ISL Engineering and Land Services

Inspiring sustainable thinking

Village of Glenwood

Final Report

Glenwood Wastewater Lagoon Study

March 2016

ISL Engineering and Land Services

ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

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1.0 Introduction / Study Area

1.1 Authorization

ISL Engineering and Land Services Ltd. (ISL) has been retained by the Village of Glenwood to assess the status of the Village wastewater lagoon and the options for the lagoon future upgrades to comply with the village future development.

1.2 Purpose of Study

The objective of this study is to address the following tasks:

1. To compile and review the existing information related to the lagoon operation.
2. To estimate the current lagoon capacity in terms of generated flows discharging into the Lagoon.
3. To assess the alternatives for the lagoon upgrades to cover the future wastewater treatment requirements.

1.3 Background

The Village of Glenwood presently has a population of 287, based on the 2011 census results. It is located 23 Km northwest of Cardston and 34 km southeast of Pincher Creek. The Village primarily consists of residential areas. A large industrial facility “Saputo cheese company”, in addition to three operating campgrounds exist in the vicinity of the Village.

2.0 Existing Wastewater Treatment Lagoon

2.1 Existing Lagoon System

The collected wastewater from the Village of Glenwood flows by gravity and discharges into the Village wastewater lagoon located roughly 500m south east of the Village. The lagoon site relative to the Village can be seen in Figure 1.

The original lagoon was built in 1978 and includes two anaerobic cells in series of roughly 700m^3 each, one facultative treatment cell with a total volume of roughly 7,600m^3 and one storage cell of roughly 26,680m^3 capacity. A blow-up of the lagoon site is shown in Figure 2. It is noted that these capacities are based on the design drawings for the lagoon and do not consider sludge accumulation or any other revisions to the system that do not have engineering drawings available. Accordingly, these capacities exist only when the system is fully maintained (e.g. solids removed, etc.) and provided there are no undocumented revisions to the system.

As per the Alberta Environmental Protection Approval, the treated lagoon effluent is discharged to the Glen Lateral and ultimately to the Belly River twice per year between March 1 and November 30, with a discharge duration of no longer than 3 weeks each time.

2.1.1 Estimated Wastewater Flows

As documented in the 2011 Census, the Village of Glenwood had a population of 287. In addition, three campgrounds have been built in the vicinity of the Village. The approximate number of total trailer spots in these campgrounds is estimated at 450. Based on discussions with the campground owners the following should be noted:

- In general, campgrounds are occupied for the period “Mid May – Mid October”. That said, however, during this period not all available trailer spots are necessarily occupied.
- Water supply volumes for the campgrounds’ use are hauled from the Village water supply system via tankers. The campgrounds do not have complete records for the supplied volumes of water.

Estimated Dry Weather Wastewater Flow

There are no records indicating the generated wastewater flows discharging into the wastewater lagoon. For the purpose of this study the Average Daily Design Dry Weather Flow was estimated based on the produced water supply in the Village Water Treatment Plant (WTP). The generated wastewater volumes are estimated at 85% of the water supply demand based on typical design expectations.

The produced water at the Water Treatment Plant is supplied to three main users: The Village residents, the three campgrounds within the Village area, and the Saputo cheese company. The following should be noted in this regard:

- The generated wastewater from the Saputo plant is conveyed to a private lagoon.
- The hauled water quantities to other users in rural areas are minimal and shall not be considered.
- At the present time, the generated wastewater volumes from one campground are dumped into the Village wastewater lagoon. The two other campgrounds are using other private “aerated dugouts” and not contributing wastewater to the Village’s lagoon.
- There are few houses in the Village that have indoor swimming pools. These are reported to drain into the municipal wastewater collection system and conveyed to the lagoon.

Based on the above, the assessment of the Village lagoon capacity shall consider only the generated wastewater effluent from the Village residents and the campgrounds. For the purpose of this study, to be conservative, it will be assumed that the three campgrounds all discharge into the Village wastewater lagoon. Consequently, the estimated lagoon Dry Weather Wastewater Flow shall present the maximum possible flow based on the current developments in the Glenwood area.

Based on water meter readings, the produced water at the Water Treatment Plant and the supplied water to the Saputo cheese plant for the years 2013-2015 are shown below in Table 1. In 2015, the Village experienced a large water consumption used by a paving firm that was hauling water quantities for their job site. These hauled quantities were not conveyed to the lagoon. In the absence of records for these water quantities, the estimated wastewater flows conveyed to the Village wastewater lagoon for 2015 could not be confirmed and the figure indicated in Table 2.1 shall be disregarded.

Table 2.1: Estimated Dry Weather Wastewater Flow

Year	Produced Water at WTP (a) m³/year	Supplied Water to Saputo (b) m³/year	Supplied Water to Village & Campgrounds (c) m³/year	Average Wastewater Flows to Lagoon (d) m³/year	Average Daily Design Flow to Lagoon m³/day
2013	141,517	86,685	54,832	46,607	127.7
2014	141,206	86,091	55,115	46,847	128.4
2015	200,338	101,782	98,556	83,773	

* (a) = (b) + (c)
** (d) = 85% of (c)

Estimated Extraneous Flow

As mentioned earlier in the absence of monitoring records for the wastewater flows discharging into the lagoon, the extraneous wet weather flows discharging into the lagoon were estimated based on the following assumptions:

- The lagoon storage cell is drained completely twice a year and the required effective time to drain the lagoon storage cell is 6-7 days. At the beginning of the draining operation, the lagoon storage cell is full to the maximum water level.
- No exfiltration flows occur from the lagoon cells.
- Average Daily Design flows (excluding extraneous wet weather flows) discharging into the lagoon is estimated at 130 m³/day (47,450 m³/day).

A flow balance assessment for the lagoon cells was completed to estimate the extraneous flows discharging into the lagoon, the results are as indicated in Table 2.2. The extraneous flows were determined as: “Lagoon Outflow” minus “Wastewater Dry Weather plus Stormwater over Lagoon” and are estimated in the range of 7,200m³.

Based on discussions with the Village, it had been understood that some of the residential units in Glenwood have their weeping tile drainage system and basement sumps discharging into the municipal wastewater system. There are no records indicating the number of these residential units and discharged flows. Any reduction of these drained water volumes conveyed to the lagoon will help in extending the period before any future expansion of the lagoon is required to handle future growth.

Table 2.2: Estimated Extraneous Flow

Inflow (m³/year)Wastewater / Drainage			Outflow (m³/year)Drainage/Evaporation	
Wastewater Dry Weather (a)	Extraneous Wet Weather (b)	Stormwater over Lagoon Cells (c)	Lagoon Drainage to Belly River (d)	Evaporation Loss (e)
47,450	7,190	9,400	49,360	14,680

* (c) = Lagoon Cells Area (22,120m²) x Precipitation (425mm/year)
** (d) = (Volume of Storage Cell (23,770m³) + Daily Flow (130m³/day) x (7 days) x 2 (drained twice a year)
*** (e) = Lagoon Cells Wet Surface Area (17,800m²) x Evaporation (825mm/year)
**** (b) = (e) + (d) – (c) – (a)

Estimated Current Wastewater Flow

The lagoon wastewater design flow is the sum of the dry weather and extraneous flows. The estimated current Average Daily Design Flow is as indicated in Table 2.3:

Table 2.3: Estimated Current Wastewater Flows

Year	Wastewater Dry Weather Flow m³/year	Extraneous Wet Weather Flow m³/year	Wastewater Design Flow m³/year	Average Daily Design Flow m³/day
2015	47,450	7,190	54,640	149.7

2.1.2 Lagoon estimated Current Treatment Capacity

The Village's lagoon capacity was determined based on the existing lagoon volumes and the required lagoon residence times. As per the Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (Alberta Environment, 2013), and the Alberta Environmental Protection Approval for the Lagoon, the minimum required hydraulic residence times in conventional facultative wastewater lagoon treatment systems are as follows:

- Anaerobic Cells – 4 days per cell with 2 cells; i.e. 8 days total (at average daily design flow, where average daily design flow is the total annual wastewater flow divided by 365 days in a year)
- Facultative Cells – 60 days total (at average daily design flow)
- Storage Cells – 183 days total (at average daily design flow), this considers the emptying of the storage cell completely twice a year

The net evaporation has been accounted for in the estimate for the capacity of the lagoon storage and aerobic cells and is determined for the Village of Glenwood area to be 400mm per year, based on a total annual evaporation for Glenwood of 825mm per year "Evaporation and Evapotranspiration in Alberta Report - 2013" minus annual precipitation of 425mm per year "Environment Canada".

Table 2.4: Estimated Lagoon Treatment Capacity

Lagoon Cells	Total Volume (a)	Hydraulic Residence Time (b)	Active Surface Area (c)	Evaporated Volume (d)	Treatment Capacity (e)	Daily Treatment Capacity (f)
Anaerobic	1,400m³	8 days	900m²	Minimal	1400m³	175.0
Facultative	7,600m³	60 days	5780m²	Minimal	7600m³	126.7
Storage	26,680m³	183 days	11,110m²	2,220m³	28,900 m³	158.0

* (d) = (c) x Net Evaporation (400mm/year) x (b) / 365days
** (e) = (a) + (d)
*** (f) = (e) / (b)

The estimated lagoon cells treatment capacity are as indicated in Table 2.4. The comparison of these treatment capacities with the estimated daily design flow (149.7m^3 / day) shows that the anaerobic and storage cells have the capacity to handle the estimated flow. The facultative cell treatment capacity is about 15% below the estimated flow. In this regard the following could be noted:

- The estimated current wastewater flow is based on the assumption that the three campgrounds in the Glenwood area are discharging their wastewater effluent into the Village wastewater lagoon. At the current time, two campgrounds are not discharging into the lagoon. An estimate for the generated wastewater volumes from the two campgrounds based on two thirds of the 450 current campground sites with an estimated wastewater flow of 80L/campsite/Day (AENV Guidelines) is 4,250m³/6 months, which represents approximately 7-8% of the lagoon estimated current wastewater flow.
- The estimated current extraneous flows discharging into the lagoon are approximate. Monitoring of flows discharging into the lagoon will provide a more accurate assessment for these flows.

Based on the above, it is concluded that the existing cells have the capacity to treat the current wastewater flows discharging into the Village lagoon. The anaerobic and storage cells have a spare capacity to take 15% more wastewater volumes, the facultative cell is on the limit. The existing lagoon does not have the capacity to take any future increase in the current wastewater influent. More detail on the future lagoon flows and required treatment capacity will follow in Section 3.0.

3.0 Future Wastewater Flows and Lagoon Expansion Options

3.1 Estimated Future Wastewater Flows

As detailed in the 2011 Census, the Village of Glenwood had a population of 287. Based on discussions with the Village, it is not expected to experience a significant population change in the future. In addition, there is no clear indication of future expansion at the campground areas. As a result a growth rate of 2.0% per annum for Glenwood could be considered reasonably conservative for the estimate of the future wastewater flows projection.

The requirements for the expansion of the Village wastewater lagoon have been assessed for the 25-year horizon, based on the 2.0% per annum expansion growth. It is assumed that the estimated extraneous wet weather flow shall increase based on the same 2.0% per annum rate. The estimated current and future Average Daily Design Flows are as indicated in Table 3.1:

Table 3.1: Estimated Design Wastewater Flows

Year	Wastewater Dry Weather Flow m^3/year	Extraneous Wet Weather Flow m^3/year	Wastewater Design Flow m^3/year	Average Daily Design Flow m^3/day
2015	47,450	7,190	54,640	149.7
2040	77,850	12,090	89,940	246.4

3.2 Wastewater Treatment Expansion Alternatives

Two alternatives are addressed for expansion of the capacity of the current wastewater treatment facility.

3.2.1 Anaerobic / Facultative Lagoon System

An expanded lagoon system could be considered for the Village to treat its wastewater long-term. The option of expanding the lagoon is feasible for the Village, given the relatively low population projection below the 20,000 population threshold commonly used as the point where a mechanical treatment plant becomes necessary.

The below driving forces exist for expanding the existing lagoon:

- Lagoons already exist. Existing infrastructure could still be utilized.
- The Village is familiar with the operation of a lagoon system. Consequently, there will be no change in the operations conditions.
- Costs are generally less than those for operating a mechanical treatment plant.

Using the above noted estimated future wastewater flow, the expanded lagoon capacity shall be as indicated in Table 3.2. The only limitation against expanding the lagoon is the requirement for land expropriation. A proposed scheme for the lagoon expansion is described in the paragraph below.

Table 3.2: Expanded Lagoon Design Wastewater Flows

Year	Total Anaerobic Cell Volume m³	Total Facultative Cell Volume m³	Total Storage Cell Volume m³
Existing	1,400	7,600	26,680
2040	1,970	14,785	44,970

Proposed Lagoon Expansion System

The proposed lagoon expansion proposes a new site to the west. This assumes the possibility to acquire an area of around 7.2 acres. Figure 3 shows the proposed lagoon expansion as well as the preferred area to be acquired. The confirmation of suitability of the area to be acquired shall be subject to a site survey and discussions with land owners. Another alternative might be the acquirement of land in the vicinity of the lagoon at the east of Highway 810. The major components of the upgraded lagoon include the following:

- The construction of two new anaerobic cells to the west of the existing anaerobic cells with a total area of about 2,000m². This requires abandoning the inlet pipe section interfering with the new cells and constructing a new inlet to the east.
- The construction of a new facultative cell to the west of the existing facultative cell with an area of about 2,000m².
- Expand the existing facultative cell by reclaiming the existing two anaerobic cells and surrounding areas. The area of the upgraded cell shall be in the range of 10,700m².
- Construct an extra storage cell to the west of the existing storage, with an area of about 8,200m². This will require the construction of an equalizing pipeline connecting the current storage cell to the new cell.
- The lagoon expansion would incorporate the reconstruction of new flow control chambers to replace the existing chambers that are in a poor condition.

The estimated preliminary cost of the proposed works is $2,826,000. This does not include the cost for acquirement of land. Relevant details are indicated in Table 3.3.

Table 3.3: Estimated Preliminary Cost – Lagoon Expansion Option

Work	Cost $
Earthworks & Subsurface Drainage	680,000
Lagoon Liner	620,000
Pipeworks & Flow Control Structures	550,000
General and Miscellaneous Works	330,000
Total 1	**2,180,000**
Contingencies 20%	436,000
Total 2	**2,616,000**
Engineering & Flow Monitoring 8%	210,000
Grand Total	**2,826,000**

3.2.2 Mechanical Treatment Plant

A second option for wastewater treatment would be a mechanical treatment plant. While this would provide high quality treatment for the Village's wastewater, several challenges would exist:

- Mechanical treatment plants require a qualified Level 2 (or higher) operator to run the system.
- Mechanical treatment plants are operated under an approval from Alberta Environment, compared to the Code of Practice that the current lagoon system is operated under. The difference here is that under an approval, mechanical treatment plants are subject to more extensive monitoring requirements while the current system under the Code of Practice for Wastewater Systems Using a Wastewater Lagoon has limited effluent monitoring requirements and does not specify any specific effluent requirements. The approval needed would require additional operator involvement to ensure effluent quality.
- The operation and maintenance cost for a mechanical treatment plant is higher than the cost for the lagoon.

Proposed Mechanical Wastewater Treatment Plant Package

The proposed mechanical wastewater treatment plant proposes the installation of a package plant to the east of the existing lagoon storage cell, as indicated on Figure 4. The existing lagoon would be kept operational and shall be used as a primary treatment and flow balancing structure. The effluent from the existing storage cell would be diverted to the installed plant for final treatment and discharge into the Belly River. The major components include the following:

- The installation of the new wastewater treatment plant
- The construction of water and power service connections for the lagoon site
- The diversion of the existing outfall from the lagoon to the installed wastewater treatment plant.
- The installation of a new outfall to the Belly River.
- Replacement of existing flow control chambers for the lagoon.

The estimated preliminary cost of the proposed works is $2,975,000. Relevant details are indicated in Table 3.4.

Table 3.4: Estimated Preliminary Cost – Wastewater Treatment Plant Option

Work	Cost $
Installation of Wastewater Treatment Package Plant	2,000,000
Water and Power service connections	25,000
Diversion of existing lagoon outfall and construction of new outfall to Belly River	35,000
Replacement of Flow Control Chambers	180,000
General and Miscellaneous Works	150,000
Total 1	**2,390,000**
Contingencies 15%	360,000
Total 2	**2,750,000**
Engineering & Flow Monitoring 8%	225,000
Grand Total	**2,975,000**

4.0 Conclusions and Recommendations

The existing wastewater lagoon has the capacity to treat the current wastewater flows discharging into the lagoon. However, the existing lagoon does not have the capacity to take any substantial future increase in the current wastewater influent. The Village should monitor on a continuous basis the normal water levels in the lagoon cells in parallel with the development of wastewater volumes conveyed to the lagoon. Once these water levels start to exceed the lagoon design normal water level, the Village should be prepared to start with the construction works for the lagoon upgrades.

The assessment in this report is based on estimated wastewater flows discharging into the lagoon. These wastewater flows were obtained using the metered produced water at the Village Water Supply Treatment Plant and the anticipated extraneous flows discharging into the wastewater collection system. These estimated wastewater flows should be confirmed prior to start with any final design for the upgrade of the lagoon treatment capacity. The following steps are recommended in this context:

1. Communicate and coordinate with the home owners in Glenwood to avoid directing any flows from the weeping tiles drainage systems to the municipal wastewater collection system.
2. Conducting a flow monitoring site assessment during dry and wet weather periods to evaluate the wastewater flows at the lagoon's inlet.

For the Village's wastewater treatment expansion, in view of the estimated close range of construction cost and the discussed advantages and disadvantages for the proposed lagoon expansion and wastewater treatment plant alternatives. The proposed current lagoon expansion alternative appears ideal to meet the Village's wastewater treatment requirements in the 25 year horizon, provided the required extra land for the lagoon expansion could be made available.

Currently, the flow circulation and water levels between the different cells of the existing lagoon is controlled by three flow control manholes. The structure of these manholes suffers from concrete deterioration and steel corrosion which will impact the structural integrity in the medium term. The use of stop boards to control the flow distribution is also inadequate. Consequently, it is recommended to remove and replace these manholes within a period of five years. If the Village anticipates to start with the expansion of the current lagoons within a period of 5-7 years, the replacement of these chambers can be incorporated into that project scope. If an expansion is to be deferred, then the chambers could be replaced separately, however rebuilding the chambers in a different location is advised in order to minimize abortive works and avoid removing the replaced chambers during the lagoon expansion works when this ultimately takes place. The estimated cost of rebuilding the chambers is in the range of $180,000.

HORZ 1:1000 0 10 20 30 40m

GLENWOOD SEWAGE LAGOON

LOCATION PLAN

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PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

FIGURE 1
FEBRUARY 18, 2016

GLENWOOD WASTEWATER LAGOON

EXISTING LAGOON LAYOUT

FIGURE 2

HORZ 1:2000 0 20 40 60 80m

FEBRUARY 2016

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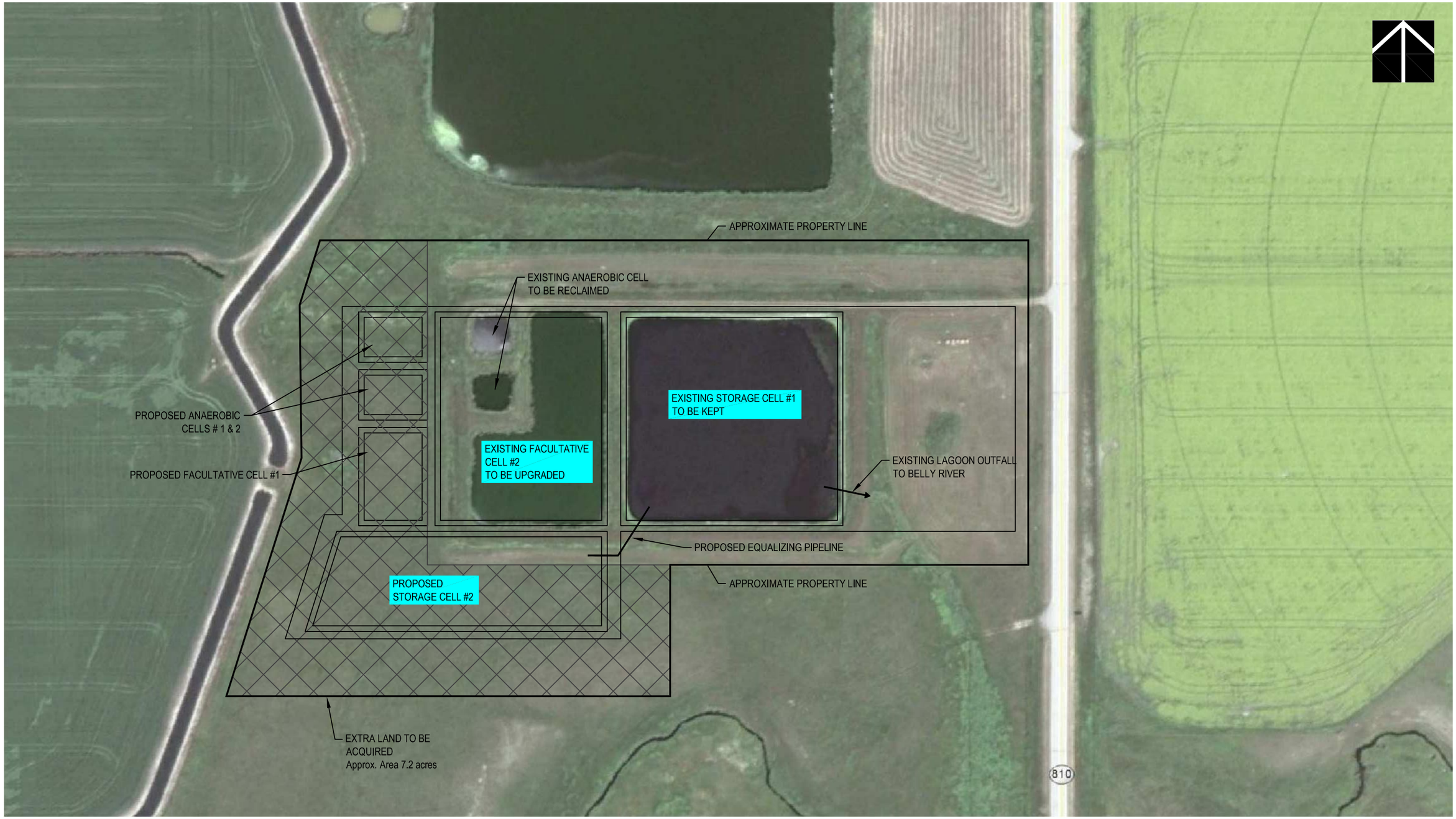

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GLENWOOD WASTEWATER LAGOON

PROPOSED LAGOON EXPANSION ALTERNATIVE

FIGURE 3

HORZ 1:2000 0 20 40 60 80m

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GLENWOOD WASTEWATER LAGOON

PROPOSED MECHANICAL WASTEWATER TREATMENT
PLANT PACKAGE ALTERNATIVE

FIGURE 4

HORZ 1:2000 0 20 40 60 80m

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