Downstream Use and Impact Study

SAL Engineering Ltd.

Beardy's & Okemasis' Cree Nation Sewage Lagoon Upgrade

Beardy's & Okemasis' Cree Nation

SLR Project No: 208.30030.00000

April 2022

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ACRONYMS

/100 mL	per 100 millilitres
BOCN	Beardy's & Okemasis' Cree Nation
BOD_5	5-day biochemical oxygen demand
cBOD	carbonaceous biochemical oxygen demand
°C	degrees Celsius
CCME	Canadian Council of Ministers of the Environment
DFO	Fisheries and Oceans Canada
DO	dissolved oxygen
DUIS	Downstream Use and Impact Study
EDO	environmental discharge objective
km	kilometre
mg/L	milligrams per litre
m^3	cubic metres
m^3/s	cubic metres per second
mg/L	milligram per litre
mL	millilitres
N	nitrogen
P	phosphorous
SAL	SAL Engineering Ltd.
SK	Saskatchewan
SLR	SLR Consulting (Canada) Ltd. and SLR International Corporation
s.u.	standard unit (pH)
TSS	total suspended solids
WQG	CCME water quality guideline
WQO	WSA water quality objective
WSA	Saskatchewan Water Security Agency
WSER	Wastewater System Effluent Regulations

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1.0 INTRODUCTION

1.1 Background

SLR Consulting (Canada) Ltd. and SLR International Corporation (SLR) were retained by SAL Engineering Ltd. (SAL) to conduct a Downstream Use and Impact Study (DUIS) on behalf of the Beardy's & Okemasis' Cree Nation in support of their sewage lagoon upgrade project. The existing Beardy's & Okemasis' Cree Nation sewage lagoon system is located north of the core community and Duck Lake as shown in Drawing 1. The existing system is designed to discharge on the west side of the lagoon to a wetland drainage course eventually leading to Chante Lake approximately 20 kilometres (km) downstream, and then to the South Saskatchewan River another one kilometre downstream. As part of the lagoon upgrade, the existing lagoon will either be expanded or replaced in its current location with continued discharge to the Duck Lake drainage.

1.2 Purpose

The purpose of this study is to evaluate the potential impacts of discharge from an upgraded lagoon system on downstream water quality. Specifically, it is to assess whether discharge requirements set forth in the Wastewater System Effluent Regulations (WSER) are adequately protective of downstream uses of the receiving water or whether more stringent limits should apply. The applicable minimum WSER discharge criteria are:

- Carbonaceous biochemical oxygen demand (cBOD) not to exceed 25 milligrams per litre (mg/L).
- Total suspended solids (TSS) not to exceed 25 mg/L.
- Unionized ammonia less than 1.25 mg/L.

WSER requirements for free chlorine do not apply because sewage treatment does not include chlorination.

1.3 Approach

The DUIS was completed in general accordance with Saskatchewan Water Security Agency (WSA) DUIS guidance. Potential impacts to the ultimate receiving water body, the South Saskatchewan River, were evaluated by assessing available dilution, predicting downstream water quality after mixing with the discharge, and comparing the resulting concentrations with Province of Saskatchewan ambient water quality objectives (WQOs) and water quality guidelines (WQGs) from the Canadian Council of Ministers of Environment (CCME). In accordance with WSA guidance, the DUIS focuses on the WSER-regulated parameters discussed in Section 1.2 (cBOD, TSS, and unionized ammonia). Nitrogen, phosphorous, *E. coli*, and total coliforms were also assessed.

1.4 Organization

This DUIS has been produced in general accordance with WSA guidance and includes:

- Characterization of the discharge (Section 2).
- Characterization of the receiving environment (Section 3).
- Impact assessment (Section 4).
- Summary and Conclusions (Section 5).

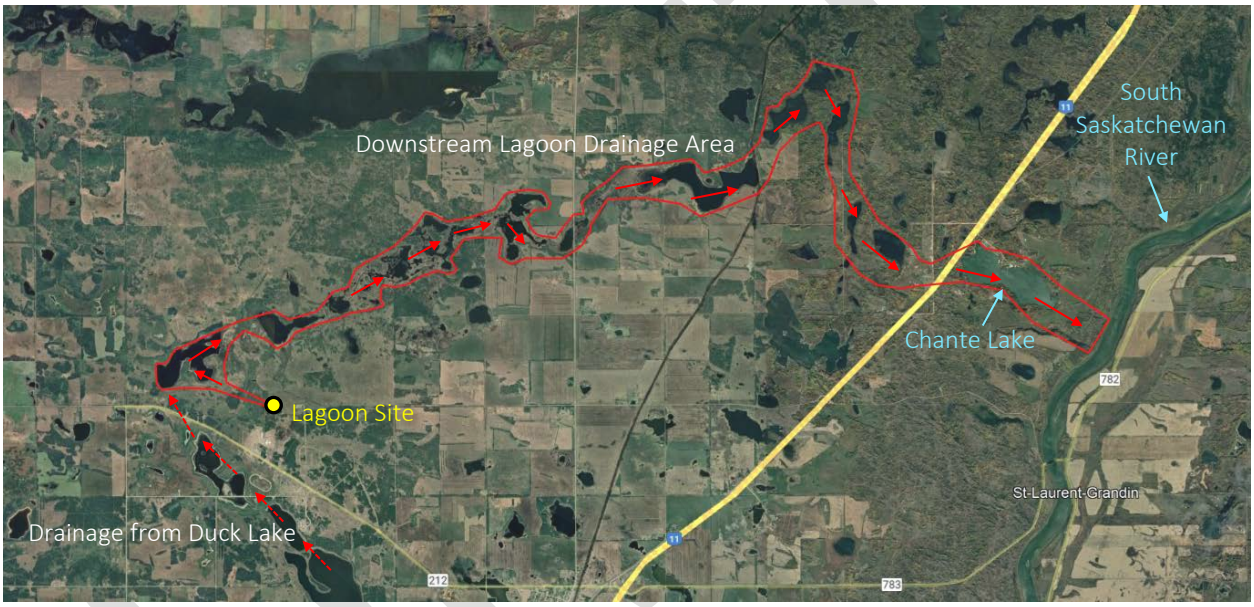
- References (Section 6).
- Statement of Limitations (Section 7).

2.0 DISCHARGE CHARACTERIZATION

2.1 Discharge Description

The upgraded sewage lagoon system will discharge to the same location as the existing lagoon, which is west towards the Duck Lake drainage. After the sewage lagoon discharge point, the drainage flows north then east approximately 20 km, through Chante Lake, and ultimately to the Saskatchewan River (Figure 1).

Figure 1. Discharge Flow Path



Flooding had historically been an issue on the Reserve along the Duck Lake drainage and surrounding area, particularly in the spring run-off when the wetland drainage depressions are full, and the ground is frozen or saturated. A drainage improvement project was undertaken in 2011 and included dredging of the main channel to improve flow (SLR, 2010). The improvements increase the likelihood that the sewage lagoon discharge will ultimately reach the South Saskatchewan River. Approximate coordinates for the lagoon site and final discharge location on the South Saskatchewan River are shown below in Table 1.

Table 1. Discharge Location

Coordinates	Lagoon Site	Discharge to S. Saskatchewan River
Latitude	52°50’39.60” North	52°51’14.26” North
Longitude	106°18’15.75” West	106°4’53.90” West

2.2 Discharge Flow Rate

As provided by SAL, discharge from the upgraded lagoon is expected to take place twice per year in the spring and fall, most likely in April and October. The maximum expected release volume as based on the 2040 design storage volume is 142,500 cubic metres (m^3) occurring over a duration of two weeks. This corresponds to a discharge flow rate of 0.118 cubic metres per second (m^3/s).

2.3 Effluent Characterization

Due to leakage, the existing sewage lagoon has not been discharged since October 2016. Effluent quality from the 2016 discharge is summarized in Table 2 below for unionized ammonia, cBOD, TSS, total nitrogen (N), total phosphorus (P), total coliforms, and *E. coli*. Also shown for comparison are the federal WSER effluent limits, Saskatchewan WSA effluent limits, and WSA performance guidelines for well-operated lagoons from the *Saskatchewan Sewage Works Design Standard*.

Table 2. 2016 Lagoon Effluent Quality and Standards

Parameter	WSER Limit[1]	WSA Limit[2]	WSA Guidelines[3]	2016 Effluent
Unionized ammonia (mg/L)[1]	**<1.25**	**<1.25**	--	0.22
cBOD (mg/L)	**25**	**25**	--	26
BOD5 (mg/L)[5]	--	**30**	Fall: 10 to 30 Spring: 25 to 70	--
TSS (mg/L)	**25**	**25**	Fall: 10 to 40 Spring: 20 to 60	45.4
Total N (mg/L)[6]	--	--	Fall: 5 to **20** Spring: 20 to **35**	9.72
Total P (mg/L)	--	--	Fall: 2 to **5** Spring: 3.5 to **7**	0.9
Total Coliforms (/100 mL)	--	--	Fall: 200 to **20,000** Spring: 2,000 to **200,000**	>2,420
E. coli (/100 mL)	--	--	--	111

Notes: **Bold** denotes worst-case expected effluent quality for the new lagoon system.

1. WSER effluent limits taken from Wastewater System Effluent Regulations SOR/2012-139.
2. WSA effluent limits from Sewage Works Design Standard EPB 503 (WSA 2012). Limit shown based on continuous or non-continuous (15 days or less) discharge to fish bearing surface waters or any of their tributaries.
3. WSA performance guidelines for facultative lagoons taken from Table 4.1 of the Sewage Works Design Standards – Typical effluent quality (WSA, 2012). WSA performance guidelines are only available for fall and spring, which is when sewage lagoons are typically discharged.
4. Ammonia criteria are expressed as the unionized fraction, f, which is pH and temperature dependant. Unionized ammonia in the effluent was calculated from total ammonia (1.37 mg/L) using the formula f = 1/(10(pka-ph)+1), pka = 0.0901821 + 2729.92/(273.2+T), and T is the water temperature in degrees Celsius. The unionized fraction was estimated from the measured effluent pH of 8.85 and a temperature of 15 degrees Celsius (°C), which is common practice in the province. "mg/L" denotes milligrams per litre.
5. BOD5 is 5-day biochemical oxygen demand. No effluent data are available for BOD5. It is included on the table because there are applicable effluent limits.
6. 2016 Effluent value shown for total N is that of total Kjeldahl nitrogen. No effluent data are available for total nitrogen.

The October 2016 effluent data meet effluent limits for ammonia and the WSA performance guidelines for nitrogen and phosphorus. The historic effluent quality data are presented for reference only; effluent quality from the new lagoon system is expected to meet effluent limits and performance criteria.

3.0 RECEIVING ENVIRONMENT CHARACTERIZATION

As described in Section 2.1, the immediate receiving water for the lagoon discharge is the Duck Lake drainage, which flows approximately 20 km before ultimately reaching the South Saskatchewan River.

3.1 Land Use

The HABISask Interactive Mapping Tool (Appendix A), was used to assess land use in the vicinity of the lagoon and along the discharge path. No agricultural lands are present in the vicinity of the lagoon, however agricultural lands are present approximately three km northeast of the lagoons in the approximate area of the discharge path. Most of the land cover in the vicinity of the lagoon site is native dominant grasslands, and land cover along the discharge path is identified as hardwoods, hay crops, and native dominant grasslands.

3.2 Downstream Water Uses and Users

As described in the draft DUIS guidance, potential beneficial uses of a water body include water supply (including industrial and agricultural), aquatic life, wildlife, and recreational uses. The Duck Lake drainage and South Saskatchewan River have been assessed for these potential beneficial uses below. All maps produced as part of this effort are included in Appendix A. Based on this assessment, applicable beneficial uses of the Duck Lake drainage include only wildlife while uses of the South Saskatchewan River include water supply, aquatic life, wildlife, and recreational uses.

It is noted that consideration of the South Saskatchewan River in this assessment is highly conservative since it is 20 km downstream of the discharge. The drainage works improvements completed in 2011 increase the likelihood that at least some of the lagoon effluent will reach the river, but significant dilution and attenuation is likely to occur along the 20 km discharge path and that attenuation was not considered here when assessing potential effects to the river.

3.2.1 Surface Water

3.2.1.1 Water Supply

The Duck Lake drainage itself was not identified as a water source. The South Saskatchewan River, however, is the single largest supplier of water in Saskatchewan with almost 50% of the Saskatchewan population relying on the river for drinking water, irrigation, and industrial water supply. As identified from Figure 25 of the *Background Report - South Saskatchewan River Watershed* (Saskatchewan Watershed Authority, 2007; Appendix A), there are surface water allocations from the river for domestic and municipal use approximately 20 km downstream of where the Duck Lake drainage meets the river (in and near St. Louis).

3.2.1.2 Aquatic Life

Potential fish habitat in the Duck Lake drainage was assessed by SLR in 2010 as part of the environmental screening for the drainage improvement project. The screening report (SLR, 2010) indicated there was no

local knowledge of fish in either Duck Lake or its drainage through the Reserve. The report also described an email from the Department of Fisheries and Oceans (DFO) from 2010 concluding that the drainage improvement project was unlikely to affect fish habitat. Based on this information, aquatic life is not identified as a use of the Duck Lake drainage.

A fishery reports for the South Saskatchewan River was run using the HABISask mapping application. Fish species known to inhabit the South Saskatchewan River include blacknose dace, brook stickleback, burbot, cisco, common shiner, emerald shiner, fathead minnow, finescale dace, fathead chub, goldeneye, Iowa darter, lake chub, lake sturgeon, lake whitefish, longnose dace, longnose sucker, mooneye, northern pike, pearl dace, quillback, rainbow trout, river shiner, sauger, shorthead redhorse, silver redhorse, slimy sculpin, spoonhead sculpin, spottail shiner, trout-perch, walleye, white sucker, and yellow perch (Appendix A). Based on this information, aquatic life was identified as a use of the South Saskatchewan River.

3.2.1.3 Wildlife and Habitat

The DFO Aquatic Species at Risk Map was used to identify potential federally protected critical aquatic habitat or species at risk in the Duck Lake drainage and downstream in the South Saskatchewan River for approximately 25 km (DFO, 2021). No federally listed critical habitat or rare, endangered, or at-risk species were identified.

The Saskatchewan Interactive and HABISask Interactive Mapping tools were used to identify the presence of rare and endangered animal species, terrestrial habitat of species-level importance, and protected areas in the vicinity of the expanded sewage lagoon and discharge path (Appendix A). There are no rare and endangered species in the immediate area of the lagoons or within the first five km of the discharge path. Rare and endangered vertebrate species (turkey vulture) have been identified along the discharge path, approximately seven km northeast of the lagoons. A rare or endangered vascular plant (Mucronate Blue-eyed-grass) was also identified approximately 12 km northeast of the lagoons along the discharge path. No game preserves, national wildlife areas, migratory bird sanctuaries, conservation easements, ecological reserves, or wildlife refuge areas were identified in the vicinity of the lagoon or along the discharge path. The nearest wildlife habitat protection areas and protected and conserved areas were identified approximately three km northeast of the lagoons along the discharge path. The nearest terrestrial wildlife habitat areas of species-level importance (as delineated through the Terrestrial Wildlife habitat Inventory) were identified approximately nine km northeast of the lagoons along the discharge path.

3.2.1.4 Recreational Use

According to the HABISask Interactive Mapping Tool (Appendix A), there are no National, Provincial, or Regional Parks, recreation sites, protected areas, or historic sites in in the vicinity of the lagoon site, along the Duck Lake drainage, or downstream in the South Saskatchewan River for approximately 25 km.

3.2.2 Groundwater

The WSA Water Wells Mapping Application was used to identify water wells in the vicinity of the Beardy's & Okemasis' Cree Nation sewage lagoons. Multiple water wells were identified and those identified within 5 km of the lagoon site are included in Appendix A with the associated well reports and are summarized below.

- WWDR-068340, Lafonde. Domestic water well completed in 1981 and located approximately 1.6 km northwest of the existing lagoon.
- WWDR-061976, Beardy's IR. Domestic water well completed in 1980 and located approximately 1.6 km northwest of the existing lagoon.
- WWDR-067770, Beardy's IR. Domestic water test hole completed in 1981 and located approximately 2.4 km northwest of the existing lagoon.
- WWDR-206350, Tournier. Domestic water well completed in 2006 and located approximately 2.9 km northeast of the existing lagoon.

3.3 Water Quality and Surface Water Quality Objectives

No surface water quality data were identified for Duck Lake or the Duck Lake Drainage. Water quality data were identified for the South Saskatchewan River at two locations, station SK05HH0267 located approximately 75 km upstream of where the Duck Lake drainage meets the river, and station SK05HH0177 approximately 60 km downstream. Data were downloaded for the two stations for the period from 2020 through 2021 and are summarized below on Table 3 for spring (March, April, May) and fall (September, October, November), when lagoon discharges would occur. Also shown on the table are the relevant CCME WQGs and WSA WQOs.

Table 3. Average Historical South Saskatchewan River Water Quality

Parameter	Criteria	Upstream Station	Downstream Station
pH (s.u.)	6.5 to 9.0[1,2]	Spring 8.32; Fall 8.35	Spring 8.31; Fall 8.43
DO (mg/L)	6.5 & 9.5[1,2,3]	Spring 11.8; Fall 11.7	Spring 10.6; Fall 11.1
Unionized ammonia (mg/L)[4]	0.019[1,2]	Spring 0.012; Fall 0.005	Spring 0.002; Fall 0.002
Total P (mg/L)	<+50%[1,5]	Spring 0.051; Fall 0.038	Spring 0.039; Fall 0.023
Total N (mg/L)	none	Spring 0.70; Fall 0.67	Spring 0.48; Fall 0.49
E.coli (/100 mL)	100[1,6]	Spring 64; Fall 244	Spring 12; Fall 21

Notes:

pH, DO, unionized ammonia, and phosphorous criteria shown above are for protection of aquatic life. *E. coli* criteria are for irrigation. There are no ambient data available for total coliforms, but the total coliforms criterion for protection of irrigation use is 1,000 per 100 mL. Similarly, there are no ambient data available for TSS but for "clear flow" the TSS WQGs are a maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 hours and 30 days).

1 CCME WQGs.
2 WSA WQOs.
3 WQGs and WQOs dissolved oxygen (DO) are 9.5 mg/L for cold-water biota in early life stages; 6.5 mg/L for cold-water biota in other life stages.
4 Historic data for ammonia were converted from total ammonia to unionized ammonia using a calculation for the fraction of the unionized form, f, where f = 1/(10(pka-ph) +1), pka = 0.0901821 + 2729.92/(273.2+T), and T is the water temperature in Celsius. The unionized fraction was estimated from the recorded pH of the sample day and a temperature of 15°C, which is common practice in the province.
5 The CCME WQG for phosphorous follows a tiered framework. Phosphorous concentrations must not exceed "trigger" ranges" for the water body or increase more than 50% above the background level. Based on the average ambient concentrations, the South Saskatchewan River is assumed to be in the meso-eutrophic range (0.02 to 0.035 mg/L) to eutrophic range (0.035 to 0.1 mg/L).
6 The WSA *E. coli* WQO of 100 per 100 millilitres (/100 mL) is based on agricultural uses (specifically irrigation). There are additional, less strict WQOs for recreation, which are a geometric mean concentration of ≤200/100 mL and a maximum concentration of 400/100 mL.

The data indicate that the South Saskatchewan River generally meets WQOs and WQGs in the spring and fall when lagoon discharges would occur, with the exception of *E.coli* in the fall at the upstream sampling location. The upstream location is less than 20 km downstream of the city of Saskatchewan and may be elevated as a result of municipal discharges.

4.0 IMPACT ASSESSMENT

4.1 Methodology

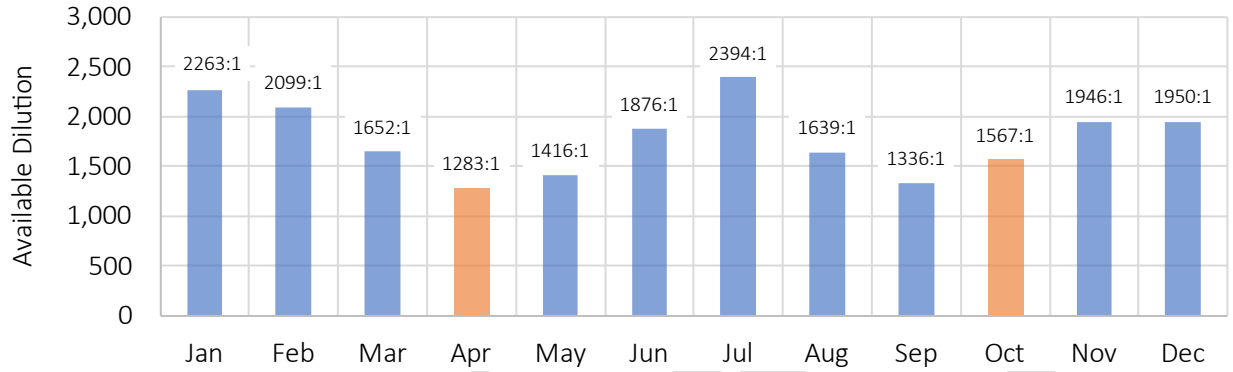
The upgraded lagoon system is being designed by SAL to meet all federal WSER effluent limitations as well as provincial WSA performance guidelines for well-operated lagoon systems. Potential impacts of the discharge to the Duck Lake drainage are not expected, largely because aquatic life, water supply, and recreational uses were not identified, and only wildlife use was found to be significant. There are no WQOs or WQGs specific to the protection of wildlife. The Saskatchewan WQOs indicate that the toxics criteria for protection of aquatic life are sufficiently stringent to protect wildlife, which rely on surface water for drinking water and their source of food supply. Ammonia is the only regulated toxic substance in sewage lagoon effluent (other constituents such as cBOD, nutrients, and bacteria aren't toxics). However, ammonia's primary mode of toxicity in fish isn't related in ingestion as it is for other toxics, rather it damages the gills of fish.

Based on the above factors, the focus of this impact assessment is on the South Saskatchewan River, which is the ultimate receiving water for the discharge. Although a distance away (approximately 20 km) drainage improvements completed in 2011 increase the likelihood that the discharge, or at least part of it, will ultimately reach the South Saskatchewan River. This approach is highly conservative since significant dilution and attenuation of the discharge is likely to occur along the drainage path and that attenuation was not considered here when assessing potential effects to the river. Instead, the assessment is performed under the conservative assumption that the entire undiluted lagoon discharge were to be released to the South Saskatchewan River. Potential impacts were evaluated by assessing available dilution, predicting concentration in the river after mixing with the lagoon effluent, and comparing those concentrations to WQOs and WQGs.

4.2 Available Dilution

Available dilutions for the lagoon discharge were conservatively estimated for each calendar month as ratios between the full projected average monthly ambient flow rates for the South Saskatchewan River and the maximum expected discharge rate of 0.118 m^3/s, which corresponds to the design volume of 142,500 m^3 being released over a 14-day period.

Graph 1. Available South Saskatchewan River Dilution by Month



Notes: Orange denotes the anticipated lagoon discharge months. Average river flows by month were assessed based on data downloaded for historic gauging station 05HH001 in St. Louis approximately 25 km downstream for the most recent 10-year period of record (1988 through 1997).

Estimated available dilutions ranged from 1,283:1 for the month of April to 2,394:1 for the month of July. These estimates are conservative since they use the maximum expected discharge rate of 0.118 m^3/s.

4.3 Predicted Water Quality

Water quality in the South Saskatchewan River downstream of the discharge was estimated for April and October, when lagoon discharges are expected to occur. Predictions were based on:

- Available dilution (Section 4.2);
- Maximum expected effluent concentrations corresponding to the effluent limits or the upper end of the WSA performance guideline ranges, whichever are higher (Section 2.3); and
- The estimated seasonal average ambient concentrations from the upstream and downstream water quality monitoring stations (see Section 3.3), whichever were higher (with the exception of DO, in which the lower value was used).

The results are conservative since the estimates were developed using maximum expected effluent concentrations, the maximum expected discharge rate, and ambient water quality data from the monitoring station representing worse-case conditions of the two.

4.3.1 Dissolved Oxygen

Cold-water WQGs for DO are a minimum concentration of 9.5 mg/L for early life stages and 6.5 mg/L for all other life stages. Impacts of the discharge related to DO were assessed for April and October by estimating the maximum DO depletion resulting from BOD in the effluent, and the resulting DO concentrations. The assessment used the maximum expected effluent BOD concentration of the effluent, 30 mg/L, which corresponds to the WSA effluent limit. (BOD was used in the assessment to be conservative rather than cBOD, which is a subset of BOD and has a lower 25 mg/L effluent limit.)

Predicted DO concentrations in the river after mixing with the effluent were 10.6 mg/L for April and 11.1 mg/L for October, meeting the strictest WQGs. Due to the large available dilution, predicted maximum DO depletion resulting from the lagoon discharge is very small, 0.023 and 0.022 mg/L for April and October, respectively. Based on these data, impacts to the river resulting from BOD in the lagoon effluent are unlikely.

4.3.2 Ammonia

The WQG for ammonia is a maximum concentration of 0.019 mg/L, expressed as the unionized fraction, for protection of aquatic life. Impacts of the discharge related to ammonia were assessed for April and October based on available dilution, seasonal average ambient unionized ammonia concentrations, and the maximum expected effluent unionized ammonia concentration of 1.25 mg/L, which corresponds to the WSER effluent limit.

Predicted unionized ammonia concentrations in the river after mixing with the effluent were 0.013 mg/L for April, representing an 8% increase, and 0.006 mg/L for October, representing a 19% increase. Predicted concentrations for both months met the WQG. Based on these data, impacts to the river resulting from unionized ammonia in the lagoon effluent are unlikely.

4.3.3 TSS

The WQGs for TSS are a maximum short-term increase of 25 mg/L and a maximum long-term increase of 5 mg/L for protection of aquatic life. Potential increases in downstream TSS concentrations were estimated for April and October based on available dilution and the maximum expected effluent TSS concentration of 25 mg/L, which corresponds to the WSER effluent limit.

Due to the large available dilution, predicted TSS increases in the river after mixing with the effluent were low, less than 0.02 mg/L for both April and October. Based on these data, impacts to the river resulting from TSS in the lagoon effluent are unlikely. It is also likely that TSS will settle or be filtered out along the Duck Lake drainage path before reaching the river.

4.3.4 Total Coliforms

The WQG for total coliforms is a maximum of 1,000 per 100 mL for protection of irrigation uses. There are no effluent limitations for total coliforms, but the lagoon effluent is expected to meet WSA performance guidelines for well-operated lagoons (200 to 20,000 per 100 mL for a fall release and 2,000 to 200,000 per 100 mL for a spring release).

Potential impacts of the lagoon discharge related to total coliforms were estimated for April and October based on available dilution and expected effluent total coliforms concentrations as based on the WSA performance guideline ranges. No ambient total coliforms data were identified for the South Saskatchewan River, so actual concentrations could not be estimated. Instead, potential increases in total coliforms resulting from the discharge were estimated.

Predicted total coliforms increases in the river after mixing with the effluent were 156/100 mL for an April release and 15/100 mL for an October release. These values are significantly below the 1,000/100 mL WQGs. Based on these data, impacts to the river resulting from total coliforms in the lagoon effluent are unlikely. It is also likely that total coliforms will settle or be filtered out along the Duck Lake drainage path before reaching the river.

4.3.5 E. coli

The WQG for *E. coli* is a maximum of 100/100 mL for protection of irrigation uses. There are no effluent limitations or WSA performance guidelines for *E. coli*, but effluent from the new lagoon is expected to be of similar or better quality than the existing lagoon, which contained 111/100 mL *E. coli* when last discharged in October 2016. For the purpose of this assessment, fall and spring effluent *E. coli* concentrations of 111/100 mL and 1,110/100 mL, respectively were assumed. A concentration 10 times higher was assumed for the spring, which is consistent with the ratio of spring to fall total coliforms in the WSA performance guidelines for well operated lagoons.

Potential increases in *E. coli* in the river after mixing with the lagoon effluent were estimated for April and October based on available dilution and expected effluent *E. coli* concentrations described above. Increases were predicted rather than actual concentrations because the average *E. coli* concentration at the upstream monitoring location exceeded the WQG for the fall.

Predicted *E. coli* increases in the river after mixing with the effluent were minor; 1/100 mL for April, and <1/100 mL for October. Based on these data, impacts to the river resulting from *E. coli* in the lagoon effluent are unlikely.

4.3.6 Total Phosphorus

CCME ambient WQGs for phosphorous are narrative; concentrations should not exceed the upper "trigger range" for the water body or increase concentrations more than 50% above background. There are no effluent limitations for total phosphorous, but effluent is expected to meet WSA performance guidelines for well-operated lagoons (2 to 5 mg/L for a fall release and 3.5 to 7 mg/L for a spring release).

Potential impacts of the discharge related to total phosphorous were estimated for April and October based on available dilution, seasonal average ambient phosphorous concentrations, and the expected effluent phosphorous concentration as based on the seasonal WSA performance guideline ranges. These data were used to estimate phosphorous concentrations downstream of the discharge after mixing.

Predicted total phosphorus concentrations in the river after mixing with the effluent were 0.056 mg/L for April, representing an 11% increase, and 0.042 mg/L for October, representing a 10% increase. The increases are below the 50% increase WQG and did not result in exceedances of trigger levels to the next trophic state. Based on these data, impacts to the river resulting from total phosphorus in the lagoon effluent are unlikely.

4.3.7 Total Nitrogen

There are no numeric ambient WQOs for nitrogen, however Saskatchewan General Objectives for effluent discharges also require that effluent be free from nutrients in concentrations that create nuisance growths of aquatic weeds or algae or that result in an unacceptable degree of eutrophication of the receiving water (WSA, 2012). For the purpose of this evaluation, an assessment level corresponding to a 50% increase over background was applied. This is the same as the approach used in the WQG for phosphorous.

There are no effluent limitations for total nitrogen, but effluent is expected to meet WSA performance guidelines for well-operated lagoons (5 to 20 mg/L for a fall release and 20 to 35 mg/L for a spring release). Impacts of the discharge related to total nitrogen were estimated for April and October based on available dilution, seasonal ambient average concentrations, and effluent nitrogen concentration as

based on the WSA performance guideline ranges. These data were used to estimate the increase in total nitrogen resulting from the discharge after mixing.

Predicted total nitrogen concentrations in the river after mixing with the effluent were 0.73 mg/L for April, representing a 4% increase, and 0.68 mg/L for October, representing a 2% increase. The increases are below the 50% increase assessment level. Based on these data, impacts to the river resulting from phosphorus in the lagoon effluent are unlikely.

5.0 SUMMARY AND CONCLUSIONS

The DUIS was completed on behalf of Beardy's & Okemasis' Cree Nation in support of its sewage lagoon upgrade project. The existing sewage lagoon system is located north of the core community and Duck Lake. The existing system is designed to discharge on the west side of the lagoon to a wetland drainage course eventually leading to Chante Lake approximately 20 km downstream, and then to the South Saskatchewan River in another one kilometre. Due to leakage, the lagoon has not discharged since October 2016. As part of the lagoon upgrade, the existing lagoon will either be expanded or replaced in its current location with continued discharge to the Duck Lake drainage. The lagoon system is being designed by SAL to meet all WSER effluent criteria and WSA performance guidelines for well-operated lagoons.

As described in the draft DUIS guidance, potential beneficial uses of a water body include water supply (including industrial and agricultural), aquatic life, wildlife, and recreational uses. The Duck Lake drainage and South Saskatchewan River were assessed for these potential beneficial uses. Based on the assessment, uses of the Duck Lake drainage are limited to wildlife while uses of the South Saskatchewan River include water supply, aquatic life, wildlife, and recreational uses.

There are no WQOs or WQGs specific to the protection of wildlife. The Saskatchewan WQOs indicate that the toxics criteria for protection of aquatic life are sufficiently stringent to protect wildlife, which rely on surface water for drinking water and their source of food supply. Ammonia is the only regulated toxic substance in sewage lagoon effluent. However, ammonia's primary mode of toxicity in fish isn't related in ingestion as it is for other toxics, rather ammonia damages the gills.

Based on the above factors, the focus of this impact assessment was the South Saskatchewan River, which is the ultimate receiving water for the discharge. Although approximately 20 km downstream, drainage improvements completed in 2011 increase the likelihood that the discharge, or at least part of it, will reach the South Saskatchewan River. This assessment approach is highly conservative since significant dilution and attenuation of the discharge is likely to occur along the drainage path and that attenuation was not considered here when assessing potential effects to the river.

Potential impacts were assessed under the assumption that the entire undiluted lagoon discharge is released to the South Saskatchewan River. Concentrations in the South Saskatchewan River after mixing with the lagoon effluent were estimated for April and October, when lagoon discharges are expected to occur. The estimates are highly conservative in that they used the maximum expected discharge flow rate as based on the 20-year design volume, maximum expected effluent concentrations corresponding to the effluent limits or the upper end of the WSA performance guideline ranges, whichever are higher, and seasonal average ambient concentrations estimated from the upstream or downstream ambient monitoring station, whichever represented the worse-case conditions.

Based on these results, adverse impacts to the South Saskatchewan River are unlikely for a new lagoon system with effluent meeting WSER and WSA effluent limits and performance guidelines and discharging

in either April or October. Specifically, exceedances of WQOs in the river after mixing with the effluent are unlikely for all parameters assessed, and stricter effluent discharge objectives are not required. A summary of the recommended EDOs is presented below in Table 4.

Table 4. Recommended Effluent Discharge Objectives

Parameter	Effluent Discharge Objective
cBOD	25 mg/L
BOD5	30 mg/L
Unionized NH_3	≤1.25 mg/L
TSS	25 mg/L
Total Coliforms	Fall: 20,000/100 mL Spring: 200,000/100 mL
Total N	Fall: 20 mg/L Spring: 35 mg/L
Total P	Fall: 5 mg/L Spring: 7 mg/L

Notes: EDOs are based on the WSER effluent limits and upper ends of the WSA performance guideline ranges for well operated lagoons, whichever are lower. The impact assessment did not indicate that stricter EDO need to be developed.

6.0 REFERENCES

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7.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Beardy's & Okemasis' Cree Nation c/o SAL Engineering Ltd. The report has been prepared in accordance with the Scope of Work and agreement between SLR and SAL. It is intended for the sole and exclusive use of SAL and the Beardy's & Okemasis' Cree Nation. Other than by Beardy's & Okemasis' Cree Nation and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion.

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Nothing in this report is intended to constitute or provide a legal opinion. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

Beardy's & Okemasis' Cree Nation may submit this report to the Saskatchewan Water Security Agency and/or related Saskatchewan and Federal environmental regulatory authorities or persons for review and comment purposes.

DRAWINGS

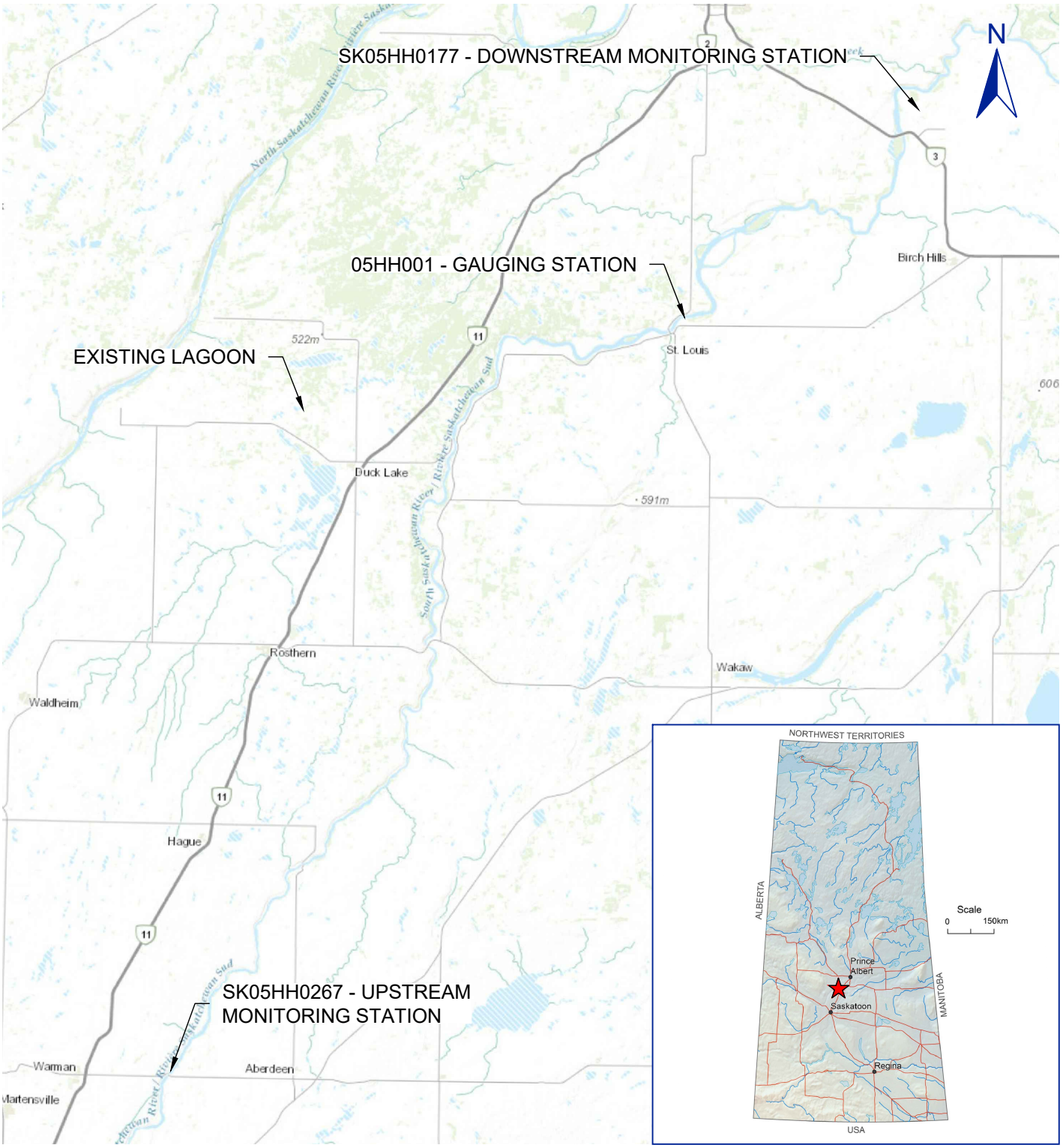
Downstream Use and Impact Study

SAL Engineering Ltd.

Beardy's & Okemasis' Cree Nation Sewage Lagoon Upgrade

Beardy's & Okemasis' Cree Nation

SLR Project No: 208.30030.00000



NOTES:
TOPOGRAPHIC MAP SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

0 5 10 20 30 km

SCALE 1:500,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 13N

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SAL ENGINEERING LTD.
BEARDY'S AND OKEMASIS CREE NATION LAGOON
BEARDY'S AND OKEMASIS CREE NATION, SASKATCHEWAN

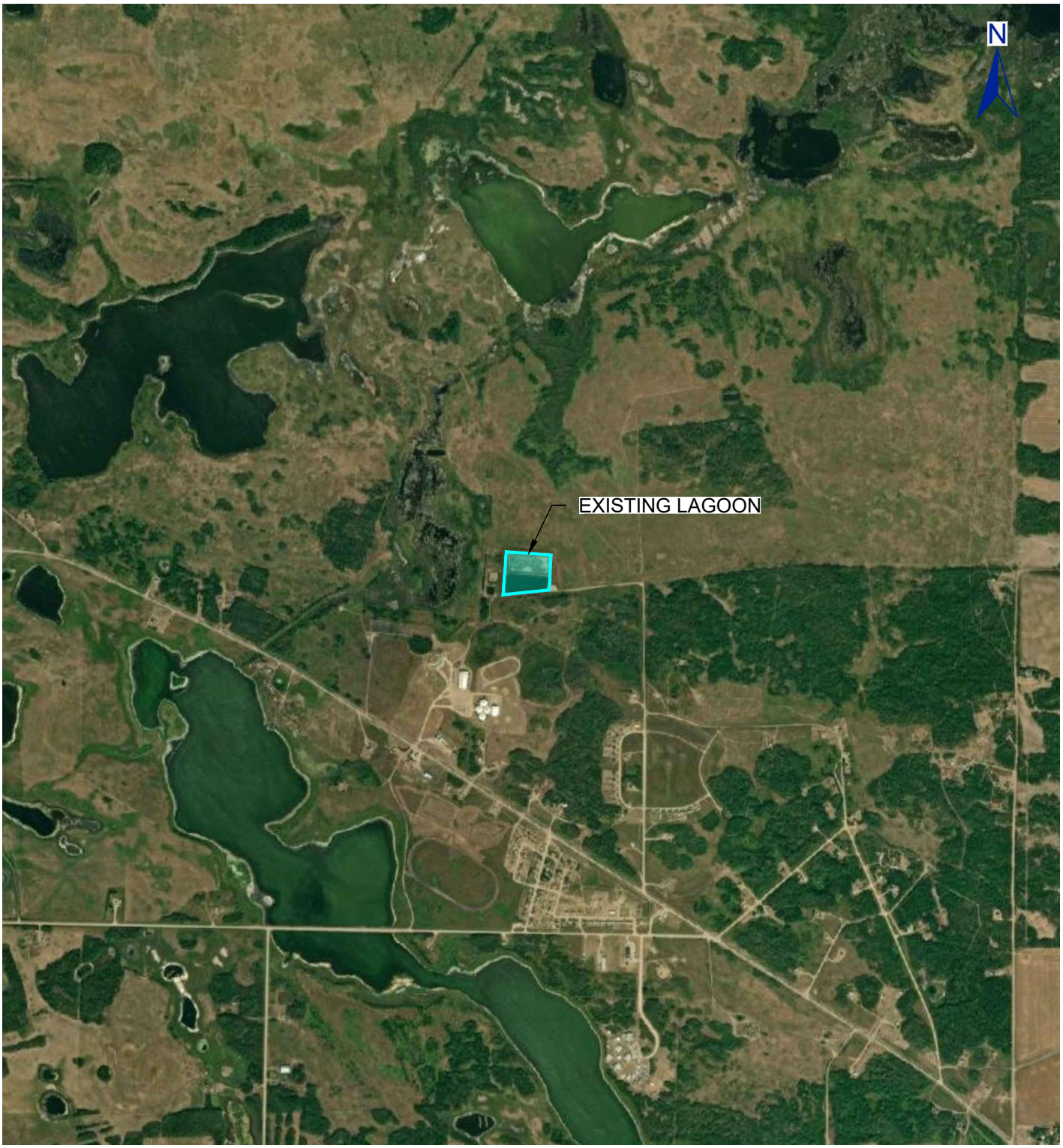
DOWNSTREAM USE AND IMPACT STUDY
BEARDY'S AND OKEMASIS CREE NATION LAGOON

SITE LOCATION PLAN

Date: April 22, 2022
Project No. 208.30030.00000

Drawing No. 1

Cadfile name: S_208-30030-00000-A1.dwg



NOTES:
IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.
IMAGE DATE: AUGUST 30, 2017

LEGEND:

EXISTING LAGOON

0 0.25 0.5 1.0 1.5 km

SCALE 1:25,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 13N

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SAL ENGINEERING LTD.
BEARDY'S AND OKEMASIS CREE NATION LAGOON
BEARDY'S AND OKEMASIS CREE NATION, SASKATCHEWAN

DOWNSTREAM USE AND IMPACT STUDY
BEARDY'S AND OKEMASIS CREE NATION LAGOON

SITE PLAN

Date: April 22, 2022
Project No. 208.30030.00000

Drawing No. 2

Cadfile name: S_208-30030-00000-A1.dwg

APPENDIX A

Environmental Mapping

Downstream Use and Impact Study

SAL Engineering Ltd.

Beardy's & Okemasis' Cree Nation Sewage Lagoon Upgrade

Beardy's & Okemasis' Cree Nation

SLR Project No: 208.30030.00000

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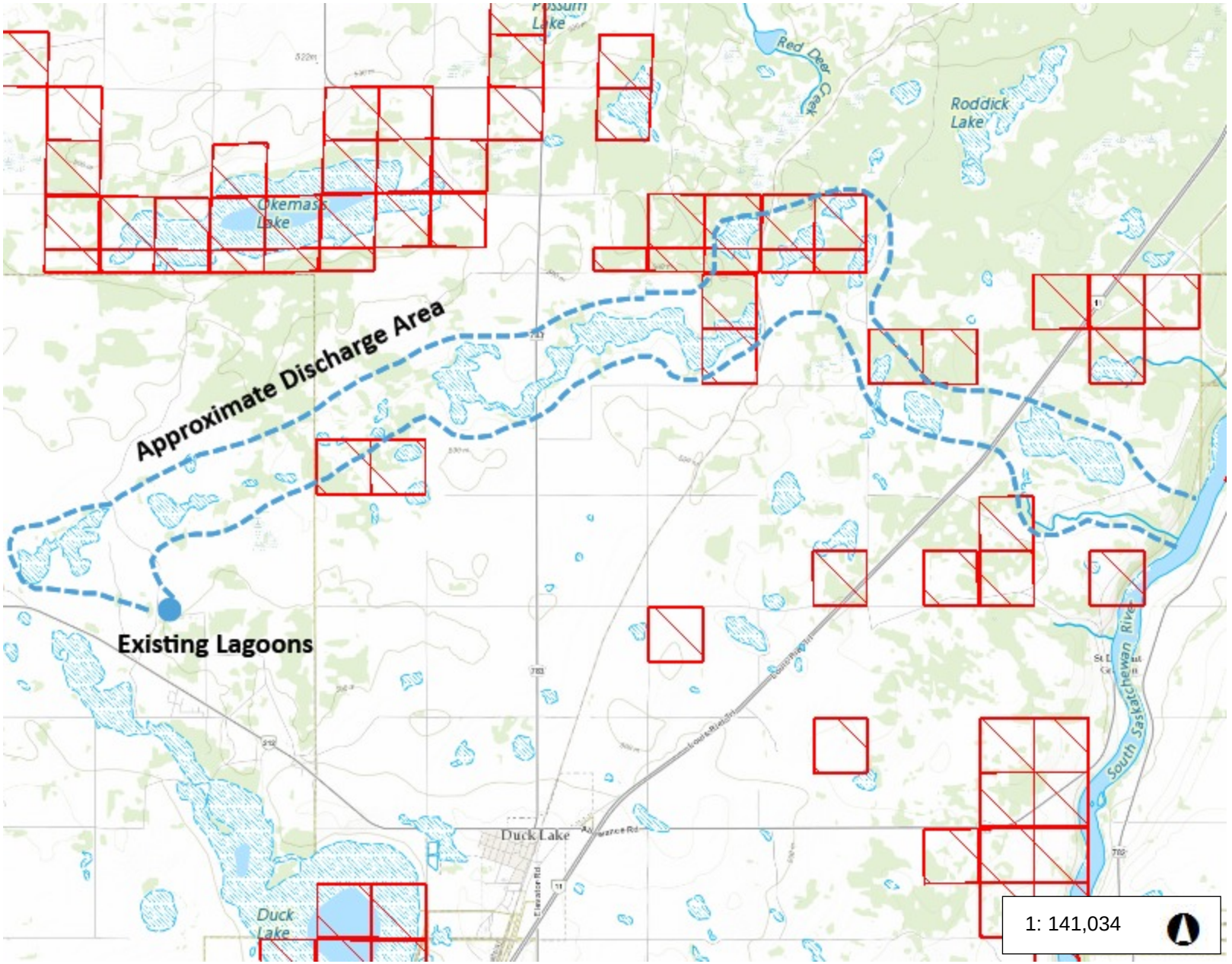
Agricultural Crown Land



Legend

- Provincial Boundary
- Agricultural Crown Land

Notes

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

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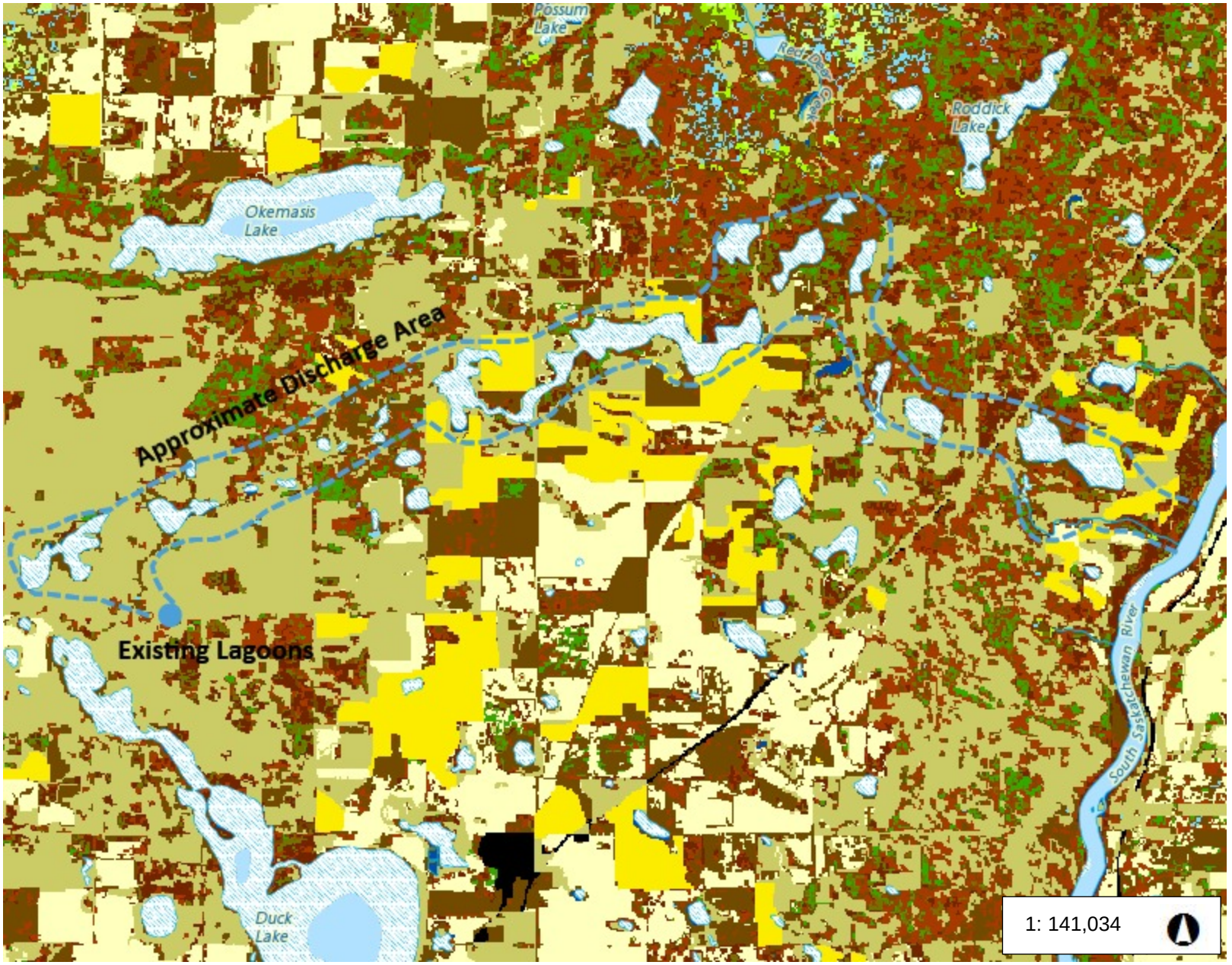
Land Cover and Use



Legend

- Provincial Boundary
- Important Natural Areas
- Sask Digital Land Cover
  - Agriculture
  - Hay Crops (Forage)
  - Native Dominant Grasslands
  - Tall Shrubs
  - Pasture (Seeded Grass Lands)
  - Hardwoods (Open Canopy)
  - Hardwoods (Closed Canopy)
  - Jackpine (Closed Canopy)
  - Jackpine (Open Canopy)
  - Spruce (Closed Canopy)
  - Spruce (Open Canopy)
  - Mixed Woods
  - Treed Rock
  - Recent Burns
  - Revegetating/Regeneration Burn
  - Cutovers
  - Water
  - Marsh
  - Herbaceous Fen
  - Mud/Sand/Saline
  - Shrub Fen (Treed Swamp)
  - Treed Bog
  - Open Bog

Notes

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

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THIS MAP IS NOT TO BE USED FOR NAVIGATION

Fisheries - Lake Report

South Saskatchewan River

Report Generated:
4/20/2022 2:37:32 PM

Fish Species

The following fish species are known to inhabit this waterbody:

Blacknose Dace	Brook Stickleback	Burbot	Cisco	Common Shiner
Emerald Shiner	Fathead Minnow	Finescale Dace	Flathead Chub	Goldeye
Iowa Darter	Lake Chub	Lake Sturgeon	Lake Whitefish	Longnose Dace
Longnose Sucker	Mooneye	Northern Pike	Pearl Dace	Quillback
Rainbow Trout	River Shiner	Sauger	Shorthead Redhorse	Silver Redhorse
Slimy Sculpin	Spoonhead Sculpin	Spottail Shiner	Trout-perch	Walleye
White Sucker	Yellow Perch			

Fish Stocking History

The following is a list of fish stocking activities for this waterbody:

Species	Size	Date	Number	Species	Size	Date	Number
Lake Sturgeon	Fingerlings	18-11-2008	11				

Mercury Consumption

Mercury is a naturally occurring element found in the earth's bedrock and soils and may enter the environment through industrial and human activities. Frequent consumption of fish with elevated mercury is a potential human health concern, especially for infants and unborn children who may be exposed to mercury through their mothers. Mercury consumption guidelines are expressed as the number of servings per month based on the size and species of fish. A serving size is considered to be 8 ounces, or half a pound. The sensitive population listed refers to women who are or could become pregnant, women who are breastfeeding, and children under the age of 12. All others belong to the general population listing.

Species	Population	< 20cm	20-30cm	30-40cm	40-50cm	50-60cm	60-70cm	70-80cm	> 80cm
Pike	General	16	16	16	8	8	4	4	
Pike	Sensitive	8	8	8	4	4	2	2	
Walleye	General	16	16	16	8	4	2		
Walleye	Sensitive	8	8	8	4	2	0		
Sauger	General	8	8	4	4	2			
Sauger	Sensitive	4	4	2	2	0			
Goldeye	General	8	8	2					
Goldeye	Sensitive	4	4	0					
Pike	Sensitive	4	4	4	4	2	2	2	0
Sauger	General	4	4	2	0	0	0		
Pike	General	8	8	8	8	4	4	4	2

Walleye	General	8	8	4	4	2	0	0
Goldeye	Sensitive	8	8	2	2			
Sauger	Sensitive	2	2	0	0	0	0	
Walleye	Sensitive	4	4	2	2	0	0	0
Goldeye	General	16	16	4	0			

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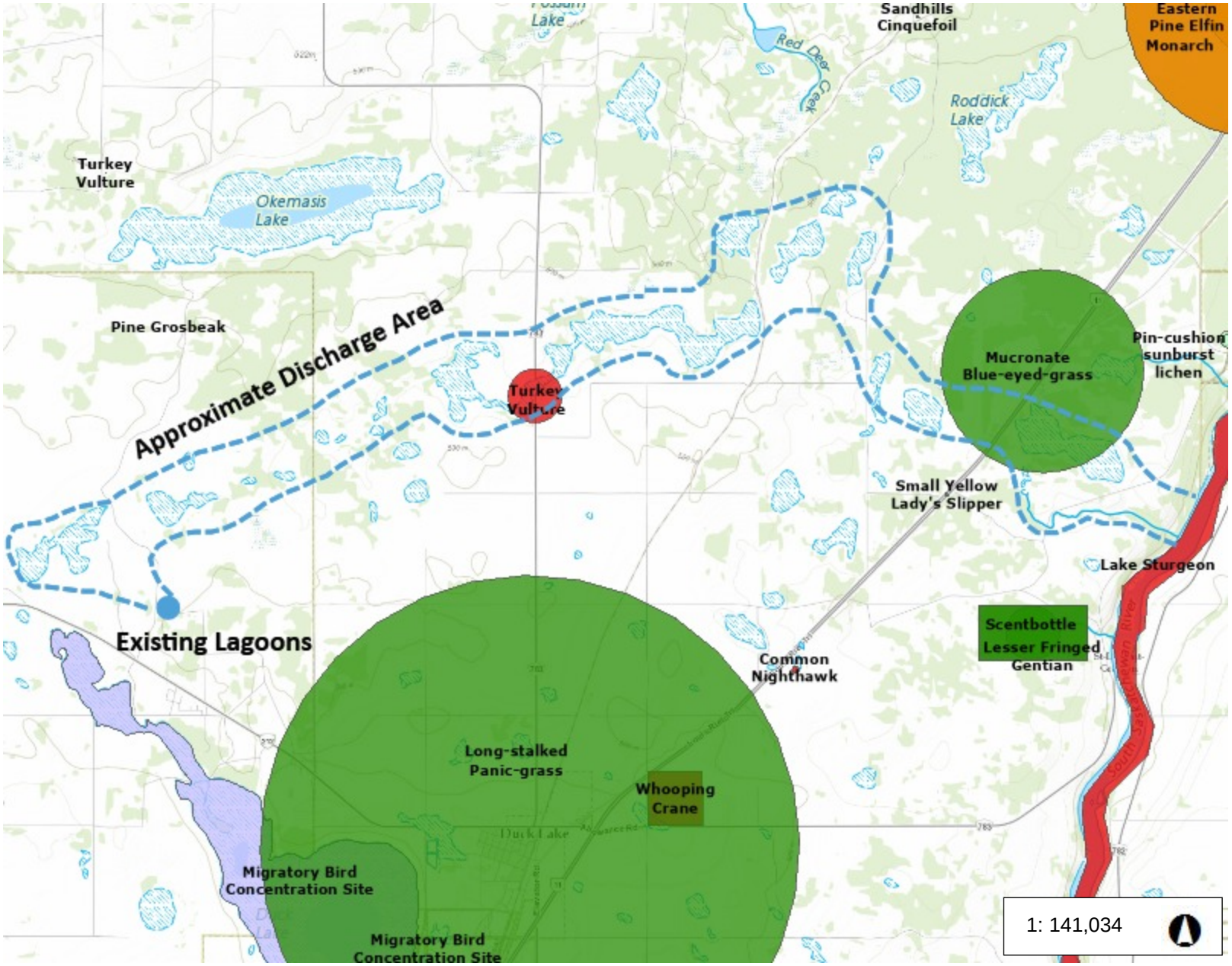
Rare and Endangered Species



Legend

- Provincial Boundary
- Rare and Endangered Species
  - Vertebrate Animal
  - Invertebrate Animal
  - Animal Assemblage
  - Vascular Plant
  - Nonvascular Plant
  - Other (Botanical)
  - Fungus

1: 141,034

Notes

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

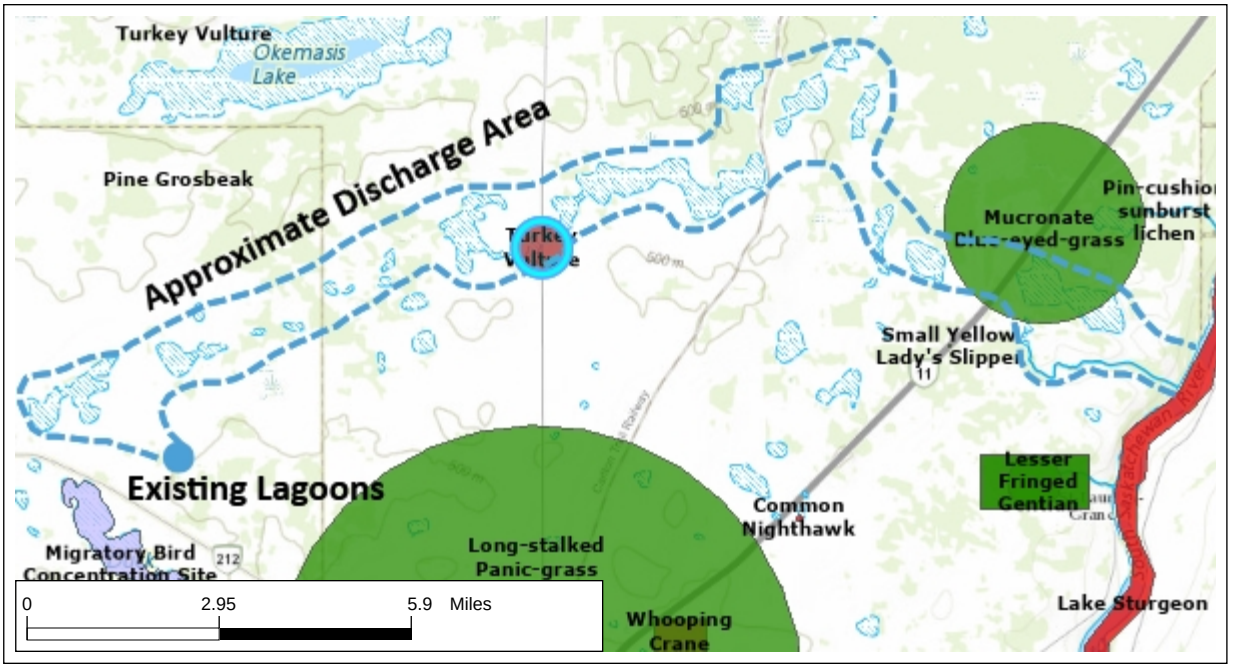
Rare and Endangered Species Report

Report Generated: 4/6/2022 1:22:47 PM

The absence of information provided by the Saskatchewan Conservation Data Centre (SKCDC) does not categorically mean the absence of sensitive species or features. The quantity and quality for data collected by the SKCDC are dependent on the research and observations of many individuals and organizations. SKCDC reports summarize the existing natural heritage information, known to the SKCDC, at the time of the request.

SKCDC data should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The user therefore acknowledges that the absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources.

Rare and Endangered Species Area of Interest



Rare and Endangered Species Report

Scientific Name: *Cathartes aura*
Common Name: Turkey Vulture
Provincial Rank: S3B **Global Rank:** G5
Observation: **First:** 2017-07-24 **Last:** 2017-07-24

Occurrence ID: 9999124653
Occurrence Class: Vertebrate Animal
Occurrence Type:
Occurrence Rank:

Provincial Legal Status:
Species at Risk Act Status:
COSEWIC Status:
General Description:
2 Adult(s) Unknown Sex; Breeding Bird Status: H; (2017)

Occurrence Data:

Directions:
Hwy 783 slough

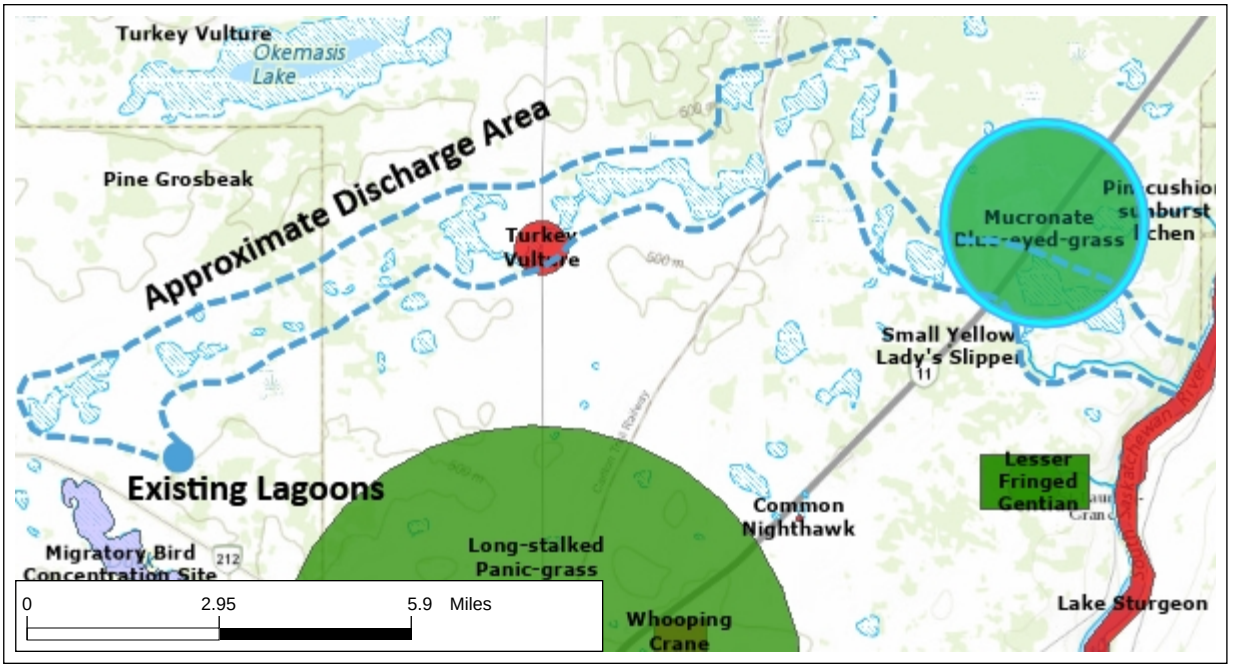
Rare and Endangered Species Report

Report Generated: 4/6/2022 1:24:22 PM

The absence of information provided by the Saskatchewan Conservation Data Centre (SKCDC) does not categorically mean the absence of sensitive species or features. The quantity and quality for data collected by the SKCDC are dependent on the research and observations of many individuals and organizations. SKCDC reports summarize the existing natural heritage information, known to the SKCDC, at the time of the request.

SKCDC data should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The user therefore acknowledges that the absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources.

Rare and Endangered Species Area of Interest



Rare and Endangered Species Report

Scientific Name: *Sisyrinchium mucronatum*
Common Name: Mucronate Blue-eyed-grass
Provincial Rank: S3 **Global Rank:** G5
Observation: **First:** 1952-06-14 **Last:** 1952-06-14

Provincial Legal Status:
Species at Risk Act Status:
COSEWIC Status:
General Description:

Occurrence ID: 16745
Occurrence Class: Vascular Plant
Occurrence Type:
Occurrence Rank: H - Historical

Occurrence Data:
1952- species observed in 1 site

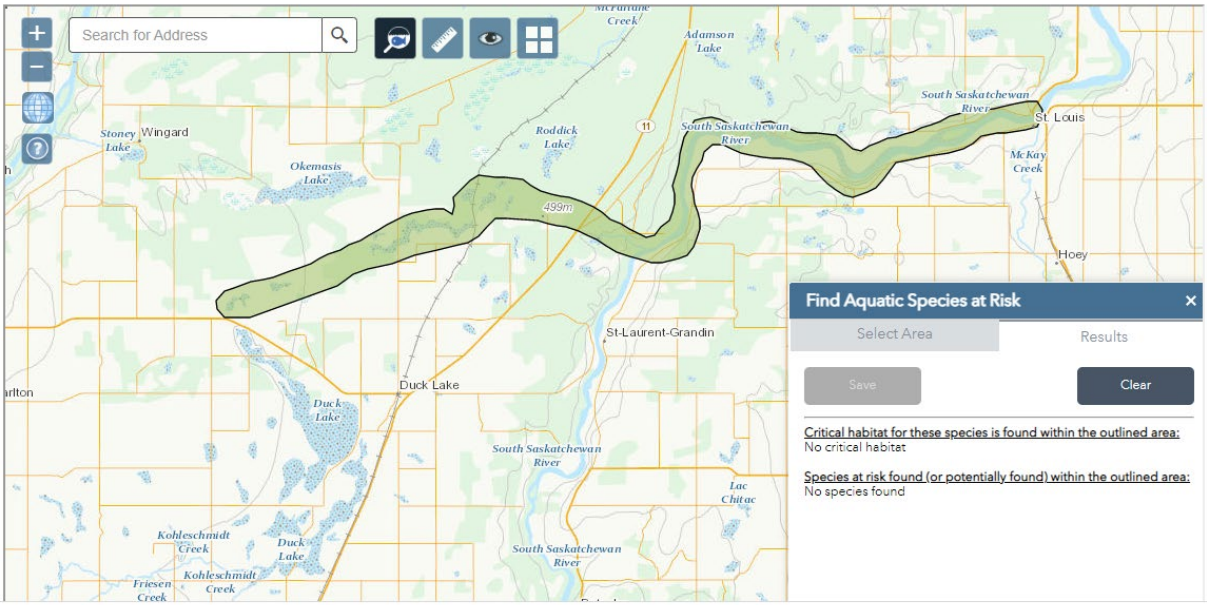
Directions:
6 mi NE of Duck Lake

Aquatic species at risk map

We've compiled critical habitat and distribution data for aquatic species listed under the Species at Risk Act (SARA). This map is intended to provide an overview of the distribution of aquatic species at risk and the presence of their critical habitat within Canadian waters. The official source of information is the Species at Risk Public Registry.

If you encounter an aquatic species at risk in an area that isn't currently mapped, please notify your regional Fisheries Protection Program office to ensure that you're compliant with SARA.

▶ **Information and legend**



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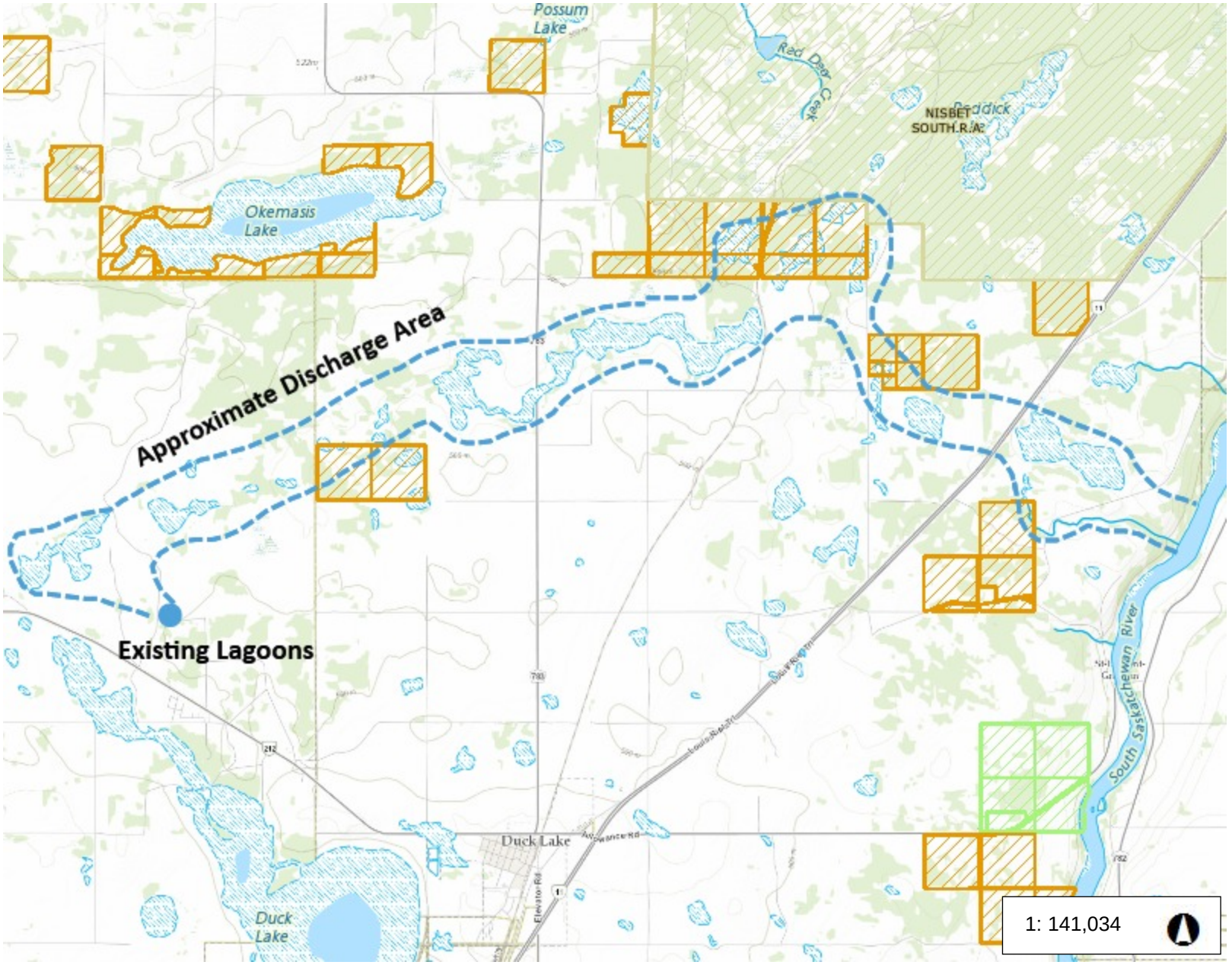
Managed Areas



Legend

- Provincial Boundary
- Important Natural Areas
- Water Security Agency
- Game Preserve
- National Wildlife Area
- Migratory Bird Sanctuary
- Conservation Easements
- Crown Land Subdivisions
- Ecological Reserves
- Fish and Wildlife Development
  - Managing Jurisdiction
  - Ducks Unlimited Canada
  - Ducks Unlimited Canada; Nature C
  - Government of Saskatchewan, Min
  - Nature Conservancy of Canada
  - Nature Conservancy of Canada; Sa Federation
  - Regina Fish & Game League
  - Saskatchewan Pheasants Forever
  - Saskatchewan Wildlife Federation
- Representative Areas
- Provincial Pastures
- Special Management Areas
- Wildlife Habitat Protection (WH
- Wildlife Refuge
- Crown Conservation Easemen

1: 141,034

Notes

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.
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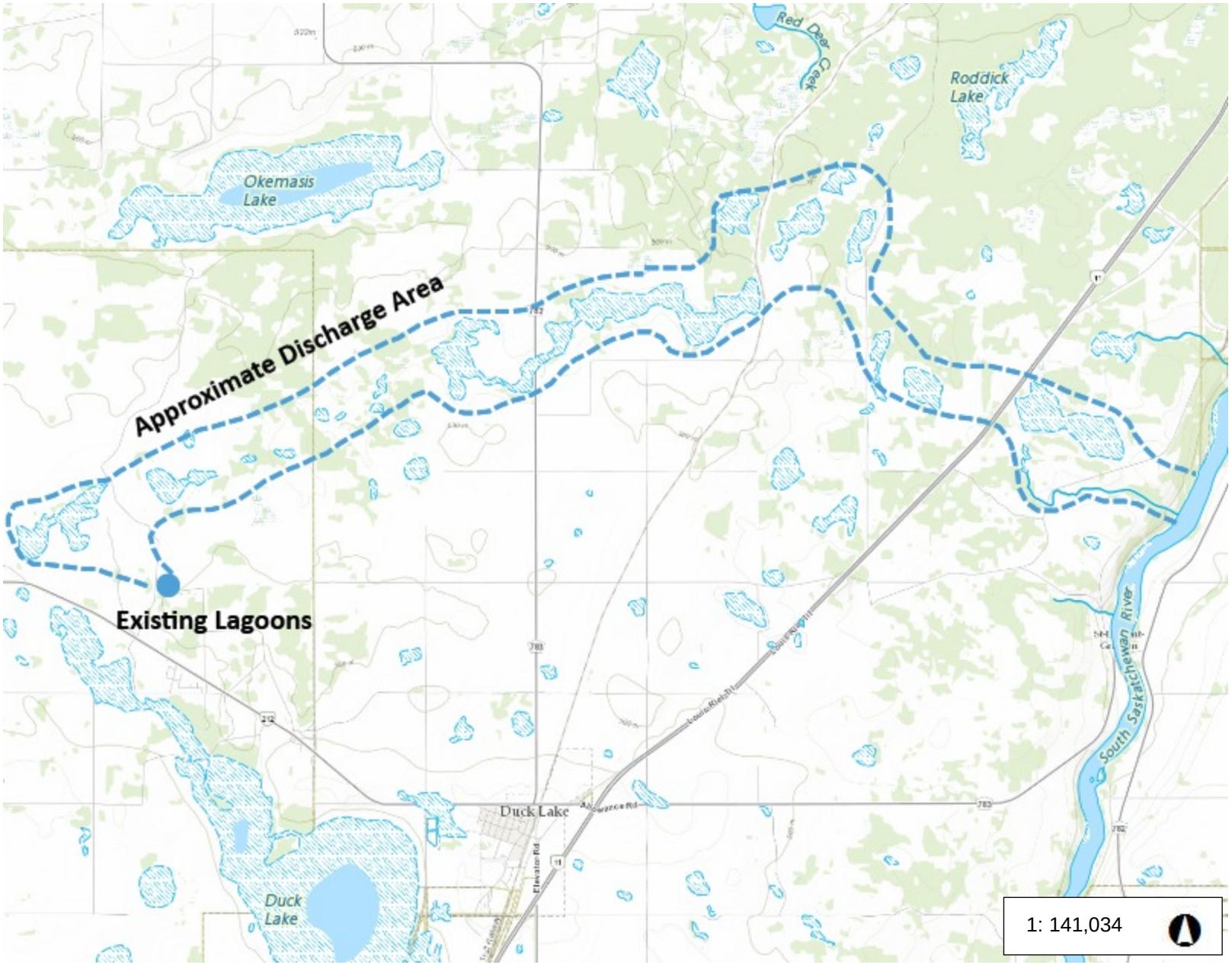
Federal Critical Habitat



Legend

- Provincial Boundary
- Black-footed Ferret
- Burrowing Owl (Generalized)
- Chestnut-collared Longspur
- Dusky Dune Moth
- Eastern Yellow-bellied Racer
- Gold-edged Gem
- Greater Sage-Grouse (Genera
- Greater Short-horned Lizard
- Loggerhead Shrike
- Mountain Plover
- Piping Plover
- Red-headed Woodpecker
- Red Knot
- Slender Mouse-ear Cress - Tra bursifolia ssp. Virgate
- Small-flowered Sand-verbena micranthus
- Smooth Goosefoot - Chenopoc
- Sprague's Pipit
- Swift Fox
- Tiny Cryptantha - Cryptantha n
- Western Spiderwort - Tradesca var. occidentalis

Notes

7.2 0 3.58 7.2 Kilometers

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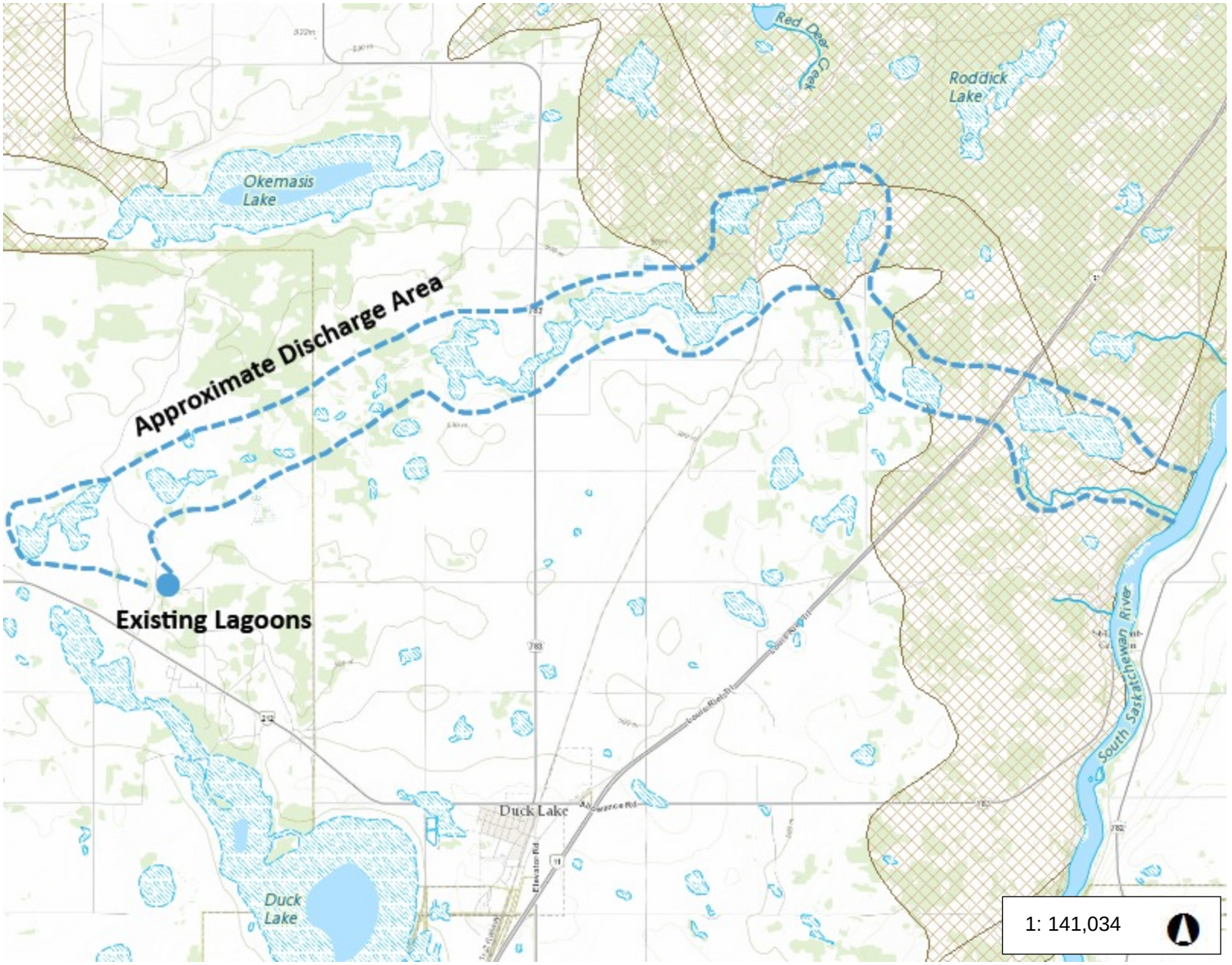
Terrestrial Wildlife Habitat



Legend

- Provincial Boundary
- Terrestrial Wildlife Habitat Inve

Notes

1: 141,034

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

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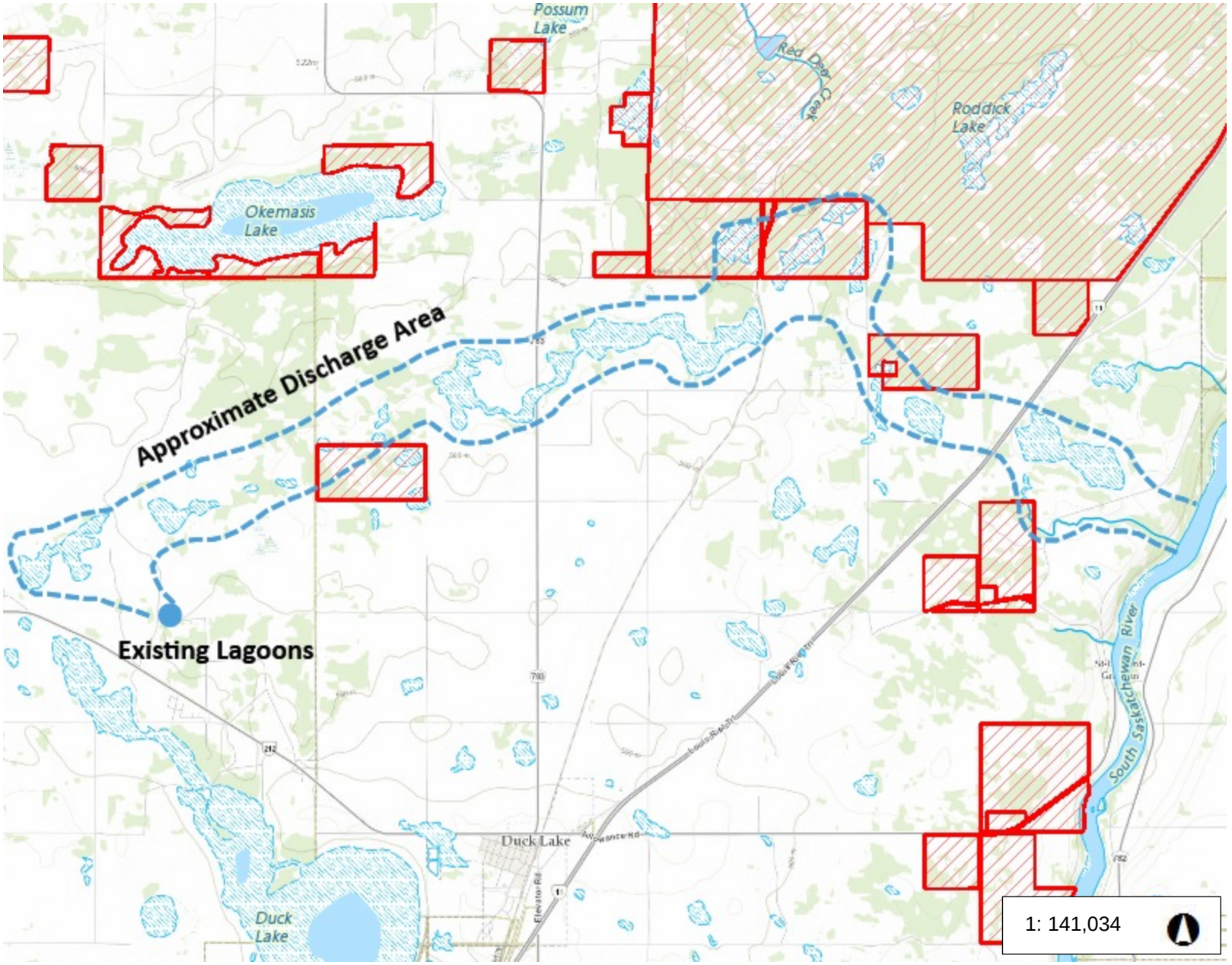
Parks



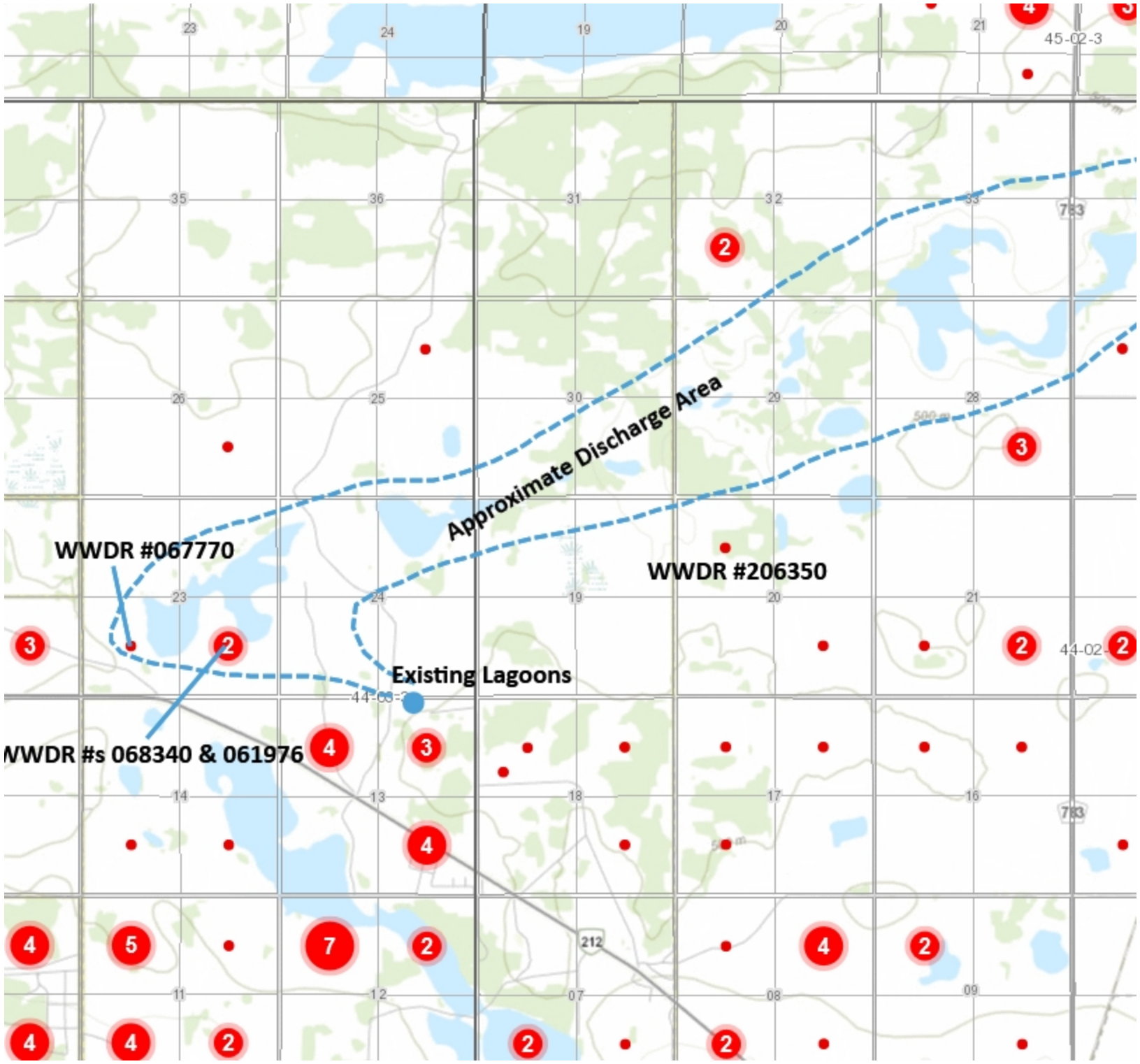
Legend

- Provincial Boundary
- Important Natural Areas
- Protected and Conserved Area
- National Park
- Provincial Park
- Recreation Site
- Protected Area
- Authority
- Historic Site
- Regional Park

Notes

7.2 0 3.58 7.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere



Water Wells Map

Notes

Projection:

WGS_1984_Web_Mercator_Auxiliary_Sphere

Scale:

1: 72,224

Date

13-Apr-22

Copyright:

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Water Security Agency

Water Well Driller's Report

13-Apr-2022
WSaskWWDR01

Well Name: BEARDYS IR WWDR #: 061976

Well Location

Land Location	SE-23-044 -03 -W3	Location of Well (in Quarter)	
LSD	00	0 ft from N/S Boundary	
Reserve		0 ft from E/W Boundary	
RM:			
NTS Map:	73B00	Major Basin:	06
Elevation (ft)	1650	SubBasin:	30
Aquifer			

Well Information

Driller	GLENWELL DRILLING LTD
Completion Date	1980.06.26
Hole #	001
Install Method	Bored
Borehole Depth (ft)	51
Bit Dia (in)	42
Water Level	20
Flowing Head	0
Water Use	Domestic
Well Use	Withdrawal
Completion Method	Curbed
E-Log	No

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
52	51	30	Copper Bearing Steel
0	0	0	
0	0	0	

Well Screens

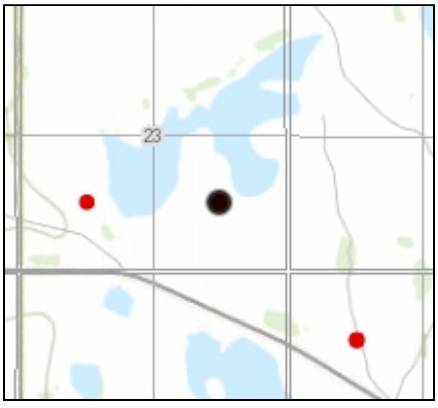
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	0	0	0	
0	0	0	0	
0	0	0	0	

Pump Test

Draw Down	0	ft
Duration	0	hrs
Pumping Rate	0	igpm
Temperature	0	deg. F
Rec. Pumping Rate	10	igpm

Lithology List

Depth (ft):	Material	Colour	Description
8	Sandy Clay	Brown	Unknown
15	Sand	Brown	Unknown
25	Clay	Black	Soft
30	Sand	Black	Silty
40	Sand	Unknown	Coarse
51	Clay	Black	Soft



Water Well Driller's Report

13-Apr-2022
WSaskWWDR01

Well Name: BEARDYS IR WWDR #: 067770

Well Location

Land Location	SW-23-044 -03 -W3	Location of Well (in Quarter)	
LSD	00	0	ft from N/S Boundary
Reserve		0	ft from E/W Boundary
RM:			
NTS Map:	73B00	Major Basin:	06
Elevation (ft)	1650	SubBasin:	30
Aquifer			

Well Information

Driller	GLENWELL DRILLING LTD
Completion Date	1981.07.15
Hole #	001
Install Method	Augered
Borehole Depth (ft)	41
Bit Dia (in)	5
Water Level	0
Flowing Head	0
Water Use	Domestic
Well Use	Water Test Hole
Completion Method	
E-Log	No

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
0	0	0	
0	0	0	
0	0	0	

Well Screens

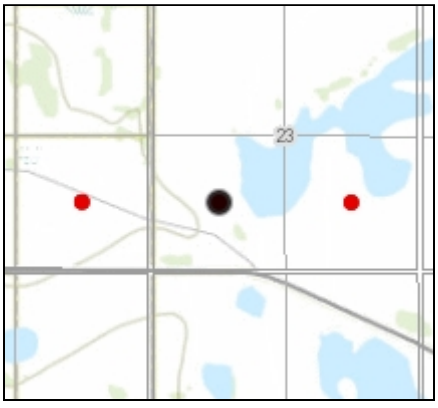
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	0	0	0	
0	0	0	0	
0	0	0	0	

Pump Test

Draw Down	0	ft
Duration	0	hrs
Pumping Rate	0	igpm
Temperature	0	deg. F
Rec. Pumping Rate	0	igpm

Lithology List

Depth (ft):	Material	Colour	Description
7	Sand	Unknown	Dry
14	Clay	Unknown	Dry
24	Clay	Unknown	Wet
38	Clay	Unknown	Dry
41	Sand	Unknown	Wet



Water Well Driller's Report

13-Apr-2022
WSaskWWDR01

Well Name: LAFONDE WWDR #: 068340

Well Location

Land Location	SE-23-044 -03 -W3	Location of Well (in Quarter)	
LSD	00	0	ft from N/S Boundary
Reserve		0	ft from E/W Boundary
RM:			
NTS Map:	73B00	Major Basin:	06
Elevation (ft)	1650	SubBasin:	30
Aquifer			

Well Information

Driller	GLENWELL DRILLING LTD
Completion Date	1981.08.28
Hole #	001
Install Method	Bored
Borehole Depth (ft)	31
Bit Dia (in)	6
Water Level	0
Flowing Head	0
Water Use	Domestic
Well Use	Withdrawal
Completion Method	Curbed
E-Log	No

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
33	31	30	Copper Bearing Steel
0	0	0	
0	0	0	

Well Screens

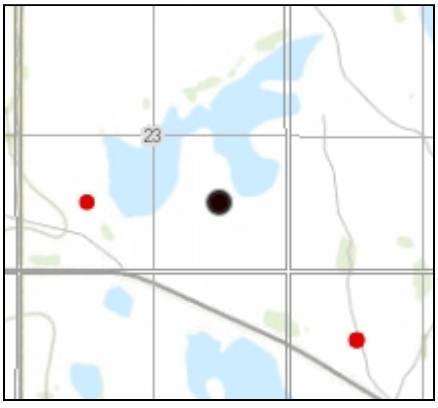
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
0	0	0	0	
0	0	0	0	
0	0	0	0	

Pump Test

Draw Down	0	ft
Duration	0	hrs
Pumping Rate	0	igpm
Temperature	0	deg. F
Rec. Pumping Rate	0	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Unknown
16	Sand	Yellow	Fine
25	Silt	Brown	Wet
31	Clay	Blue	Unknown



Water Well Driller's Report

13-Apr-2022
WSaskWWDR01

Well Name: TOURNIER WWDR #: 206350

Well Location

Land Location	NW-20-044 -02 -W3
LSD	00
Reserve	
RM:	463
NTS Map:	73B16
Elevation (ft)	1650
Aquifer	

Location of Well (in Quarter)

100	ft from N/S Boundary	S
400	ft from E/W Boundary	E

Major Basin:	06
SubBasin:	30

Well Information

Driller	D. SCHMIDT DRILLING
Completion Date	2006.06.14
Hole #	00000001
Install Method	Drilled
Borehole Depth (ft)	50
Bit Dia (in)	5.1
Water Level	12
Flowing Head	0
Water Use	Domestic
Well Use	Withdrawal
Completion Method	Well Screen And Gravel Pack
E-Log	No

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Material
29	28	4.5	P.V.C.
0	0	0	
0	0	0	

Well Screens

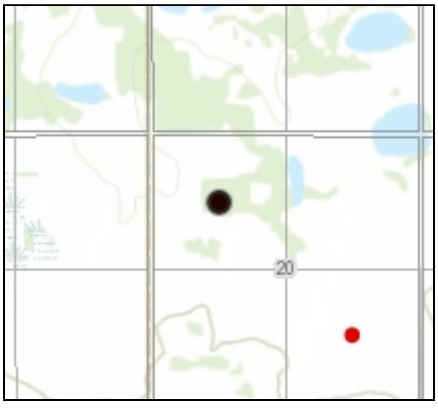
Length (ft)	Bottom (ft)	Dia (in)	Slot (in)	Material
5	33	5	10	Stainless Steel
0	0	0	0	
0	0	0	0	

Pump Test

Draw Down	4	ft
Duration	2	hrs
Pumping Rate	12	igpm
Temperature	0	deg. F
Rec. Pumping Rate	12	igpm

Lithology List

Depth (ft):	Material	Colour	Description
1	Topsoil	Unknown	Sandy
4	Sand	Yellow	Fine
13	Silty Clay	Yellow	Unknown
33	Sand	Yellow	Fine-medium
50	Silty Clay	Grey	Unknown



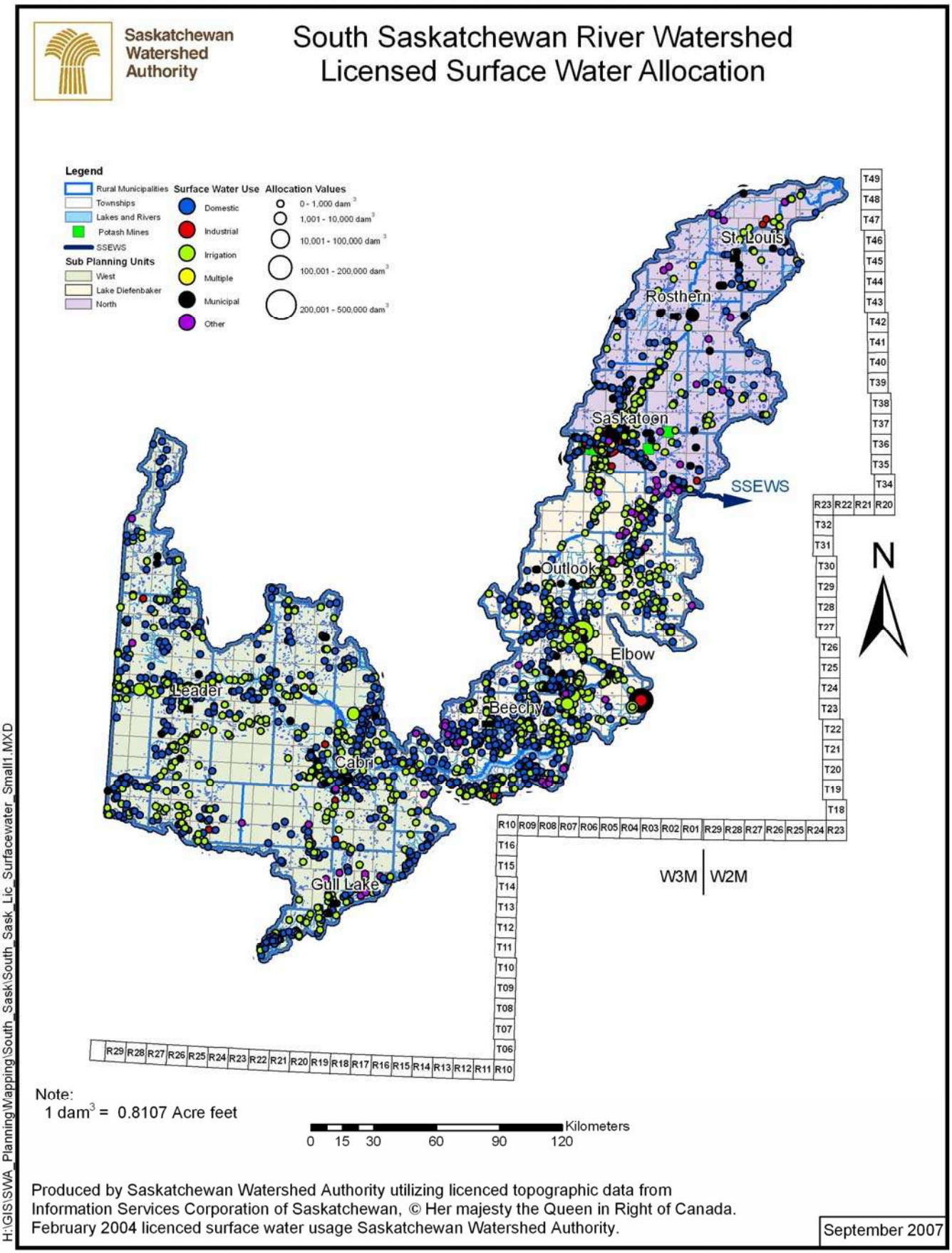


Figure 25: Licensed Surface Water allocation