CANADIAN MANUFACTURERS AND EXPORTERS

WASTEWATER PROCESSING STUDY
SUMMARY REPORT

ORIGINAL

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ORIGINAL

PROJECT NO.: 221-13075-00
DATE: MAY 08, 2023

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May 08, 2023

Confidential

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Attention: Ron Koslowsky, Divisional Vice President, MB

Dear Sir:

WSP Canada Inc. is pleased to submit the Summary Report for the Wastewater Processing Study to Canadian Manufacturers and Exporters (CME). This report summarizes and highlights key aspects of the Wastewater Study previously submitted to CME on April 4, 2023.

We appreciate the opportunity to continue to work with CME. Should you have any questions or would like to discuss the submission further in detail, please do not hesitate to contact us.

Yours sincerely,

Dana Bredin, P.Eng., PMP
Project Manager

DB/BL/dlr

cc: Carrie Schroeder, Director of Operations

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REVISION HISTORY

FIRST ISSUE

May 8, 2023	Summary Report - Final		
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1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Canadian Manufacturers and Exporters (CME) to provide consulting services for a Wastewater Processing Study. The Wastewater Processing Study is part of Project ASPIRE: Accelerating Sustainable Protein Impact and Results. Project Aspire's goal is for Manitoba to become a global leader in the development and production of sustainable protein manufacturing. Food manufacturers and processing industries have expressed interest in building or expanding in Manitoba, however, both water supply and wastewater treatment capacities are a concern. It is recognized that in many areas within Manitoba, municipal wastewater treatment facilities that receive industrial wastewater are nearing or at capacity, as well as limited in their ability to treat the unique attributes of non-domestic wastewater.

The objectives of the study follow:

- Create and conduct a survey of existing Manitoba communities to develop an inventory of clean water availability, types of wastewater treatment, and pre-treatment systems currently in use, and identify the capacity of those systems.
- Create an inventory of existing and emerging technologies in improving wastewater treatment and pre-treatment in other jurisdictions to determine options that could be feasible in Manitoba.
- Provide an overview of regulatory requirements and available funding for municipal wastewater treatment in Manitoba.
- Produce a brief summary of available water supply in southern Manitoba.
- Develop an analysis of various wastewater treatment technologies identified as part of the inventory of the surveyed food processing industry and Manitoba municipalities.
- Prepare a final report communicating the findings of the Project.
- Present the findings of the Project to CME and government stakeholders.
- Prepare a summary report for public review and distribution.

The purpose of this report is to summarize the findings of the study for public review and distribution. All identifying and confidential information provided by municipalities and industries has been redacted in this report.

2 MUNICIPAL SURVEY FINDINGS

2.1 BACKGROUND

A survey was sent to 32 Manitoba Municipalities on December 22, 2022, to develop an inventory of clean water availability, types of wastewater treatment and pre-treatment systems currently in use, and the capacities of those systems. At the end of the study period, 22 of the 32 municipalities responded to the survey.

2.2 WASTEWATER TREATMENT IN MANITOBA

2.2.1 WASTEWATER TREATMENT PROCESSES

A review of the submitted survey responses identified that municipalities in Manitoba rely on mechanical plants, SAGRs, and facultative and aerated lagoons to treat wastewater. The percentage of each type of treatment facility is presented in **Figure 2-1**.

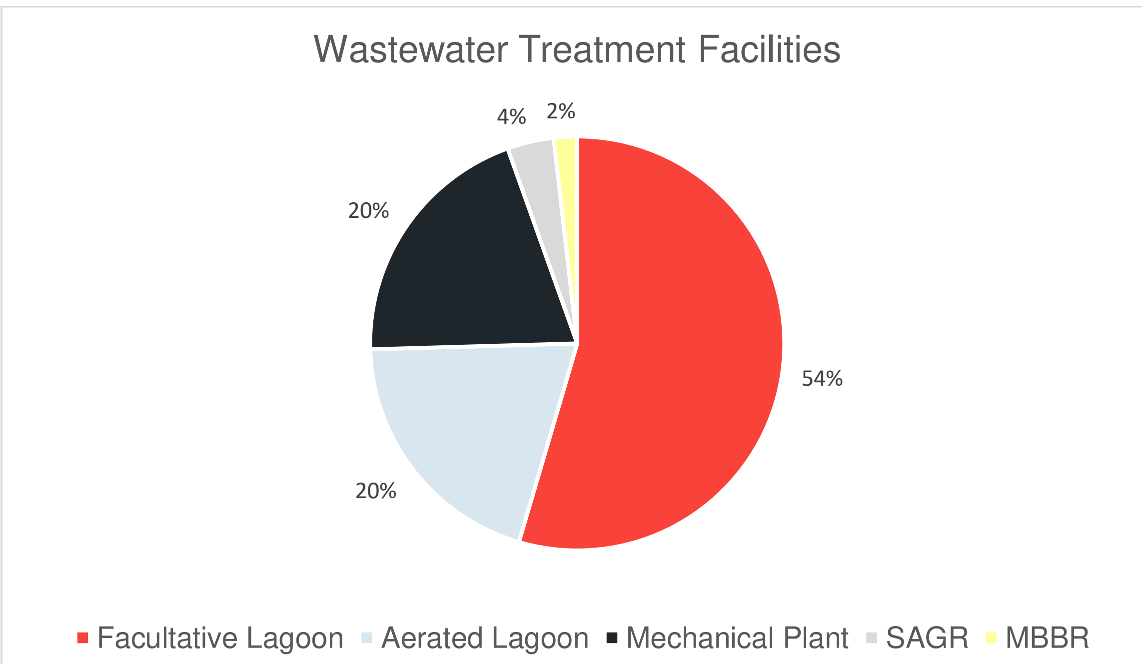

Figure 2-1: Wastewater Treatment Facilities in Manitoba

In Manitoba, a majority of municipalities rely on intermittent discharging facilities such as facultative or aerated lagoons to treat the wastewater generated by their community. Historically, lagoons have been the default wastewater treatment selection for communities due to their lower capital costs, ease of operation, and availability of land for their development. Many of these communities that utilize facultative lagoons for their wastewater treatment do not have significant contributions from local industries in relation to the volume of domestic wastewater generated by their population base. The move to more intensive treatment processes is usually triggered by a growing population base of an already large community and/or high-strength wastewater that requires enhanced treatment. Typically, moving to an aerated lagoon is the first step in upgrading a lagoons treatment process as it is more economical than a mechanical plant.

Communities that have large populations (> 5,000) or large volumes of industrial wastewater and are near a body of water that flows year-round, typically select continuous discharging facilities such as aerated lagoons with SAGRs or mechanical treatment plants. These facilities are advantageous because they require a smaller footprint than intermittent discharging facilities and can provide improved treatment including ammonia and phosphorus removal.

2.2.2 WASTEWATER TREATMENT CAPACITIES AND PLANT EXPANSION SUMMARY

The survey highlighted that often municipalities are unaware of their treatment facility's capacities and the volume of wastewater being generated by the community. The communities who had a strong understanding often recently completed an engineering assessment, an upgrade to their treatment system, or have known capacity or operational issues.

Major population centres that have recently expanded or are in the process of completing an expansion to their treatment plants include:

- City of Winnipeg, South End Pollution Control Centre
- City of Selkirk
- Town of Virden
- Town of Neepawa
- RM of Gimli
- RM of Headingley
- Town of The Pas
-

Major population centres that are in the planning process of expanding their treatment capacities include:

- City of Winnipeg, North End Pollution Control Centre
- City of Winkler
- City of Portage la Prairie

Finally, the Red-Seine-Rat (RSR) wastewater treatment facility and conveyance system is currently in the planning and design phase and will provide the Town of Niverville, and the municipalities of Tache, Hanover, and Ritchot with a regional wastewater treatment facility to help serve the current and future needs of a growing population and the industries within the region. Following the construction and commissioning of the RSR facility, the wastewater treatment capacities will change in the region, as the following lagoons will no longer operate as treatment facilities:

- Blumenort Lagoon
- New Bothwell Lagoon
- Grunthal Lagoon
- Mitchell Lagoon
- Kleefeld Lagoon
- Landmark Lagoon
- Lorette Lagoon
- Niverville Lagoon
- St. Agathe Lagoon
- St. Adolphe Lagoon
- Ile des Chenes Lagoon
-

It is anticipated more community lagoons will be added to the development in the future.

This facility will also accept wastewater from several food processing facilities in the region, which currently are treated at their nearest municipal lagoon facility. These include Bothwell Cheese in New Bothwell, Exceldor Cooperative (Granny's Poultry) and Jowett Farms (Country Meat & Sausage) in Blumenort, Lactalis (Paramlat Canada) in Grunthal, and Viterra in Ste. Agathe.

2.2.3 INDUSTRIAL WASTEWATER TREATMENT

By the responses received in the survey, many communities appear to lack critical information regarding the wastewater contributing to their treatment facilities by industry. Most communities had a general understanding of what industries largely contribute to their wastewater facilities. However, while the industries were able to be identified, the communities were often unable to provide details of the strength and volume of the wastewater and the allocation of capacity of their wastewater treatment facility.

Based on the survey results, communities that have Industrial Service Agreements (ISA) in place, were able to provide more detailed information regarding industrial wastewater contributions including volume, strength, and the type of pre-treatment at the contributing industrial facility. This is not surprising as ISAs typically outline limits to industrial wastewater volume and strength, reporting procedures, and fines should the industry exceed the imposed limits.

2.3 RAW AND TREATED WATER SUPPLY IN MANITOBA

Following the completion of the review of treated water capacities from survey respondents, two main issues were highlighted that limit communities' ability to supply potable water, the issues include limited raw water supply and water treatment plant (WTP) capacity.

Communities in Manitoba rely on two source types for raw water supply, the sources are surface water and groundwater. Groundwater wells can be either privately owned and supply a single resident or used to supply a WTP that services a community or region. The use of groundwater versus surface water as a raw water source varies throughout the Province. Many communities rely on surface water sources that are completely allocated, and as a result, communities are unable to supply additional potable water to prospective industries and developers.

2.4 BARRIERS FOR EXPANSION

The three major barriers to the expansion of water and wastewater infrastructure as reported by the communities are funding, raw water supply, and a lack of available and suitable land. Financial considerations and a lack of funding were highlighted by 55% of respondents; it was also noted that the rising costs of construction are another concern. The lack of raw water supply was noted by four communities in southern Manitoba. Lastly, three communities noted the lack of available and suitable land as a barrier to expansion.

3 INDUSTRIAL SURVEY FINDINGS

3.1 BACKGROUND

A survey was sent to select Manitoba protein, food, and manufacturing industries on January 20, 2023, to develop an inventory of types of wastewater pre-treatment systems currently utilized by manufacturing and processing industries. At the end of the study period, 9 of the 23 industries responded to the survey.

3.2 TREATMENT PROCESSES

3.2.1 PRE-TREATMENT

Manitoba industries reported using the following pre-treatment processes: chemical treatment, physical treatment processes, and flow equalization.

Physical treatment processes refer to dissolved air flotation (DAF), membrane filtration, media filtration, aeration, and UV disinfection. Physical treatment processes are most commonly used in meat, dairy, and cheese processing facilities.

Chemical treatment refers to the process of dosing wastewater with chemicals for either pH adjustment, coagulation, or chlorination. Chemical treatment is used in meat, cheese, pea and protein, fertilizer, and coin manufacturing.

Flow equalization is the process of equalizing the wastewater flows during periods of peak and low flows before being treated at the municipal wastewater treatment plant. It can also be used as a process step for onsite treatment. Flow equalization is used in meat, cheese, and protein processing due to the high organic strength of the wastewater.

3.2.2 SECONDARY TREATMENT

As reported in the survey, 9 out of 10 industries generate wastewater and provide on-site pre-treatment. The wastewater then undergoes secondary treatment at one of the following locations: municipal treatment facilities, on-site, or a neighbouring company facility. A breakdown of secondary treatment locations is presented in **Figure 3-1**.

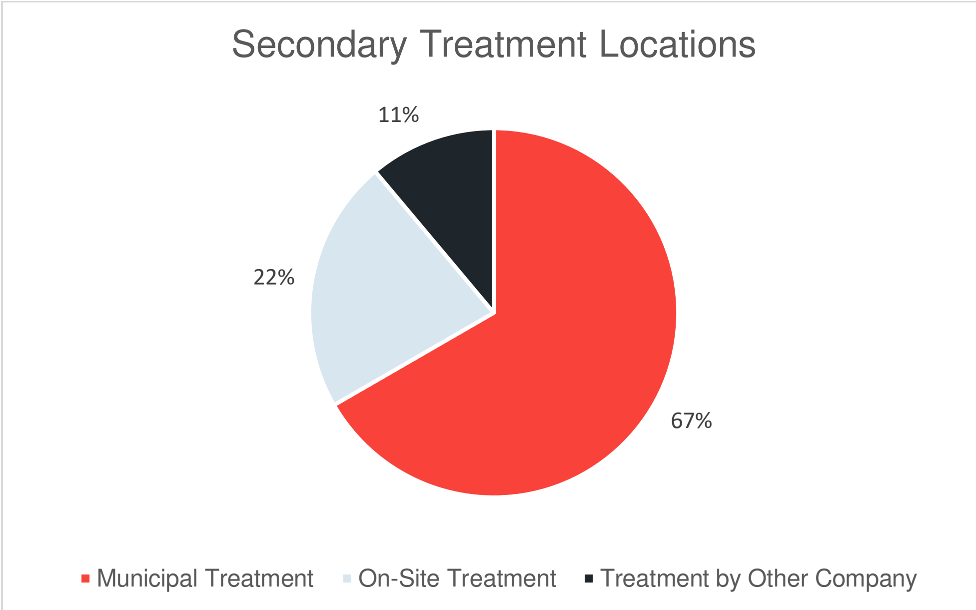

Figure 3-1: Secondary Treatment Locations

Six of the respondents (67%) rely on municipal facilities to treat industrial wastewater generated by their process. Many of the municipalities that treat industrial process wastewater utilize lagoons that are not ideally suited for the treatment of industrial-strength wastewater. Of the remaining respondents, two industries (22%) provide complete treatment on-site, and one industry (11%) relies on a neighbouring company to treat their process wastewater; these industries rely on mechanical processes and filtration.

3.3 BARRIERS TO EXPANSION

As part of the survey, industries were asked to identify any barriers to the operation or expansion of their business related to wastewater. The majority of responses indicate that industries consider regulatory requirements, municipal infrastructure capability, and financial considerations as key barriers they face **Figure 3-2** presents the number of industries that face each barrier to operation or expansion.

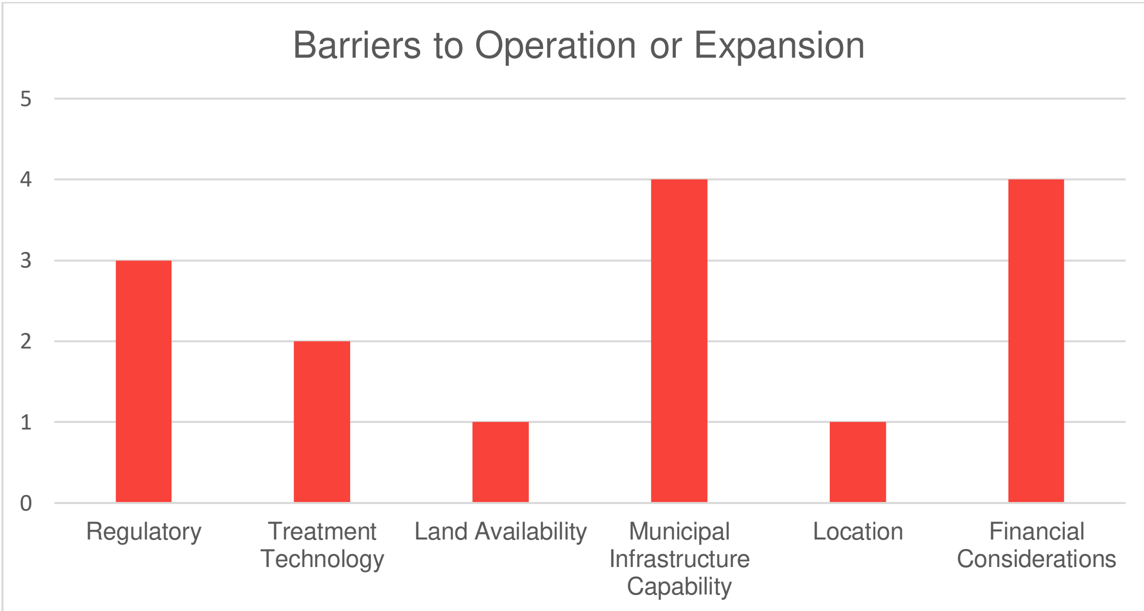

Figure 3-2: Barriers to the Operation or Expansion of Industries

Four (44%) industries identified financial considerations and municipal infrastructure capability as barriers to expansion and operation. As previously discussed, many of these industries rely on municipal treatment facilities to provide secondary treatment of their process wastewater. However, many of the municipal treatment facilities are at or near capacity, or cannot treat industrial-strength wastewater, and thus cannot support the potential expansion of an industry. The inability to treat wastewater has caused industries to either leave the Province or look into developing their secondary treatment processes at their own expense.

Financial concerns are also critical to the industries, as they are typically not eligible for any municipal funding programs unless they partner up with a municipality. Industries have expressed concerns that the need to provide long-term financial contributions to local municipal wastewater treatment facilities, impacts the ability of the industry to remain competitive both within Canada and internationally.

3.4 WASTEWATER REUSE

Respondents had a mixed response related to wastewater reuse, many respondents expressed an interest in reuse but also noted it is difficult due to concerns relating to pathogens and disease transferring to the environment, complex regulatory requirements, and financial considerations.

4 WATER SUPPLY IN MANITOBA

This section identifies and summarizes how surface water supply is allocated, as well as the licencing requirements for both surface water and groundwater use for municipal and industrial users.

4.1 SURFACE WATER SUPPLY

Surface water supply sources are identified as perennial streams and intermittent streams. Perennial streams flow year-round, whereas intermittent streams flow only during the spring melt or significant rainfall events. A risk level is applied to each water supply source; the risk-level identifies the probability that a water supply does not meet the licenced demand. The risk-level for each supply source is presented in **Table 4-1**.

Table 4-1: Surface Water Supply Source Level of Risk

Supply Source	Risk-level
Perennial Streams with Reservoirs	1 in 50 years
Perennial Streams with no reservoirs	2 in 10 years
Intermittent Streams	2 in 10 years

A firm water supply source has the lowest risk of a water shortage; these water sources are typically perennial streams with reservoirs such as Stephenfield Reservoir and the Boyne River. The firm annual yield is the annual volume of water that can be supplied from a storage reservoir continuously during the driest period on record; this results in a 1 in 50-year risk level. Firm annual yields allow for reliable flows in rivers and streams year-round under natural conditions. Firm annual yields are increased through the construction of additional reservoirs.

To minimize the risk associated with perennial streams with no reservoirs and intermittent streams, water users may need to construct off-channel storage ponds. The water that is captured during the spring runoff will then be available during the growing season or later in the year. An example is the Morris Water Treatment Plant which constructed raw water storage ponds to increase the resiliency of the plant during periods of drought. The water treatment plant was able to draw water from the ponds during the 2021 drought, and they were also able to use the pond to supply raw water during the 2022 flood when the raw water quality was poor.

In Manitoba, four major rivers provide surface water for human consumption, these are the Assiniboine River, Red River, Souris River, and Winnipeg River. Additional surface water for human consumption is located in the smaller tributaries of each watershed. Both the Souris and Assiniboine River are nearing or completely allocated. The Boyne River and Dead Horse Creek sub-watersheds are also completely allocated. Each surface water supply also has unlicenced water users, who are legally entitled to withdraw up to 25,000 L/d.

4.2 SURFACE WATER RIGHTS LICENCING

For an industry to become a licenced water user, they must go through the Water Rights Licencing and Drainage Branch and apply for a water rights licence. To begin the application, process the proponent must provide an ideal site where they want to draw water from and several points of diversion. Following the submission of the points of diversion an assessment is completed by the province to determine an allocable volume at a particular location.

The assessment incorporates an analysis of historical streamflow data, water use requirements of existing licenced water users on the system, and instream flow requirements, along with other site-specific considerations. Instream flow requirements were established to protect a stream's environmental needs and downstream users. Users can only pump from the stream when the flow is greater than the instream flow requirements, otherwise, all pumping must be ceased. Licencing decisions are based on individual site-specific assessments, or in areas of high-water use are part of the pre-determined water budget for the entire watershed or river.

Following the completion of the assessment Water Rights will work with the proponent to establish if the allocated pumping rate will work for the proposed development. The licencing process can take up to a year to complete, however, if the request is urgent the Water Rights Licencing and Drainage Branch will expedite the request. Expedited requests still require a few months to be completed.

4.3 GROUNDWATER RIGHTS LICENCING

Groundwater projects undergo a similar application process to surface water projects. The proponent must complete a Water Rights Licence application. In the application process, the proponent must select a point of groundwater diversion and the location of the project site. The proponent is then required to retain a hydrogeologist to complete a groundwater exploratory study. The hydrogeologist is required to conduct a well inventory of the area, oversee drilling and pump testing, and submit a final report of the findings to the Water Use Licencing Section.

Following the submission of the groundwater exploratory study the application will be reviewed to determine an allowable pumping rate and the issuance of a Water Rights Licence.

4.4 CLIMATE CHANGE

The biggest risk to the surface water supply in Manitoba is climate change. With climate change, more periods of drought and high flow conditions are expected to occur. During droughts, water usage increases; this is very noticeable in the agricultural sector in Manitoba. PVWC reported that 30% of the annual demand for treated water goes to the agriculture industry. Notably, one-third of the annual demand for treated water in the agriculture sector is used for agricultural spraying. Spraying happens over a 1-2 month period, often during periods of drought when there is a high water demand. The high volume of water usage places a strain on WTPs, which are often at max capacity during periods of drought. WTP plants are limited by raw water pumping and treatment capacity, which is controlled by the minimum instream flow requirements that are set in the Water Use Licence. Consumers may be required to limit their water use to minimize the strain on the system. Limiting water use has a ripple effect in the agriculture sector; livestock require large volumes of water, therefore limiting water consumption would result in the slaughtering or selling of animals. Limitations would be detrimental to the dairy and pork industries and may result in shortages of dairy or pork products.

To increase resiliency and the volume of surface water available for allocation, off-channel storage must be built. Off-channel storage will allow for the capture of surface water during periods of high flow and can be used to supplement the water demand. Off-channel storage and structures such as storage ponds can be constructed by farmers for private use or structures such as dams be publicly funded to increase the capacity of a water body.

Ultimately, it is recommended that a study is completed to determine the impact climate change and population growth will have on the raw water demand in Manitoba. The study should also identify regions where the construction of off-channel storage and structures should be located to help improve the reliability of the surface water supply in Manitoba.

5 REGULATORY REQUIREMENTS IN MANITOBA

This section summarizes and highlights the regulatory approval process in Manitoba for wastewater treatment and water re-use for both new and existing industries that are either seeking to establish or expand their capacities.

5.1 REGULATORY APPROVALS

5.1.1 NEW INDUSTRY

When an industry plans to construct and operate a new facility that generates process wastewater, they are required to obtain an EAL. Typically, EC will dialogue with the industry in the development and planning stages to discuss the requirements that will be required for the facility to obtain an EAL.

The typical licencing process starts with the submission of an EAP which consists of a cover letter, signed EAP form, electronic copies of the EAP, and an application fee which is currently $7,500 for a Class 2 development. Food processing plants are considered Class 2 developments under The Environment Act. The EAP is then assigned to a program officer for review and is distributed to the Technical Advisory Committee (TAC) and advertised publicly, requesting comments within a specific timeframe. After the TAC review period, comments and questions are sent to the industry for a response. It is then decided if a public hearing is warranted; if no hearing is warranted, a draft EAL will be issued for review by the TAC board and interested public before finalization.

If a public hearing is warranted, the Minister will request the Clean Environment Commission to conduct a hearing, in which a decision will be made to refuse or approve an EAL, which can be appealed to the Minister.

Upon issuance of the EAL, if the industry is treating all wastewater on-site and directly discharging to the environment no further action is required provided the industry meets all requirements set in the EAL. If the industry is discharging wastewater to a municipal facility, an Industrial Service Agreement (ISA) is required as part of the EAL. An ISA is negotiated between the local government (e.g., municipality) and industry and establishes the relationship between both parties for the acceptance of the wastewater while setting limits for effluent quality, volumes, fee schedules, and other requirements.

5.1.2 EXPANSION OF EXISTING INDUSTRY

Industries that already have an EAL and want to expand are not required to submit a new EAP and undergo the TAC review process again. Instead, they must submit a Notice of Alternation (NOA). A complete NOA includes the following components: a cover letter, NOA form, an electronic copy of the NOA report, and an application fee which currently is $500. The NOA report includes a description of the proposed expansion, the environmental and human health effects of the development, and the mitigation measures.

5.1.3 FEDERAL EFFLUENT REGULATION

The effluent quality of wastewater discharges is also regulated federally. In 2012, the Wastewater Systems Effluent Regulation (WSER) came into effect for all wastewater discharges greater than 100 m^3/d in Canada. A copy of the regulation is available online: Wastewater Systems Effluent Regulations (justice.gc.ca). All new facilities must adhere to these regulations, including effluent reporting.

5.2 NEW TECHNOLOGIES

According to EC, one of the perceived regulatory barriers by industries and municipalities is the implementation of new wastewater treatment technologies. However, EC has stated that they are open to new wastewater treatment technologies, and they frequently meet with suppliers of these new technologies. To approve the implementation of a new technology, EC requires proof or examples of the technology's performance in cold climates similar to that of Manitoba and proof that the technology can meet Manitoba water quality standards.

The piloting of new treatment technologies is encouraged by EC. There are two separate methods for the approval of bench pilots:

- The location does not have an EAL where otherwise a licence would be required. These pilots are limited to some kind of waste handling. Clause 6 of the Classes of Development Regulation States:

  > "*A person does not require a licence to conduct a short-term pilot project involving the burning, incineration, gasification or other method of waste conversion or waste disposal or destruction, if the person has written authority from the director to conduct the project and is complying with all terms and conditions imposed by the director on that authorization."*

- Piloting at an existing licenced facility. Piloting at an existing facility requires the submission of an NOA. A time-limited alteration approval is typically issued with terms and conditions in a letter of approval.

In both cases, permanent use of the pilot method would require subsequent approval and a valid licence.

EC noted a common barrier seen by technology suppliers is the requirement to include additional details and information in the EAP to explain how the technology works. Suppliers are cautious to share proprietary information as the EAP is available to the public. However, this information can be redacted for public documents under the proprietary information section of the Environment Act.

5.3 WASTEWATER REUSE

Municipal and industrial wastewater that meets Provincial and Federal effluent regulations can be put to beneficial use particularly with water scarcity becoming a greater concern every year. The reuse of wastewater has been recognized in Manitoba by EC as beneficial for agricultural irrigation, as well as for other purposes such as reuse for an industrial process (e.g., cooling water). Wastewater reuse in Manitoba is not yet a common practice when compared with Saskatchewan, Alberta, and the U.S., To date only a handful of municipal and industrial wastewater treatment systems are set up for reuse applications with the main reuse being irrigation. The following section discusses the regulatory framework required for the irrigation of wastewater effluent, as well as options for other water reuse.

5.3.1 IRRIGATION

Wastewater reuse for irrigation provides environmental, agronomic, and sustainable benefits including increased nutrients, improved crop quality and yields, and less demand on surface and groundwater resources. There is significant potential for wastewater effluent irrigation as a resource for cash and forage crops in Manitoba, particularly in the south-central and western regions, where soil conditions are favorable for agricultural irrigation.

For local governments or industries considering the reuse of wastewater for irrigation, the regulatory approval process starts in the EAP phase or through an NOA. Before beginning the regulatory process, there are several considerations to explore to determine whether irrigation is suitable and will be accepted and licenced by EC.

- Wastewater effluent must be properly characterized, as it may contain elevated concentrations of salts, heavy metals, and pathogens that may affect soil, groundwater, and food quality.
- An irrigation program must match the wastewater effluent quality to the land and crop suitability as the EAL will limit the types of crops that can be grown.
- In wet years when there will be obstacles to irrigation, it is a necessity that the EAP provides an alternative discharge plan should the amount of wastewater effluent stored surpass the amount needed for irrigation. When approved, both discharge methods become components of the EAL thus preventing the need for an emergency discharge.
- Public concern must be addressed as part of the regulatory submission and approvals process as perceived concern for public health, food safety, and odour may delay the issuance of an EAL.

Currently, there are only three municipal wastewater effluent irrigation projects in Manitoba, the RM of Roblin, the Town of Carberry, and the RM of Lac du Bonnet. However, the RM of Roblin no longer utilize irrigation for their effluent discharge. Two private industry wastewater irrigation programs in Manitoba reuse industrial effluent for the irrigation of both forage and cash crops across upwards of 1,000 ha of land.

5.3.2 OTHER REUSE

For an industry to reuse wastewater for purposes other than irrigation, the regulatory approval process can be completed as either an NOA or, if required, an EAP. The industry must set appropriate limits for the quality of the effluent to be used in their process, and they must also indicate a backup water source to use if the effluent cannot be used for any reason. As part of the licencing process, an ISA must be negotiated and signed between the industry and the backup water source.

6 FUNDING

This section summarizes the roll of the Manitoba Water Services Board (MWSB) for funding municipal water and wastewater infrastructure projects.

6.1 MANITOBA WATER SERVICES BOARD FUNDING

6.1.1 MUNICIPAL FUNDING

One of the biggest barriers preventing municipalities from expanding their water and wastewater infrastructure is funding. In Manitoba, municipalities can apply for funding through the Manitoba Water Services Board. MWSB offers a cost-sharing program of up to 50% on water and wastewater treatment plants and conveyance projects, with up to $3,000,000 available in funding for each project. Cost-sharing of up to 30% is available for water and sewer main renewals.

The application process begins each year in January; Municipalities are sent application forms to complete where they must provide a project description, the urgency of the project, and environmental impacts. MWSB reviews the applications received and typically selects projects that rectify environmental impacts including boil water advisories and projects needed due to population growth. In the 2022 fiscal year, MWSB received $750,000,000 in funding requests from 270 applications submitted by municipalities, however, MWSB only had $20,000,000 available for funding projects.

An additional barrier highlighted by MWSB and survey respondents was an overall disjoint in funding from the government. It was highlighted that seven different government departments are responsible for water, and to apply for different governmental funding programs you need to deal with multiple departments, each with a unique uptake process.

6.1.2 INDUSTRIAL FUNDING

MWSB does not provide direct funding for industry projects. Industries must partner with municipalities to receive funding.

6.1.3 FUNDING NEW TECHNOLOGIES

MWSB is interested in funding emerging treatment technologies. Similar to EC, they require that the technology has demonstrated successful treatment of wastewater in cold climates similar to Manitoba and can meet the required treated effluent parameters. Currently, MWSB is providing funding to the Town of Neepawa for the construction of a moving bed biofilm reactor (MBBR). This is the first public MBBR to be constructed in Manitoba.

6.2 MUNICIPAL - INDUSTRIAL FUNDING BARRIERS

When a municipality expands its water and wastewater treatment facilities, they often only consider the 20-year population growth and current industrial demands but nothing more. Typically, municipalities do not have the financial capability to construct or expand their treatment facility with a capacity allowance for an industry that may or may not come to the community. These financial limitations make it very difficult for new industries to move into the communities and connect to existing municipal infrastructure. An added difficulty for municipalities, if they were able to make accommodations for future industries in the design of a new or expanding treatment facility, is that each industry has different treatment needs and wastewater generation rates and therefore requires unique treatment capacities.

Industries need to support municipalities during the planning stage; this will allow treatment facilities to be designed to meet the unique requirements of each industry. ISAs should be formed between the industry and the community. ISAs can be used to protect both industries and communities and do not leave either party solely responsible for the costs associated with constructing and operating treatment facilities.

6.3 FUNDING LARGE PROJECTS

A major barrier to the development of new infrastructure in Manitoba is the lack of funding and governmental leadership available for large projects. The Prairie Farm Rehabilitation Administration (PFRA) was developed in the 1930s and mandated to secure the rehabilitation of the drought and soil drifting areas in the prairie provinces and to develop and promote in those areas farm practices, water supply, land utilization, and land settlement to afford greater economic security. In Manitoba, the PFRA funded and improved water services through the construction of water treatment plants, pipelines, and wastewater treatment facilities. Following the dissolving of the PFRA, minimal government leadership and funding have been made available for large water or wastewater projects in Manitoba.

MWSB noted upgrading existing infrastructure and building new dams and reservoirs will cost billions of dollars. The Government of Manitoba is limited in its ability to fund these infrastructure projects. With the growing threat of climate change and the expected increase in periods of drought, and the continual population growth in Manitoba, the need for the development of alternative raw water supply sources such as groundwater exploration and increasing the storage capacity of surface water through the construction of dams, structures, and reservoirs is critical. As municipalities are responsible for the leadership of water-related projects, these projects are less eligible for federal funding. There is an opportunity for provincial leadership to coordinate and connect these much-needed projects to federal funding and assist them with the long-term planning of water projects in Manitoba.

7 WASTEWATER TREATMENT TECHNOLOGIES SUMMARY ANALYSIS

The following section describes different wastewater treatment technologies that are either in use in Manitoba and in the other prairie provinces, and highlights their advantages and disadvantages.

7.1 FACULTATIVE LAGOON

A facultative lagoon is a simple and proven system and is used extensively throughout rural Manitoba for wastewater treatment. Large ponds with long retention times provide adequate treatment even under conditions where large fluctuations in wastewater flow and strength are common. In Manitoba, facultative lagoons can only be constructed with a maximum operating depth of 1.5 m and have a required 227-day storage period.

The advantages and disadvantages of facultative lagoons are presented in **Table 7-1**.

Table 7-1: Facultative Lagoon Advantages and Disadvantages

Advantage	Disadvantage
– Easy to operate. – No/little energy inputs. – Effective at removing BOD and TSS. – Cost-effective for rural communities.	– Requires desludging. – Requires large areas of land. – Strong odours may occur during the spring ice thaw. – Struggles to treat the high strength wastewater. – Difficult to remove ammonia. – Nutrient removal strategy required. – Can only be discharged from June 15 – October 31

7.2 AERATED LAGOON

Aerated lagoon systems have become more common in Manitoba in recent years, particularly in areas where facultative lagoons are no longer cost-effective generally due to a lack of available land or a requirement to treat high-strength industrial wastewater. In an aerated lagoon system, the air is supplied through blowers and submerged diffusers to the primary cells. Typically, there are at least two deep primary cells (3 m or deeper) that are aerated. The provincial lagoon design guidelines also allow for deeper (unaerated) secondary cells (2.1 m maximum operating depth) after aerated primary cells, thereby reducing the overall footprint of the lagoon even further when compared with a facultative system.

The advantages and disadvantages of aerated lagoons are presented in **Table 7-2**:.

Table 7-2: Aerated Lagoon Advantages and Disadvantages

Advantage	Disadvantage
– Require less land than facultative lagoons. – Better suited to treat industrial-strength wastewater than facultative lagoons. – Economic treatment technology for smaller municipalities. – Reliably meet current Provincial and Federal effluent targets (BOD, TSS, fecal coliforms, and unionized ammonia).	– Difficult to remove ammonia. – Power supply required. – Requires chemical dosing to reliably treat ammonia and phosphorus. – Can only be discharged from June 15 – October 31.

7.3 SUBMERGED ATTACHED GROWTH REACTOR

The Submerged Attached Growth Reactor (SAGR) is designed to provide ammonia removal or nitrification in cold to moderate climates. A SAGR is a clean gravel bed with evenly distributed wastewater flow across the width of the cell and a horizontal collection chamber at the end of the treatment zone. Aeration throughout the floor of the SAGR provides aerobic conditions that are required for nitrification. The gravel bed is insulted with wood chips or mulch.

The advantages and disadvantages of facultative lagoons are presented in **Table 7-3**.

Table 7-3: SAGR Advantages and Disadvantages

Advantage	Disadvantage
– Require less land than facultative lagoons. – Can be discharged continuously if an appropriate watercourse exists. – Can be discharged earlier (e.g., May to October) in an intermittent discharging facility. – Is well-proven to provide nitrification in cold climates. – Relatively easy to operate. – SAGR systems provide nitrification, solids separation, and disinfection.	– More power intensive than an aerated lagoon with the requirement for additional blowers. – Requires recirculation pumps for an intermittent discharging facility. – Life-cycle is 15 years.

7.4 BIOCORD REACTORS

Biocord Reactors provide a low-energy, fixed-film biological treatment process to increase the capacity and performance of wastewater lagoons and conventional activated sludge systems. Biocord Reactors are equipped with a fine bubble aeration system that provides the optimum level of oxygen transfer and mixing to support bacterial growth and nutrient removal.

The advantages and disadvantages of Biocord Reactors are presented in **Table 7-4**.

Table 7-4: Biocord Advantages and Disadvantages

Advantage	Disadvantage
– Customizable design, performance, and deployment. Each system is customized to fit any type of secondary treatment process and to handle the anticipated flow and loading parameters. – Can easily be expanded in planned phases as treatment needs increase. – Self-regulating systems that can quickly respond to variable influent without operator attention or process modification. – Low capital and operating costs. Biocord systems require no additional tanks or blowers to operate. The reactors are self-cleaning and require no operator oversight and maintenance.	– Require additional capital compared to lagoon systems alone. – Installation of baffle curtains may be required. – Is not yet proven successful long-term in a cold climate application.

7.5 CONVENTIONAL ACTIVATED SLUDGE

The conventional activated sludge (CAS) process is one of the most common secondary treatment processes used at WWTPs. BNR relies on suspended microbial growth that utilizes gravity solids separation. In the aeration basin of the bioreactor, wastewater mixes with return activated sludge (RAS) sent back from the secondary clarifier underflow. The resulting wastewater and sludge mixed liquor is then aerated to allow for microbial activity to assist in the breakdown of BOD_5 and conversion of ammonia to nitrates (nitrification). Effluent from the aeration basin is conveyed to a secondary clarifier for gravity separation of the solids and liquids fractions. A majority of the sludge from the secondary clarifier underflow is returned to the aeration basin to support the microbial community for nutrient removal in the bioreactor. To maintain a balance in the microbial biomass growth in the bioreactor and control the solids retention time (SRT), a fraction of the RAS or the aeration basin's mixed liquid is wasted (waste-activated sludge).

The advantages and disadvantages of CAS are presented in **Table 7-5**:

Table 7-5: Activated Sludge Advantages and Disadvantages

Advantage	Disadvantage
– Can achieve high removal rates of BOD and TSS. – Long established technology. – Lower capital costs compared with other mechanical treatment technologies. – The system allows for future modification of the process to meet further stringent effluent requirements as needed.	– Large footprint for secondary clarification. – Moderate to high energy costs for continuous aeration. – Issues with sludge bulking can occur in cold climates. – Limited at nutrient removal (N and P), require chemicals or additional processes. – Sensitive to high-loading events (organic or hydraulic). – Higher sludge production results in higher sludge management costs.

7.6 SEQUENCING BATCH REACTOR

Using activated sludge as the primary means for nutrient removal, sequencing batch reactors (SBRs) are similar to conventional activated sludge or BNR bioreactors. However, treatment for an SBR system consists of having the biological process and clarification process occur within one single reactor basin, using a fill-and-draw system. SBR technology is the other most common process for municipal wastewater treatment along with activated sludge.

In an SBR system, the first step of the treatment process consists of the fill cycle, in which the reactor tank is filled with wastewater from the headworks. Biomass remaining within the reactor from the previous treatment cycle is mixed with the incoming wastewater. Air is then added to begin the aeration cycle, which facilitates biological growth and nutrient removal. Following the aeration cycle, the mixing and aeration are stopped so that the reactor tank operates under a settling cycle. During the settling cycle, gravity separation of solids (sludge) from the liquid stream occurs, and the solids settle to the bottom of the reactor tank. The final cycle is the decant cycle whereby the treated wastewater effluent is discharged from the top of the reactor.

Under normal operating conditions, the duration of an entire cycle from fill to decant takes approximately four hours and can be reduced to three hours during peak flows. However, cycle times are adjustable based on the control system of the SBRs and can be tailored accordingly based on the wastewater conditions.

The advantages and disadvantages of SBRs are presented in **Table 7-6**.

Table 7-6: SBR Advantages and Disadvantages

Advantage	Disadvantage
– Well-equipped to accommodate wide variations in influent wastewater characteristics and flow rates. – Lower energy consumption due to the use of periodic aeration cycles. – Reduced sludge production.	– Higher capital costs. – As system capacity increases, more complex and sophisticated operating systems are required. – Dependent on automatic control to function. – Requires higher footprint due to the need for multiple SBR basins. – May require more frequent maintenance due to the complex mechanical systems. – Limited nutrient removal.

7.7 MOVING BED BIOFILM REACTOR

The Moving Bed Biofilm Reactor (MBBR) technology is a submerged attached growth process that utilizes a conventional bioreactor filled with carrier media suspended within a tank. Aeration or mixers keep the carrier media suspended within the tank, and the carrier media provides a surface for attached biological growth to take hold. High surface area per unit volume and a unique geometry protect the biofilm growth on the carrier media from shear forces of hydraulic flow. A sieve is used to retain the carrier media in the bioreactor tanks as the treated wastewater is discharged. With the MBBR process, management of waste activated sludge (WAS), MLSS, or RAS is not needed due to the MBBR system being a single-pass system. In general, MBBR systems can be provided as a modular plant in a containerized system with all the process and controls systems installed, typically at 1/3 the footprint required for conventional BNR plants. Overall, this results in small footprint fixed film process that can achieve high effluent standards, and if required to meet further stringent requirements in the future, the MBBR can be attached with a downstream dissolved air flotation (DAF) clarifier for additional BOD_5 and TSS polishing.

The advantages and disadvantages of MBBRs are presented in **Table 7-7**.

Table 7-7: MBBR Advantages and Disadvantages

Advantage	Disadvantage
– High treatment efficiency with a compact design and small footprint. – Simple to operate and tolerate variations in loading as the biomass film will self-adjust based on variable organic loading in the influent wastewater. – Increased wastewater loading can be addressed by the addition of more carrier media, providing additional design flexibility. – Operating efforts are decreased without the need to manage recycling and waste flows.	– This technology is not as mature as activated sludge, however, there are over 50 installations in North America. – Higher capital costs. – Poor settling requires DAF instead of secondary clarifiers to meet effluent requirements. – Additional maintenance and replacement costs associated with the need to replace biofilm media over time.

7.8 MEMBRANE BIOREACTOR

Membrane Bioreactors (MBR) operate with a suspended growth biological reactor combined with solids removal using micro or ultrafiltration. Wastewater is conveyed into an aerated bioreactor to first allow for biological growth and nutrient removal. The membranes are submerged in the final tank of the secondary process and are in direct contact with the mixed liquor originating from the bioreactor. The membrane acts as a filtration unit for the separation of solids from the liquid effluent. A vacuum is applied to the membranes to draw the treated effluent through the membranes and into the pump which transfers the liquid effluent directly to the discharge. Air introduced to the bottom of the membrane modules is used for continuous scouring of the membrane's external surface as well as for some biological process oxygen requirement. Excess sludge biomass is wasted directly from the MBR process tank for disposal or for further thickening with a DAF system. Newer membrane technologies allow for membranes to be cleaned in place using sodium hypochlorite and citric acid; therefore, no removal of the membrane cassettes is required.

The advantages and disadvantages of MBRs are presented in **Table 7-8**.

Table 7-8: MBR Advantages and Disadvantages

Advantage	Disadvantage
– Capable of producing high-quality effluent suitable for reuse. – Compact design and smaller footprint in comparison to other mechanical plants. – Lower sludge production and disposal costs, as the plant can operate with higher mixed liquor.	– High capital costs for the use of membrane filtration. – Higher process air requirements with higher energy use. Vacuum and pumping requirements for backwashing and cleaning the membranes also contribute to more intensive energy use. – More complex and difficult to operate, higher operator certification required. – The risk associated with membrane failure, which can draw mixed liquor from the bioreactors into the treated effluent.

7.9 EMERGING TECHNOLOGIES

There are a few emerging technologies for wastewater treatment, particularly for high-strength wastewater. Some of these technologies are still in the research and development phase, though they are beginning to be more widely adopted in both municipal and industrial sectors. The following three technologies were chosen to be highlighted as part of this study as they may be applied to the food and pea processing industries.

7.9.1 FORWARD OSMOSIS

Forward Osmosis (FO) is an emerging technology that uses a semi-permeable membrane to separate water from dissolved solutes. This process uses less energy than reverse osmosis (RO) and can produce high-quality water for reuse. It was the ability to handle high-strength wastewater and has a compact design that can be installed in small spaces. It can also be combined with other wastewater treatment processes like MBR.

FO is still in the research and development stage and has not yet been widely adopted for wastewater treatment, thus, it will certainly have a high capital and operating costs. It is also prone to the same problems as RO, with membranes fouling and requiring replacement. It has potential for use in the dairy industry, though this wastewater is complex and can be highly variable, requiring careful selection of the membrane material to ensure effective treatment and prevent fouling.

7.9.2 ELECTROCOAGULATION

Electrocoagulation (EC) uses an electrical current to destabilize and remove contaminants from wastewater. This technology can remove suspended solids, metals, and organic compounds from wastewater and is becoming more widely used in the treatment of industrial wastewater. It can handle a wide range of contaminants without a need for chemical addition. EC technology works by passing an electric current through two metal electrodes immersed in wastewater. The electric current causes a reaction at the surface of the electrodes, producing coagulating agents that neutralize and aggregate contaminants in the wastewater. These coagulated particles can then be easily removed through sedimentation or filtration.

The main drawback to this treatment technology it is very expensive to implement, requiring high capital costs. Furthermore, the electrodes require frequent replacement, particularly with wastewater that has a high concentration of salts. Operationally, it requires careful monitoring and control of environmental conditions, including pH and temperature to maintain its efficiency.

There is some potential use for this technology in the food industry, particularly in the dairy and meat processing sectors. Studies of the use of this technology has shown that EC can remove nutrients (P and N) and BOD from the wastewater. However, high energy usage and cost to replace the electrodes have prevented large-scale operation of this technology, which potentially limits its scalability.

7.9.3 ANAEROBIC MEMBRANE BIOREACTOR

Anaerobic Membrane Bioreactor (AnMBR) combines anaerobic treatment with membrane filtration to remove organic matter and pathogens from wastewater. It uses anaerobic microorganisms to degrade organic matter in wastewater, combined with the use of membrane filtration to separate solids from the liquid effluent. This technology is well-suited for high-strength wastewater and has the potential to produce biogas, which can be used for energy production. It has increased treatment efficiency and a reduced footprint when compared with conventional anaerobic digestion processes.

Like most emerging technologies, AnMBR requires high initial capital costs. It also has high energy consumption costs. However, the AnMBR process does produce a biogas that can potentially be used for energy production, offsetting the high energy costs. As with the MBR process, membrane fouling remains as the main drawback to this technology, which requires operating below capacity in order to reduce the fouling rate.

The AnMBR process can treat a wide range of organics found in food processing wastewater, including fats, oils, and greases, carbohydrates, and proteins. Food and beverage processing plants that have implemented AnMBR technology for wastewater treatment include dairy processing plants, meat processing plants, and breweries.