (SDWT) in the Amherstburg IPZ-3.*

The anaerobic digestion facility will not require nor result in the handling or storage of large volumes of liquid fuel and therefore is not considered a SDWT.

In addition, the LRPCP, is located in the IPZ-2 for the A.H. Weeks (Windsor) Water Treatment Plant (refer to Map 8 of the Essex Region SPP). The application and storage of hauled sewage is considered a SDWT in this zone and further is prohibited in Windsor IPZ-1 and IPZ-2. No sewage will be applied, transported, or stored as a part of this work.

ERCA is the designated Risk Management Official/Inspector providing Risk Management Services for the ERSPA. Proposed work within this area may require approval by the Essex Region Risk Management Official (RMO) to ensure that threats to potential drinking water are mitigated. The RMO has provided preliminary comments for this project and should continue to be consulted as the project progresses regarding Source Water Protection and the applicable source protection plan policies that may apply to the site.

8.2.8.2 Wellhead Protection Areas

Wellhead Protection Areas are not applicable in the Essex Region, as none of the municipal drinking water systems are supplied by groundwater.

8.2.8.3 Highly Vulnerable Aquifers (HVAs)

Highly Vulnerable Aquifers (HVAs) are defined as aquifers on which external sources have or are likely to have a significant adverse impact and include the land above the aquifer. In the Essex Region Source Protection Area (ERSPA) these HVAs are generally located in the sandy soil areas in the southern part of the region, including most of Pelee Island (refer to Map 4 of the Essex Region Source Protection Plan). The proposed site for this project does not fall within a HVA with high vulnerability (6.0). There are no associated Significant Drinking Water Threats (SDWTs) or policies within this area because the municipal water treatment plant does not use groundwater as its supply.

8.2.8.4 Significant Groundwater Recharge Areas (SGRAs)

Significant Groundwater Recharge Areas (SGRAs) are defined as per Regulation 287/07 as areas within which it is desirable to regulate or monitor drinking water threats that may affect the recharge of an aquifer. Groundwater recharge occurs where rain or snowmelt percolates into the ground and flows to an aquifer. The greatest recharge usually occurs in areas which have loose or permeable soil such as sand or gravel that allows the water to seep easily into the aquifer.

Most of the SGRAs in the ERSPA are in the southern Essex Region in sandy soil areas, such as Harrow, Leamington, Kingsville, and limited parts of the Turkey Creek and Pelee Island subwatersheds (refer to Map 5 of the Essex Region Source Protection Plan). The proposed site for this project does not fall within a SGRA with medium or high vulnerability (4.0 to 6.0). There are no associated Significant Drinking Water Threats (SDWTs) or policies with this area because the municipal water treatment plant does not use groundwater as its supply.

8.2.8.5 Overall Vulnerability Assessment Summary

Table 8.2 provides a summary of threats to vulnerable areas and the subsequent actions to be taken, relating to this project.

Table 8.2: Summary of Threats to Vulnerable Areas

Vulnerable Area	Threat Potential	Action Taken
Intake Protection Zone	Low	None
Wellhead Protection Areas	Not applicable	None
Highly Vulnerable Aquifer	Not applicable	None
Significant Ground Water Recharge Areas	Not applicable	None

Based on the assessment provided above, no further action is recommended to be taken; however, additional action may be taken to address low and moderate threats at the discretion of the Source Protection Committee.

8.3 SOCIO-ECONOMIC IMPACTS AND MITIGATING MEASURES

8.3.1 Archaeological Resources

During the implementation phase of this project, should previously undocumented archaeological resources be discovered, there may be a new archaeological site and therefore subject to Section 48(1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the Ontario Heritage Act. If any further archaeological field investigation is required, as identified above, the City will engage with all indigenous communities that have been engaged with to date and will facilitate the participation in archaeological field work (if applicable) via a Fieldwork Participation Agreement.

The Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 requires that any person discovering human remains must cease all activities and notify the police or coroner. If the coroner does not suspect foul play in the disposition of the remains, in accordance with Ontario Regulation 30/11 the coroner shall notify the Registrar, Ontario Ministry of Public and Business Service Delivery, which administers provisions of that Act related to burial sites. In situations where human remains are associated with archaeological resources, the Ministry of Citizenship and Multiculturalism should also be notified (at archaeology@ontario.ca) to ensure that the archaeological site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act

8.3.2 Community

8.3.2.1 Disruption of Traffic

Construction of the proposed facility will result in temporary detours or lane restrictions that will disrupt traffic in the area. All emergency services will be notified of detours prior to commencement of construction. Mitigating measures are to provide and maintain detours, provide for safe alternate routes, and select alternate routes to minimize inconvenience.

8.3.2.2 Inconvenience During Construction

Construction activities will create noise and traffic from construction vehicles resulting in temporary inconvenience to area residents and businesses. The best available construction techniques shall be applied to the construction of the proposed tunnel sewer to mitigate noise and vibration. The noise and vibration limits set for the project will ensure that the community, all buildings, including those with heritage features, are protected. Monitoring during construction will ensure that noise and vibration are kept below the established limit.

8.3.2.3 Proximity to Existing Dwellings

Since the anaerobic digestion facility will include fully enclosed digesters units it does not represent a significant source of odour or noise.

8.3.2.4 Proximity to Arterial Roadway

It is not expected that there will be any significant traffic disruptions during the construction of the proposed work. The EC Row Expressway and Highway 401 are the two major roadways, which provide interconnection and access to Windsor communities and neighboring areas. These roads are located significantly far away from the proposed construction; therefore, it is not expected that there will be any significant traffic disruptions during construction.

8.4 PERMITTING CONSIDERATIONS

8.4.1 Site Plan Approval of the Facility and Associated Civil Work

It will be likely that Site Plan Approval of the facility and the associated works, such as access/egress to and from the facility as well as water, sanitary, and storm water servicing. The preparation of the required plans, drawings, and report will comply with the City's specifications and would be completed together with the above-described environmental compliance work.

Finally, some land use planning work may be required if development of the preferred property for the proposed facility would require Amendment to the City's Official Plan and/or Zoning By-law and provisions.

8.4.2 Essex Regional Conservation Authority

The proposed facility is not located in the Essex Region Conservation Authority (ERCA) regulated area of the Detroit River and McKee Drain and as such may not be subject to the policies of O. Reg. 158/06 under the Conservation Authorities Act. Any excavations, construction of structures, drain crossings, or the placement and grading of fill, undertaken within the regulated area would require permits from ERCA under this regulation (Development, Interference with Wetlands and Alteration to Shorelines and Watercourse Regulations - Section 28 of the Conservation Authorities Act).

The site is partially within the Event Based Area for Source Water Protection and may be subject to Source Water Protection regulations per Section 36 of the *Clean Water Act*. This project may require approval by the Essex Region Risk Management Official (RMO) to ensure that appropriate actions are taken to mitigate any potential drinking water threats.

8.4.3 Ministry of the Environment, Conservation and Parks

The Endangered Species Act, 2007 may identify species at risk as having potential to occur within the study area, however, there is a low likelihood of occurrence because there are no recent records, and the area is heavily disturbed. Avoidance of the migratory bird nesting season (April 1 - August 31) is recommended. If this is not possible, then bird nesting surveys must be completed in advance of construction. With the implementation of this mitigation, no authorizations are needed under the ESA. It is the responsibility of the proponent to ensure that Species at Risk are not killed, harmed, or harassed, and that their habitat is not damaged or destroyed through the proposed activities to be carried out on the site.

Consultation with MECP once design details and staging plans are available to confirm mitigation measures and determine authorization and mitigation requirements, if any, for provincially regulated species at risk. Consultation with MECP is recommended prior to construction.

The MECP indicated through consultation activities that an Air Environmental Compliance Approval application will be required for the proposed works. In Phase 5 implementation of this project, the proponent will consult further with the MECP Environmental Permissions Branch regarding Air ECA requirements.

Depending on the area of the new construction as well as municipal requirements a stormwater strategy may be required, which in turn will require an Environmental Compliance Approval application to the ministry. In Phase 5 implementation of this project, the proponent will consult further with the MECP Environmental Permissions Branch regarding potential ECA requirements. Should a stormwater management strategy and/or ECA application be required, the proponent will obtain an ECA prior to starting the construction of the proposed pumping station.

Facilities that use biogas to produce electricity onsite may be required to obtain a Renewable Energy Approval (REA) per Ontario Regulation 359/09, from the ministry, depending on the fuel mixture and other factors. Proponents proposing to generate electricity using biogas and other organics are encouraged to have a pre-submission meeting with MECP to discuss whether REA or other permissions may apply. Pre-submission meeting requests can be submitted in writing to enviropermissions@ontario.ca. In Phase 5 implementation of this project, the proponent will consult further with the MECP Environmental Permissions Branch regarding potential REA requirements. Should a REA application be required, the proponent will obtain an REA prior to starting the construction of the proposed work.

8.4.4 City of Windsor – Building Permit

The proposed pumping station is located within the City of Windsor and as such would require a building permit prior to construction. Building permits ensure that construction within our municipality meet the standards set out in the Ontario Building Code. In addition, this permitting process ensures all zoning requirements, fire and structural safety standards, and other building standards are met.

8.5 RECOMMENDED ASSESSMENTS / SURVEYS

8.5.1 Natural Heritage Impact Assessment – Future Survey Recommendations

The following studies are proposed during the detailed design phase to determine if SAR and SOCC are present in the defined study area:

- Birds: Breeding bird surveys – Two surveys during the breeding season, from May to July
- Snakes: Artificial cover object survey and visual encounter surveys – Ten surveys from April to July, as per the MNRF Survey Protocol for Ontario's Species at Risk Snakes (OMNRF 2016)
- Bats: Acoustic bat surveys utilizing automatic recording units (ARU) – Two-week ARU survey in June
- Plants: Botanical survey – One survey in July

8.5.2 Air Quality Impact Assessment

At this stage of the project (high-level planning), it is not possible to determine the exact mitigation measures that will be required as a part of these works. During the detailed design phase and after the preferred size, layout, and technical specifications for the facility are determined an Emission Summary and Dispersion Modelling (ESDM) Report should be prepared in accordance with Ontario Regulation 419/05, Air Pollution – Local Air Quality. The ESDM Report should outline the potential impact of the proposed facility on local air quality and outline mitigation measures to be followed during the design, construction, and operation of the proposed facility. If source separate organics are to be processed at the new facility the ESDM Report will include this in the assessment. Further, the proponent will commit to developing an Odour Management and Mitigation Plan during detailed design and prior to the implementation of the works.

The ESDM Report will identify and assess project specific mitigation measures, emission controls, and odour best management practices (BMPs) that will prevent offsite odour and air impacts from the proposed anaerobic digestion facility. Although it is not possible to outline the exact mitigation measures, controls, and management practices at this time, the ESDM should develop an effective and efficient management of odours through the following four stages:

1. Planning
    - Assess facility processes and site operations to identify potential sources of odour, frequency of odour emissions, and manner of discharge.
    - Detail odour avoidance, control, and mitigation strategies specific to the facility and site operations based on material and waste handling, production systems, ancillary services, preventative maintenance, and general site operations.
2. Doing
    - Identify best management practices to be implemented.
    - Develop an Odour Management and Mitigation Plan.
    - Establish odour complaint response protocols.
    - Implement administrative controls such as staff training, development of Standard Operating Procedures (SOPs), preventative maintenance schedules and recordkeeping.
3. Checking
    - Odour monitoring and inspection protocols.
    - Recordkeeping.
4. Acting
    - Periodic review of the effectiveness of the BMPs and update of the Odour Management and Mitigation Plan a regularly scheduled basis, or when changes are made at the facility.

The MECP indicated through consultation activities that an Air Environmental Compliance Approval application will be required for the proposed works. In Phase 5 implementation of this project, the proponent will consult further with the MECP Environmental Permissions Branch regarding Air ECA requirements.

The following is a discussion of the local air quality in the region of the proposed work. The area surrounding the preferred site is primarily zoned for Heavy Industrial Land Use and some Light Industrial / Business Park Land Use. This includes the Lou Romano Water Reclamation Plant, Brighton Beach Power (natural gas fired combined cycle fossil fuel power station), Windsor Salt, BP Canada – Windsor Storage Facility, and Nemak Engineering Centre. A number of these facilities utilize processes which have potential to impact local air quality and as a mitigative measure the City of Windsor has restricted land use in the area via zoning by-laws. The implementation of an anaerobic digestion facility is fitting to the zoning by-laws and current land use in the region.

Sensitive receptors are defined as a building, 'amenity area', or outdoor space where routine or normal activities occurring at reasonably expected times would experience 1 or more 'adverse effect(s)' from contaminant discharges generated by a nearby 'facility'. The 'sensitive land use' may be a part of the natural or built environment. Depending upon the particular 'facility' involved, a sensitive land use and associated activities may include one or a combination of:

- Residences or facilities where people sleep (e.g., single and multi-unit dwellings, nursing homes, hospitals, trailer parks, camping grounds, etc.). These uses are considered to be sensitive 24 hours/day.
- A permanent structure for non-facility related use, particularly of an institutional nature (e.g., schools, churches, community centers, day care centers).
- Certain outdoor recreational uses deemed by a municipality or other level of government to be sensitive (e.g., trailer park, picnic area, etc.).
- Certain agricultural operations (e.g., cattle raising, mink farming, cash crops and orchards).
- Bird/wildlife habitats or sanctuaries.

Based on Ontario Guideline D-2 'Compatibility between Sewage Treatment and Sensitive Land Use', sensitive land uses should not be placed adjacent to treatment facilities, where practical. When new facilities (or enlargements to existing facilities) are proposed, an adequate buffer area should be acquired as part of the project. Where acquisition of a buffer is not possible, future sensitive uses on adjacent lands should be discouraged through appropriate official plan and zoning constraints, or ownership by a responsible public authority.

In terms of existing nearby sensitive receptors, the buffer zone between the proposed expansion and nearest sensitive receptors is greater than 800-meters. In terms of future nearby sensitive receptors, all lands within an 800-meter distance of the facility are zoned for Light and/or Heavy Industrial land use which restricts any development for sensitive land uses. Due to the zoning constraints and existing land use in the area the project is not anticipated to have significant air quality impacts on sensitive receptors.

Should odour complaints be received regarding the proposed facility, a 'Complaint Response Protocol' will be followed to address the concerns. Developing an established method of responding to odour complaints allows for issues to be addressed quickly and professionally. Further, documenting questions and responses can assist in identifying potential issues and corrective actions to control, reduce or mitigate the perceived impact. This 'Complaint Response Protocol' should be developed during the detailed design period and consider the findings of the ESDM Report. Basic steps of the 'Complaint Response Protocol' may include:

- Develop a 'Odour Complaint Form' which records the complainant's contact information and description of the odour (magnitude, location, source, substance/process);
- Record weather conditions at the time of the complaint;
- Record the facility and operational activities at the time of the odour to determine whether it corresponded to a specific activity or to a potential abnormal event such as a process upset;
- Conduct a site walkthrough to see if odours are still present and what is causing them;
- Where possible and appropriate, initiate response procedures to mitigate odours;
- Ensure completion of the Odour Complaint Form and retain on site as a means to track and deal with repeat complaints; and,
- Notify the MECP if required by the Terms and Conditions of the facility's ECA or where Section 34 of O. Reg. 1/17 applies.

9.0 CONSULTATION

The Municipal Class Environmental Assessment process provides a minimum of three points of contact, for a Schedule C undertaking, where members of the public and review agencies have the opportunity to review the project findings and submit comments for consideration in development of the project. The following sections summarize the approach that has been taken with respect to consultation during this project. For this Class EA, consultation will include:

- Publication of all mandatory notices and circulation to review agencies, interested stakeholders, Indigenous communities, and the general public.
- A detailed communications and consultation strategy will be outlined as a key component of the study-initiation and organization process.
- Communications would utilize a Project Site developed on the City of Windsor's website which would encourage input and interaction as the studies proceed.
- All the communications and consultation activities including the input and comments received would be documented in a comprehensive Consultation Plan.

9.1 PUBLIC PARTICIPATION

A notice of commencement advising of the initiation of this Class EA undertaking and inviting input was originally published in the January 15, 2022, edition of the Windsor Star and on the City of Windsor's Webpage. A copy of the notice and the Windsor Star advertisement is contained in **Appendix B**.

In addition to this discretionary point of contact, there are three points for mandatory public contact during the Class EA process, namely:

- Phase 2: Public Consultation and Information Centre #1
- Phase 3: Public Consultation and Information Centre #2
- Phase 4: Notice of Completion

A public Open House was held on June 29, 2022, to provide information regarding this undertaking and to invite input and comment from interested persons. The open house notice was published in the June 18, 2022, edition of the Windsor Star and on the City of Windsor Webpage. A copy of the notice and the Windsor Star advertisement is contained in **Appendix B** along with a copy of the handout materials that were provided to attendees.

A second public Open House was held on January 31, 2023, to review progress made since the first open house. Information on alternative concepts for the preferred design selected in the Class EA process was available for review. The open house notice was published in the January 21, 2023, edition of the Windsor Star and on the City of Windsor Webpage. A copy of the notice and the Windsor Star advertisement is contained in **Appendix B** along with a copy of the handout materials that were provided to attendees.

9.2 REVIEW AGENCIES

The Class EA process provides an opportunity for involvement in the project by various branches of the MECP as well as other provincial and federal ministries or outside agencies. The list of Review Agencies varies depending upon the scope of the project, its location, and the potential environmental impacts.

An email advising of the initiation of this project and including the notice of project commencement was sent to review agencies on January 14, 2022. A copy of the email and the list of review agencies included are contained in **Appendix B**.

Information on alternative design solutions for the proposed Biosolids Management Strategy as part of Phase 2 of the Class EA process were distributed to review agencies and mandatory contacts in an email on June 17, 2022. This email package included a copy of the notice of the first public information centre. A copy of each email and the distribution list is included in **Appendix B**.

Information on alternative design concepts for the proposed Biosolids Management Strategy as part of Phase 3 of the Class EA process were distributed to review agencies and mandatory contacts in an email on January 20, 2023. This email package included a copy of the notice of the first public information centre. A copy of each email and the distribution list is included in **Appendix B**.

Copies of this Draft ESR Report are being distributed to review agencies and mandatory contacts by email in March 2023.

9.3 RESPONSE FROM PUBLIC AND REVIEW AGENCIES

9.3.1 Notice of Project Initiation

The notice of initiation of the project did not generate any public response. The following responses (copies included in **Appendix B**) were received from review agencies and mandatory contacts.

- Ministry of the Environment, Conservation, and Parks – provided acknowledgment of Notice of Project Initiation in an email dated February 9, 2022.
- Essex Region Conservation Authority (ERCA) – advised in an email dated February 14, 2022, that ERCA has an interest in the project and can provide input on the project.
- Ministry of Tourism, Culture and Sport – advised in an email dated January 21, 2022, that the Class EA should identify and address potential impacts to Archaeological resources, including land-based and marine; built heritage resources, including bridges and monuments; and Cultural heritage landscapes.
- Essex-Windsor Solid Waste Authority (EWSWA) – advised in an email dated January 25, 2022, that they would like to participate in the study and be notified of project updates.
- The Town of Essex – advised in an email dated January 25, 2022, that they would like to participate in the study and be notified of project updates.

- SYNAGRO – advised in an email dated January 24, 2022, that they would like to participate in the study and be notified of project updates.

9.3.2 Public Open House # 1

A total of eight (8) people attended the Open House held on June 29, 2022. A list of attendees, the open house display material, and the provided feedback form is included in **Appendix B**. The following comments (copies included in **Appendix B**) were received from review agencies and mandatory contacts.

- Ministry of Municipal Affairs and Housing – acknowledged receipt of this Notice in an email dated June 20, 2022.

- Transport Canada – advised in an email dated July 27, 2022, that the project proponent is requested to self-assess if the project will interact with a federal property and/or waterway and require approval and/or authorization under any Acts administered by Transport Canada.

9.3.3 Public Open House # 2

A total of eight (8) people attended the Open House held on January 31, 2023. A list of attendees, the open house display material, and the provided feedback form is included in **Appendix B**. The following comments (copies included in **Appendix B**) were received from review agencies and mandatory contacts.

- City of Windsor Planning & Building Services – advised in an email dated January 24, 2023, that portions of the Lou Romano Water Reclamation Plant (LRWRP) and the Windsor Biosolids Processing Facility are in areas of high archaeological potential and works proposed would have to be subject to the City of Windsor adopted Archaeological Management Plant (WAMP) and Official Plan policies concerning archaeology.

- Fisheries and Oceans Canada – advised in an email dated January 24, 2023, that the Fish and Fish Habitat Protection Program is not able to provide comment regarding general planning. If planned works may cause any of the prohibited effects under the Fisheries Act or Species at Risk Act, a Request for Review form should be completed for the works and submitted to FisheriesProtection@dfo-mpo.gc.ca

- Windsor Police Services – advised in an email dated January 23, 2023, that they have no additional comments or concerns at this time. If any aspect of the project could impact public safety in any way, to notify them for further conversations.

- COTFN – advised via online consultation tool on February 16, 2023, that they have no comments or concerns with the preferred design concepts after reviewing PIC No.2 material.

9.3.4 Notice of Draft Environmental Study Report

The notice of Draft ESR did not generate any public response. The following responses (copies included in **Appendix B**) were received from review agencies and mandatory contacts.

- Ministry of Citizenship and Multiculturalism – provided comments on the Draft ESR in a letter dated August 1, 2023. The MCM found that due diligence has been undertaken in preparing the ESR.
- Essex Region Conservation Authority – provided comments in an email dated August 1, 2023. ECRA is in support of Site Alternative No. 2 (the recommended alternative) as this address is not subject to regulation by ERCA under the *Conservation Authorities Act* (Ontario Regulation No. 158/06). However, ERCA noted that the site is partially within the Event Based Area for Source Water Protection and may be subject to subject to Source Water Protection regulations per Section 36 of the *Clean Water Act*.
- Ministry of Municipal Affairs and Housing – indicated in an email on August 2, 2023, that they do not have any provincial land use planning concerns at this time.
- Windsor Police Services – indicated in an email on August 3, 2023, that they do not have any concerns with the project at this stage, nor do they have any specific comments. In addition, they noted that they may provide feedback on review of site plans should any layout changes be contemplated.
- Ministry of the Environment, Conservation, and Parks – provided comments on the Draft ESR in a letter dated August 15, 2023.
- Essex Region Conservation Authority, Source Water Protection Team – provided comments in a letter dated August 18, 2023.

9.4 INDIGENOUS CONSULTATION

Consultation with Indigenous communities is ongoing in accordance with the Municipal Class EA requirements. As part of this Environmental Assessment, communications with Indigenous agencies and communities are being undertaken in parallel with the other stakeholder communications and consultations. This report will be sent to the Indigenous groups and organizations to solicit their interest or non-interest in the study. The communities contacted as part of this EA study include:

- Aamjiwnaang First Nation
- Caldwell First Nation
- Walpole Island First Nation (Bkejwanong Territory)
- Chippewas of the Thames First Nation
- Chippewas of Kettle & Stony Point First Nation
- Oneida Nation of the Thames (ONYOTA'A:KA)
- Métis Nation of Ontario

- Moravian of the Thames (Delaware Nation)

Documentation of consultation with First Nations communities during the Environmental Assessment Process is located in **Appendix B**.

10.0 SUMMARY

The City of Windsor owns and operates two wastewater treatment facilities, the LRWRP and the LRPCP, which produce approximately 8,500 and 2,500 dry tonnes of biosolids each year, respectively. Currently dewatered sludge from the two WWTPs are heat dried and pelletized at the City-owned WBPF. Based on future biosolids projections, the biosolids management facility should have the capacity to treat upwards of 24,000 dry tonnes of biosolids each year (20 – year projection) and 34,500 dry tonnes of biosolids each year (ultimate projection). To address current and future biosolids management needs at the two wastewater treatment plants, the City initiated this study to identify the preferred means of processing biosolids. This problem / opportunity statement was developed in fulfillment of Phase 1 of the Class EA process.

In **Section 5.0**, alternative design solutions for the management of wastewater residuals from the two WWTPs were identified and evaluated based on a variety of social, natural environmental, economic, and technical criteria. This section of the report was completed in fulfillment of Phase 2 of the Class EA process. The most preferred alternative and therefore the recommended solution was determined to be 'Anaerobic Digestion and Biogas Utilization'. Under this strategy, the biosolids produced in the City's two WWTPs would be processed at a centralized anaerobic digestion facility. The biogas produced from the anaerobic digesters is a form of renewable energy which can be used as a source to produce heat, electricity, and/or fuel. Biogas utilization within the City of Windsor is expected to result in significant energy savings and reduced GHG emissions for the two wastewater treatment facilities. A quantitative analysis of the anticipated biogas production, energy savings, and reduction in GHG emissions is shown in **Section 5.8**.

In **Section 6.0,** alternative design concepts (technical alternatives) for the preferred solution were identified and evaluated with the objective of determining which alternative best addresses the preferred solution. This section of the report was completed in fulfillment of Phase 3 of the Class EA process. The most preferred alternatives and therefore the recommended design concepts were determined to be:

Sludge Handling Alternative → LRPCP Sludge Cake Trucked to Anaerobic Digestion Facility
Sludge Pretreatment Alternative → Thermal Pretreatment via THP (Interim Solution – No Pretreatment)
Type of Anaerobic Digestion Alternative → Mesophilic Anaerobic Digesters
Site Selection Alternative → WBPF
Digestate Handling Alternative – Solids Disposal → Storage and Land Application
(Interim Solution – Continued use of WBPF)
Biogas Utilization Alternative → Combined Heat and Power

The most preferred alternatives within each category form the recommended solution and are outlined in **Table 7.1.** The simple process schematic for the preferred design is shown in **Figure 7.1** of **Section 7.0**.

This study follows the Class Environmental Assessment process of the Municipal Engineers Association and is documented within this Environmental Study Report. This Environmental Study Report documents the planning, design, and consultation process for the project and was completed in fulfilment of Phase 4 of the Class EA process.