



## Keeyask Generation Project Fisheries Offsetting and Mitigation Plan

# Lake Sturgeon Production and Stocking Report

FOMP-2022-01



# **KEEYASK GENERATION PROJECT**

## **FISHERIES OFF-SETTING AND MITIGATION PLAN**

REPORT #FOMP-2022-01

### **LAKE STURGEON PRODUCTION AND STOCKING SUMMARY FOR BIRTHDAY RAPIDS AND BURNTWOOD RIVER POPULATIONS**

**NOVEMBER 2020 TO SEPTEMBER 2021: YEAR 8 CONSTRUCTION**

Prepared for

Manitoba Hydro

By

C. Klassen, Y. Michaluk, S. Kirchmann, & L. Boudreau

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# SUMMARY

## BACKGROUND

Construction of the Keeyask Generation Project at Gull Rapids began in July 2014. Before government allowed construction to begin the Keeyask Hydropower Limited Partnership (KHLP) had to prepare a plan outlining activities that could reduce the potential effects of the Keeyask Generation Project on fish in the Nelson River (the Fisheries Offsetting and Mitigation Plan, FOMP). The plan also explained how the proposed activities would be completed and monitored.

Activities directed at Lake Sturgeon (*Namoo* in Cree) were included in the plan because of its importance to the partner First Nations, because the population in Gull and Stephens lakes were low before the Project, and because the generating station will change or destroy habitat used for spawning and early life stages both upstream and downstream.

In 2017, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) reviewed and maintained the previous (2006) recommendation of listing the Nelson River population of Lake Sturgeon as Endangered. The goal of the KHLP is to have self-sustaining populations of Lake Sturgeon in this area in the future. To help achieve this, the KHLP has made a commitment to produce and release hatchery-reared sturgeon into the Keeyask area (i.e., Keeyask reservoir and Stephens Lake) and the Burntwood River until there are self-sustaining populations. These two areas are stocked in alternate years using the offspring from adults captured at Birthday Rapids on the Nelson River and First Rapids on the Burntwood River.

This report describes the hatchery production and stocking activities of Lake Sturgeon from November 2020 to September 2021.



**Lake Sturgeon feeding on bloodworm at the Grand Rapids Fish Hatchery**

## STOCKING PROGRAM

Lake Sturgeon are produced at the Grand Rapids Fish Hatchery (GRFH) located in Grand Rapids, MB from the eggs and milt (sperm) of wild adults. Offspring are reared in fiberglass troughs using well water. Fish are started on a diet of newly hatched brine shrimp and later transitioned to frozen bloodworm.

Lake Sturgeon are released as yearlings (12 months old) after spending their first winter in the hatchery. However, due to limited tank space, it is often necessary to release some of the sturgeon as fingerlings (3 to 4 months old) prior to winter. In the past, the hatchery also stocked larvae (less than 1 month old) but are no longer able to do that due to current virus testing criteria which require that the sturgeon be at least 9 weeks old. Virus testing before stocking is necessary to ensure hatchery fish do not increase the amount of Namao Virus present in wild populations. The virus does not appear to effect adults but can cause mortality among young sturgeon.

Prior to release, yearlings are marked with uniquely numbered Passive Integrated Transponder (PIT) tags, inserted into the muscle along the fish's back. PIT tag scanners held over the fish can detect a tag and display the number on a screen. This marking technique helps to identify hatchery-reared fish caught in the river and can be used to assess the movement and growth of individual fish following stocking. Fish released as fingerlings are not large enough to be PIT tagged. Instead, tissue samples from individuals representing all family groups are preserved to provide a genetic 'fingerprint', allowing future identification of stocked individuals.



**PIT tagging activities at the Grand Rapids Fish Hatchery**

Since 2013, when the KHLP began producing Lake Sturgeon, larvae, fingerlings, yearlings and two-year old's have been stocked (see table below).

### Summary of Lake Sturgeon stocking in the Keeyask area since 2014

Year	Burntwood River			Keeyask Reservoir			Stephens Lake		
	Larvae	Fingerlings	Age-1+	Larvae	Fingerlings	Age-1	Larvae	Fingerlings	Age-1
2014	0	0	595	152,926	4,656	0	0	0	0
2015	0	0	0	0	0	423	0	0	418
2016	0	0	23	192,167	780	0	184,134	799	0
2017	71,740	3,765	0	0	0	463	0	0	720
2018	0	0	739	0	933	0	0	1,009	0
2019	0	3,681	0	0	0	398	0	0	390
2020	0	0	574	0	0	0	0	0	0
2021	0	0	188*	0	0	0	0	1,050	0
<b>Total</b>	<b>71,740</b>	<b>7,446</b>	<b>2,119</b>	<b>345,093</b>	<b>6,369</b>	<b>1,284</b>	<b>184,134</b>	<b>2,858</b>	<b>1,528</b>

\* 2-year old sturgeon

### BURNTWOOD RIVER POPULATION (2019 YEAR-CLASS)

#### Hatchery Production

Eggs and milt were collected in spring 2019 from spawning adults captured near First Rapids.

Due to the cancellation of the spring field activities in 2020 as a result of Covid-19, 382 yearlings were kept at the hatchery over summer. There were no mortalities prior to the fall stocking in September 2020.

A total of 192 Burntwood River yearlings remained at the hatchery for the 2020/21 winter. In late December 2020, the 2019 year-class was moved out of the main hatchery building and into the recently renovated Pickerel Place (previously referred to as the Service Garage) in order to accommodate on-going construction activities. Survival from the beginning of November 2020 until the spring stocking in June 2021 was over 97%.

#### Stocking

In spring 2021, a total of 188 Lake Sturgeon aged 2-years old were transported by truck to the Orr Creek boat launch and released from shore into the Burntwood River (see map below) on June 3 (95 sturgeon) and June 5 (93 sturgeon). On average, yearlings were 34 cm long and weighed 154 g.



**Release site for Burntwood River sturgeon (2019 year-class) stocked into the Burntwood River in spring 2021 (Site 1). Stocked sturgeon were the offspring of spawning adults collected near First Rapids (Site A).**

## **BIRTHDAY RAPIDS POPULATION (2021 YEAR-CLASS)**

### **Spawn Camp**

Wild Lake Sturgeon adults were captured using gill nets set downstream of Birthday Rapids in June 2021. Adults identified as spawning fish were maintained in tanks along the shore of the Nelson River for several days. Selected adults (1 female, 8 males) received a small dose of hormone to facilitate the release of eggs and milt. Use of this product does not present a threat to the Lake Sturgeon or to humans. The hormone is produced by the fish naturally and is present within their body during spawn. This method has been successfully used by other sturgeon conservation programs in North America and helps to synchronize egg and milt collection for fertilization.

The first sign of eggs was observed approximately 36 hours following hormone injection at 06:30 on June 11. A total of 400 ml of eggs (unfertilized) was collected and mixed with the milt from 4 males to create four family groups (F1xM3, F1xM5, F1xM6, F1xM8). Number of fertilized eggs transported to GRFH was estimated to be 40,750.

Following egg collection, recovery of the female was monitored closely and she was released in good health. The males were also released in good health following milt collection, with the exception of M4, which unfortunately did not survive after jumping out of the holding tank during the night. Virus testing of the broodstock revealed that M5 was positive for Namao Virus. All other broodstock and offspring tested negative for the virus.



## Hatchery Production

Prior to entering GRFH, the sturgeon eggs were soaked in a disinfectant for 10 minutes to kill any potential pathogens (e.g., viruses) that may have attached to the surface of the egg during fertilization and/or transportation. Five days following fertilization, eggs were checked for viability and the estimated hatch was low (35%). Immediately prior to hatch, all viable eggs were counted and total number of good eggs was 5,250 (13%).

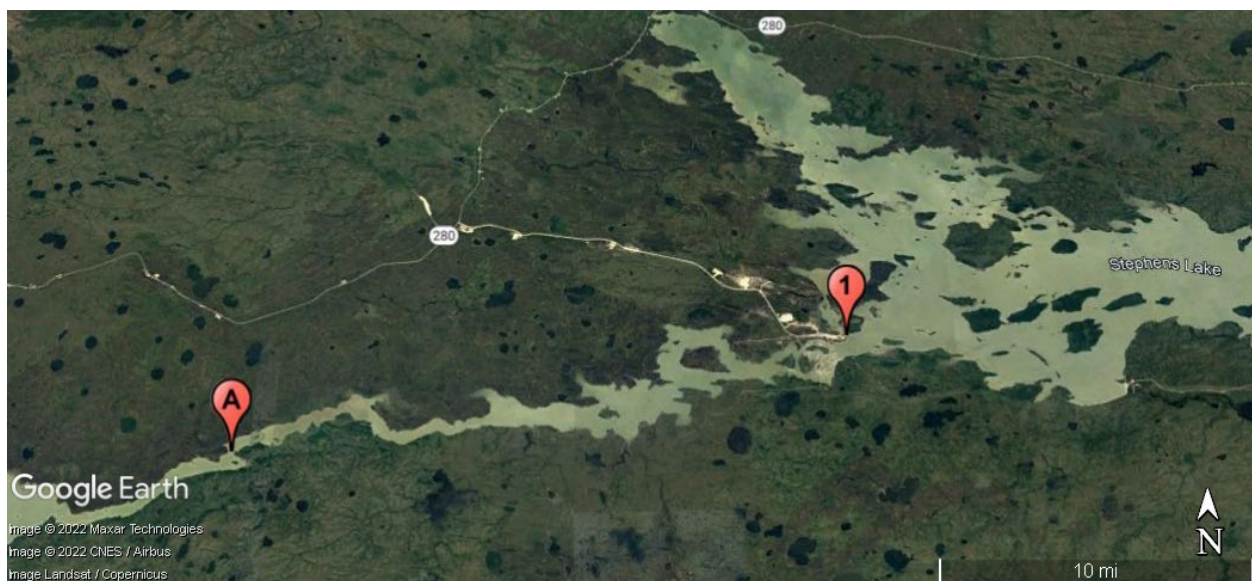
From the point of hatch to the end of September, monthly survival rates were greater than 80%, except for July where it was closer to 60%. Larvae were introduced to brine shrimp and transitioned to chopped bloodworm during July, a period when the highest mortalities are typically observed. The F1xM5 family had the lowest hatch rate (<1%) and no offspring survived past July 13.

Following the fingerling release in September, a total of 799 fish from the Birthday Rapids population were kept at GRFH for further growth over winter.

## Stocking

On September 28, 2021 a total of 1,050 fingerlings (F1xM3 = 325; F1xm8 = 425) were transported by truck to the downstream boat launch at Keeyask and released from shore into Stephens Lake (Site 1, see map below).

Fingerlings had an average total length of 11 cm (range: 9 to 13 cm) and average weight of 5.0 g (range: 2.8 to 7.7 g).



**Release site for Birthday Rapids sturgeon (2021 year-class) stocked into Stephens Lake in fall 2021 (Site 1). Stocked sturgeon were the offspring of spawning adults collected near Birthday Rapids (Site A).**



## **STOCKING RESULTS**

Since the stocking program began in 2013 a total of 600,967 larvae, 16,673 fingerlings, 4,743 yearlings and 188 sturgeon aged 2-years have been released by GRFH for the KHLP. Annual monitoring programs being conducted by the KHLP in the Keeyask and Upper Split Lake areas have captured a total of 550 hatchery-reared sturgeon released as yearlings. Annual survival of stocked yearlings in Stephens Lake, Keeyask reservoir and Upper Split Lake area has been estimated to be 78%, 92% and 91%, respectively.

## **FUTURE ACTIVITIES**

Hatchery-reared sturgeon from the Birthday Rapids population (2021 year-class) will be released in spring 2022, pending provincial approval. Egg and milt collection from wild adults will take place near First Rapids along the Burntwood River in spring 2022.

Upgrades to the infrastructure at GRFH are expected to be completed by summer 2022.

# PRODUCTION AND STOCKING TEAM

## Grand Rapids Fish Hatchery

- Yhana Michaluk, Fish Culture Supervisor
- Shaun Kirchmann, Senior Fish Culturist
- Luc Boudreau, Senior Fish Culturist
- Jerry Cook, Fish Culturist
- Morgan Blacksmith, Fish Culturist
- Tobias Dolinski, Fish Culturist
- Cory Ferland, Fish Culturist
- Jesse Scott, Assistant Fish Culturist
- Emily Cook, Assistant Fish Culturist

## Environmental Licensing and Protection

- Shelley Matkowski, Department Manager
- Warren Coughlin, Senior Environmental Specialist
- Cheryl Klassen, Environmental Specialist

# TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
<b>2.0</b>	<b>BURNTWOOD RIVER POPULATION (2019 YEAR-CLASS).....</b>	<b>6</b>
2.1	PAST PRODUCTION AND STOCKING.....	6
2.2	PRODUCTION.....	7
2.2.1	Winter.....	7
2.3	STOCKING.....	10
2.3.1	Spring.....	10
<b>3.0</b>	<b>BIRTHDAY RAPIDS POPULATION (2021 YEAR-CLASS).....</b>	<b>12</b>
3.1	SPAWN CAMP.....	12
3.1.1	Broodstock Collection .....	12
3.1.2	Egg and Milt Collection .....	13
3.1.3	Broodstock Health .....	14
3.2	PRODUCTION.....	15
3.2.1	Egg Incubation and Hatch.....	15
3.2.2	Larvae and Fingerlings.....	15
3.3	STOCKING.....	18
3.3.1	Fall.....	18
<b>4.0</b>	<b>POST-STOCKING RECAPTURES .....</b>	<b>20</b>
<b>5.0</b>	<b>PRODUCTION AND STOCKING ACTIVITIES IN 2021/22.....</b>	<b>22</b>
<b>6.0</b>	<b>SUMMARY AND CONCLUSIONS.....</b>	<b>23</b>
<b>7.0</b>	<b>LITERATURE CITED.....</b>	<b>24</b>



# LIST OF TABLES

Table 1:	Summary of Lake Sturgeon stocking in the lower Nelson and Burntwood rivers since 2014 .....	3
Table 2:	Number of Burntwood River sturgeon (2019 year-class) released into the Burntwood River in 2021 .....	11
Table 3:	Broodstock tag numbers, weight and GnRH dose used during gamete collection on the Nelson River downstream of Birthday Rapids, June 2021 .....	12
Table 4:	Number of Birthday Rapids sturgeon (2021 year-class) released into Stephens Lake in 2021 .....	19
Table 5:	Number of PIT tagged hatchery-reared Lake Sturgeon stocked into the lower Nelson and Burntwood rivers and number recaptured between 2014 and 2021.....	20
Table A1-1:	Survival (%) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021 .....	28
Table A1-2:	Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Burntwood River (2019 year-class) reared at Grand Rapids Fish Hatchery.....	29
Table A1-3:	Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Burntwood River Lake Sturgeon (2019 year-class) reared at Grand Rapids Fish Hatchery .....	30
Table A1-4:	Biological and PIT tag information for hatchery-reared Lake Sturgeon aged 2-years released into the Burntwood River in 2021.....	31
Table A2-1:	Survival (%) of Birthday Rapids sturgeon (2021 year-class) at GRFH from June 21 (hatch) to September 30, 2021 .....	39
Table A2-2:	Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Birthday Rapids (2021 year-class) reared at Grand Rapids Fish Hatchery .....	40
Table A2-3:	Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Birthday Rapids sturgeon (2021 year-class) reared at Grand Rapids Fish Hatchery.....	41
Table A3-1:	Reported Lake Sturgeon threshold values for Dissolved Oxygen, Dissolved Carbon Dioxide, pH, Ammonia-Nitrogen and Nitrite Nitrogen .....	43

# LIST OF FIGURES

Figure 1:	Monthly survival (%) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021.....	7
Figure 2:	Water temperatures (°C) in rearing troughs holding Burntwood River (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021 .....	7
Figure 3:	Average, minimum and maximum rearing density (fish per m <sup>2</sup> ) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021.....	8
Figure 4:	Average, minimum and maximum monthly dissolved oxygen (DO), dissolved carbon dioxide (dCO <sub>2</sub> ), pH, un-ionized ammonia (UIA) and nitrite-nitrogen (NO <sub>2</sub> -N) values in rearing systems holding Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021 .....	9
Figure 5:	Average, minimum and maximum total length (mm) and weight (g) for Burntwood River sturgeon (2019 year-class) at GRFH from November 2020 to the end of May 2021 .....	10
Figure 6:	Monthly survival (%) of Birthday Rapids sturgeon (2021 year-class) at GRFH from June 21 to the end of September, 2021. Fish euthanized due to sampling events were excluded from monthly survival rates. ....	15
Figure 7:	Water temperature (°C) in rearing troughs holding Birthday Rapids sturgeon (2021 year-class) at GRFH from June 11 to the end of September, 2021 .....	16
Figure 8:	Average, minimum and maximum rearing density (fish per m <sup>2</sup> ) of Birthday Rapids sturgeon (2021 year-class) at GRFH from the end of July to the end of September, 2021 .....	16
Figure 9:	Average, minimum and maximum monthly dissolved oxygen (DO), dissolved carbon dioxide (dCO <sub>2</sub> ), pH, un-ionized ammonia (UIA) and nitrite-nitrogen (NO <sub>2</sub> -N) values in rearing troughs holding Birthday Rapids sturgeon (2021 year-class) at GRFH from June to the end of September, 2021 .....	17
Figure 10:	Average, minimum and maximum total length (mm) and weight (g) for Birthday Rapids sturgeon (2021 year-class) at GRFH from July to the end of September, 2021 .....	18

## LIST OF MAPS

Map 1:	Location of Keeyask Generation Project and Grand Rapids Fish Hatchery.....	2
Map 2:	Stocking location for Burntwood River sturgeon (2019 year-class) released into the Burntwood River in spring 2021. First Rapids is marked 'A' .....	11
Map 3:	Stocking locations for Birthday Rapids sturgeon (2021 year-class) released into Stephens Lake in fall 2021. Birthday Rapids is marked 'A' .....	19

## LIST OF PHOTOS

Photo 1:	Rearing troughs used for Lake Sturgeon production at GRFH prior to Jan 2021.....	4
Photo 2:	New water recirculating aquaculture systems in Pickerel Place.....	5
Photo 3:	Equipment used to test dissolved oxygen (A), dissolved carbon dioxide (B), pH (C), total ammonia nitrogen (D) and nitrite-nitrogen (D) at GRFH.....	8
Photo 4:	Broodstock holding tanks at the Birthday Rapids spawn camp, June 2021 .....	13
Photo 5:	Fingerlings prior to being released in fall, 2021 .....	19

## LIST OF APPENDICES

Appendix 1: Burntwood River (2019 Year-Class).....	27
Appendix 2: Birthday Rapids (2021 Year-Class).....	38
Appendix 3: Water Quality Thresholds .....	42



# 1.0 INTRODUCTION

In June 2012, the Keeyask Hydropower Limited Partnership (KHLP) filed an Environmental Impact Statement (EIS) in support of the Keeyask Generation Project (the Project), a 695 megawatt hydroelectric generating station (GS) to be built at Gull Rapids on the Nelson River (Map 1). Construction of the Project began in July 2014 following regulatory approval.

As discussed in the EIS, construction and operation of the Project will result in the alteration and destruction of Lake Sturgeon habitat, thereby potentially affecting regional populations.

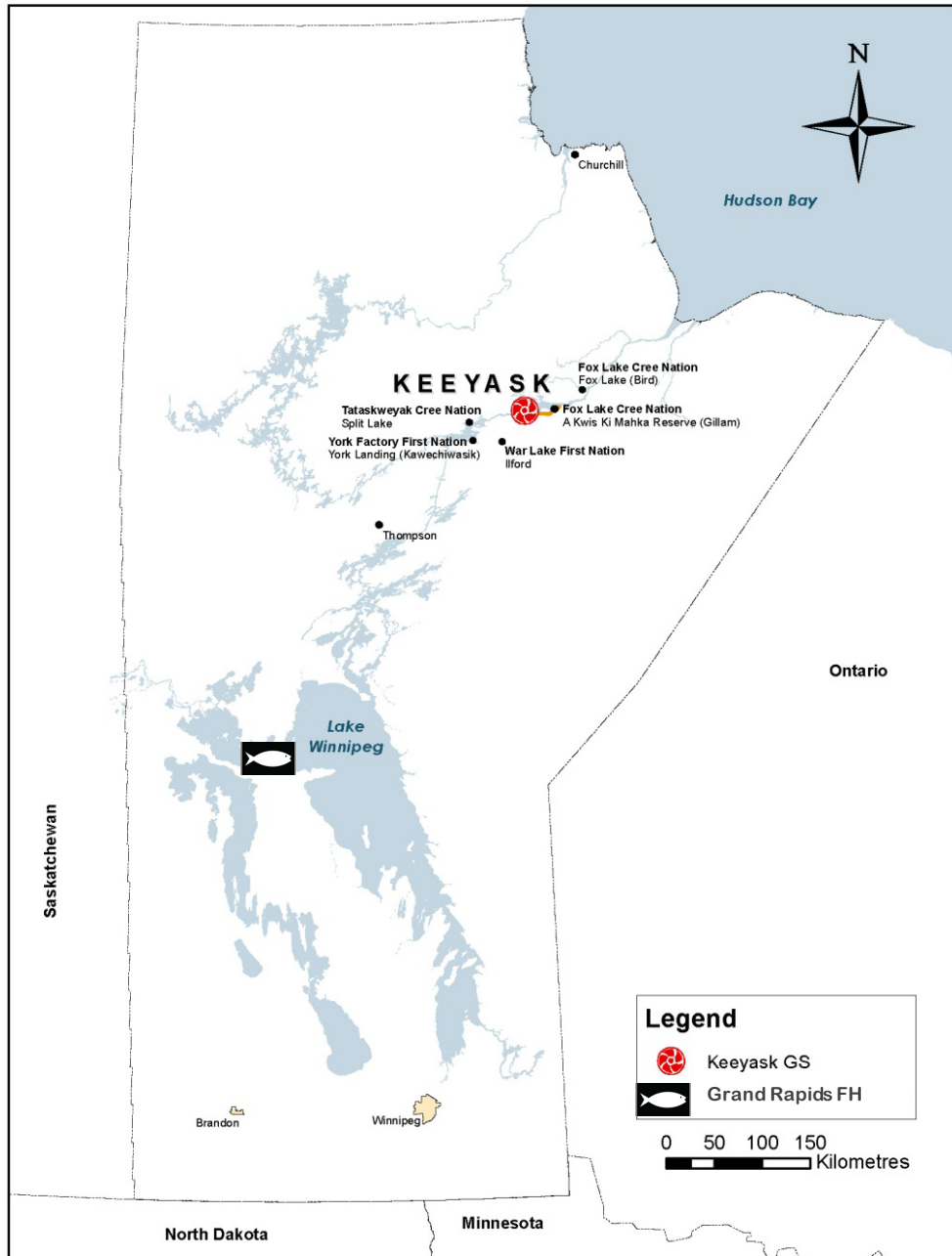
To mitigate impacts of the Project, the KHLP has developed a strategy that involves several components, including:

- management measures during construction to avoid mortality of sturgeon;
- stocking of sturgeon into Stephens Lake during construction to offset potential effects of the loss of spawning habitat in Gull Rapids;
- spawning habitat creation in the tailrace of the GS;
- alternations to habitat upstream of Birthday Rapids, if post-Project monitoring demonstrates that this area is no longer suitable for spawning sturgeon;
- creation of young-of-the-year rearing habitat at the upper end of Gull Lake following impoundment, if post-Project monitoring demonstrates that suitable habitat is not available;
- on-going studies to determine requirements (if any) for upstream fish passage;
- the use of monitoring of downstream movements and mortality to determine the need for any additional fish protection measures related to downstream passage at the GS;
- a conservation stocking program, with the objective of re-establishing a self-sustaining Lake Sturgeon population; and
- a conservation awareness program, highlighting the vulnerability of Lake Sturgeon.

Stocking was identified as being critically important because Stephens Lake may be able to support more Lake Sturgeon than are currently present. Therefore, a conservation stocking plan for the lower Nelson and Burntwood rivers was designed to address:

- existing low population numbers due to historic effects;
- potential effects of creation of the Keeyask reservoir, including possible emigration of adult Lake Sturgeon in response to water level changes at impoundment, and reduced year-class strength in the initial years of impoundment due to changes in spawning and young-of-the-year habitat. These effects are predicted to be restricted to the first years of impoundment, if they occur at all; and

- potential decrease in year-class strength of sturgeon in Stephens Lake, due to the alteration and ultimate loss of spawning habitat in Gull Rapids during construction of the GS. This effect is offset during the operation phase by the constructed spawning habitat.



**Map 1: Location of Keeyask Generation Project and Grand Rapids Fish Hatchery**

An initial 10-year stocking plan was developed and described in the Fisheries Offsetting and Mitigation Plan (FOMP). During the initial 10-year plan, the number of sturgeon released at each developmental stage (larval, fingerling and yearling) will be dependent upon:

- the number of Lake Sturgeon available at each developmental stage;
- the amount of hatchery space available to enable ‘normal’ growth of fish; and
- the end goal of maintaining 2,000 fingerlings annually through the winter to be released as yearlings the following spring.

Lake Sturgeon stocking in the lower Nelson and Burntwood rivers began in 2014 and has included the release of multiple stages over the years (Table 1).

**Table 1: Summary of Lake Sturgeon stocking in the lower Nelson and Burntwood rivers since 2014**

Year	Burntwood River			Keeyask Reservoir <sup>a</sup>			Stephens Lake		
	Larvae	Fingerlings	Age-1+	Larvae	Fingerlings	Age-1	Larvae	Fingerlings	Age-1
2014	0	0	595	152,926	4,656	0	0	0	0
2015	0	0	0	0	0	423	0	0	418
2016	0	0	23	192,167	780	0	184,134	799	0
2017	71,740	3,765	0	0	0	463	0	0	720
2018	0	0	739	0	933	0	0	1,009	0
2019	0	3,681	0	0	0	398	0	0	390
2020	0	0	574	0	0	0	0	0	0
2021	0	0	188 <sup>b</sup>	0	0	0	0	1,050	0
<b>Total</b>	<b>71,740</b>	<b>7,446</b>	<b>2,119</b>	<b>345,093</b>	<b>6,369</b>	<b>1,284</b>	<b>184,134</b>	<b>2,858</b>	<b>1,528</b>

<sup>a</sup> previously referred to as Gull Lake and the future Keeyask Reservoir

<sup>b</sup> two-year old sturgeon

The Keeyask Fisheries Regulatory Review Committee (which also undertakes the role of Lake Sturgeon Advisory Committee as described in the *Environment Act* licence) may decide to modify the stocking plan based on annual monitoring activities.

Lake Sturgeon stocking in the lower Nelson and Burntwood rivers will continue until self-sustaining populations are established. At present, it is anticipated that stocking will occur for at least one full generation (25 years) to restore the historically depleted population.

To meet the goals outlined in the FOMP, the KHLP is stocking Lake Sturgeon hatched at the Grand Rapids Fish Hatchery (GRFH). The hatchery, located in the community of Grand Rapids, MB (Map 1), was constructed in the early 1970's by the province of Manitoba. The building was originally configured for production of Walleye, Whitefish and a variety of trout species. In 1994, GRFH began producing Lake Sturgeon for the Nelson River Sturgeon Board, in support of efforts to conserve populations in the upper Nelson River.

Manitoba Hydro purchased GRFH in 2007 and the facility was operated in partnership with Manitoba Conservation and Water Stewardship (now Agriculture & Resource Development) through a Joint Management Committee. At the end of 2012, Manitoba Hydro assumed full operation of the hatchery and currently employs 7 permanent and 2 seasonal staff. Operations and regulatory matters are overseen by Manitoba Hydro's Environmental Licensing and Protection Department. Building and equipment maintenance is conducted in partnership with the



Grand Rapids Generating Station. Since 2012, GRFH has focused its production efforts exclusively on Lake Sturgeon and Walleye.

Prior to January 2021, the facility housed 18 gray fiberglass rearing troughs measuring 4.6 x 0.55 x 0.25 m (L x W x H; Photo 1). The troughs were configured to permit the use of both well water and surface water (Cedar Lake). However, operations are restricted to well water use only due to the potential presence of pathogens (e.g., viruses) within the surface water. Large concrete floor tanks, originally used for fish production, served as water reservoirs in a simple sump pump operated water re-circulation system. Well water temperature (approximately 5°C) was warmed using ambient room temperature and submersible water heaters.



**Photo 1: Rearing troughs used for Lake Sturgeon production at GRFH prior to Jan 2021**

Total usable rearing area for Lake Sturgeon was approximately 46 m<sup>2</sup>. Rearing space was shared between the two stocking programs: Keeyask Generation Project and the Nelson River Sturgeon Board.

To meet future annual stocking targets, Manitoba Hydro is upgrading and expanding rearing capacity at GRFH. In March 2014, a facility assessment was completed by HDR Inc. which confirmed that the existing infrastructure could not meet projected Lake Sturgeon production commitments. Upgrades were also necessary to attain national and provincial biosecurity standards and recommendations to reduce the risk of pathogens from entering and spreading within the facility.

Planning for infrastructure upgrades and expansion of GRFH began at the end of 2014 and managed by Manitoba Hydro's Generation Project Department. A final design was completed by SNC Lavalin in spring 2019 and a contract was awarded to Newton Mechanical and Electrical for construction in fall 2019.

Pickrel Place (previously referred to as the Service Garage), was commissioned in November 2020 and is serving as the interim sturgeon production facility until renovations in the main hatchery is completed. Commissioning and handover of the main hatchery building was attained

in October 2021; however, well water issues causing iron and calcium build-up in the new systems has led the project team to review additional water treatment options.

Lake Sturgeon production will remain in Pickerel Place until a water treatment solution for the raw well water is implemented (expected to be completed by summer 2022), after which time the building will be dedicated to GRFH's Walleye program. The building houses two separate water recirculating aquaculture systems, each with 2 grey rearing troughs measuring 8.1 x 0.9 x 0.5 m (L x W x H; Photo 2). Each tank can be divided into 4 equal sections. The original piping feeding the building with surface water (Cedar Lake) was capped and a new well water line was installed. Water treatment equipment within the aquaculture systems include drum filter, biofilter, degasser, and UV disinfection. Temperature is controlled using a hot water tank and adjustments to the rate of make-up water added.

Total usable rearing area for Lake Sturgeon in Pickerel Place is approximately 27 m<sup>2</sup>. Rearing space is shared between the two stocking programs: Keeyask Generation Project and the Nelson River Sturgeon Board.



**Photo 2: New water recirculating aquaculture systems in Pickerel Place**

The purpose of this report is to provide a summary of Lake Sturgeon production at Grand Rapids Fish Hatchery and stocking activities for the Keeyask Generation Project in 2020/21.

Klassen et al. (2015; 2016; 2017; 2018; 2019; 2020; 2021) provides summaries from past years.

## **2.0 BURNTWOOD RIVER POPULATION (2019 YEAR-CLASS)**

### **2.1 PAST PRODUCTION AND STOCKING**

Wild Lake Sturgeon adults from the Burntwood River were captured downstream of First Rapids (Map 2) in early June 2019. On June 6 the milt (sperm) from six males (M1, M2, M3, M4, M5, M6) was mixed with the eggs from one female (F2). The total number of eggs brought to GRFH was estimated to be 211,865. The overall percentage of viable eggs was estimated to be 76%. To reduce issues associated with overcrowding, one jar of eggs from each family was removed from the system. Some of the eggs went to the University of Manitoba to support on-going research. As a result, the estimated number of hatched larvae was 80,895.

Survival during the spring and summer months was at or greater than 80%. Due to space constraints and virus testing criteria which require fish to be at least 9-weeks old, some larvae had to be culled. Survival during the months of September and October was close to 100%. On September 26, a total of 1,664 fingerlings were released into the Burntwood River with assistance from Manitoba Hydro's boat patrol crews. On the same day, 50 fingerlings were released from shore into the Burntwood River at the Orr Creek boat launch as part of a Kischi Sipi Namao Committee stocking event. On October 3, another 1,967 fingerlings were stocked into the Burntwood River with assistance from Manitoba Hydro's boat patrol crews. At the time of the fall stocking fingerlings had an average total length of 106 mm (range: 87 to 125 mm) and average body weight of 4.9 g (range: 2.9 to 8.5 g).

A total of 774 Lake Sturgeon fingerlings were held at GRFH over the 2019/20 winter season for further grow-out. Overwinter survival was 99%. On June 20 and 22, a total of 384 yearlings were transported by truck to the Orr Creek boat launch. Following a period of acclimation, the sturgeon were released from shore into the Burntwood River. At the time of the spring stocking yearlings had an average total length of 237 mm (range: 186 to 300 mm) and average body weight of 49 g (range: 22 to 106 g).

A total of 382 Burntwood River yearlings were kept at the hatchery over summer in 2020. There were no mortalities prior to the fall stocking. On September 24, a total of 190 yearlings were transported by truck to the Orr Creek boat launch and released from shore into the Burntwood River, following a period of acclimation. At the time of the fall stocking yearlings had an average total length of 257 mm (range: 172 to 313 mm) and average body weight of 67 g (range: 20 to 133 g).

Klassen et al. (2020; 2021) provides additional detail on past production and stocking activities for the Burntwood River sturgeon (2019 year-class).

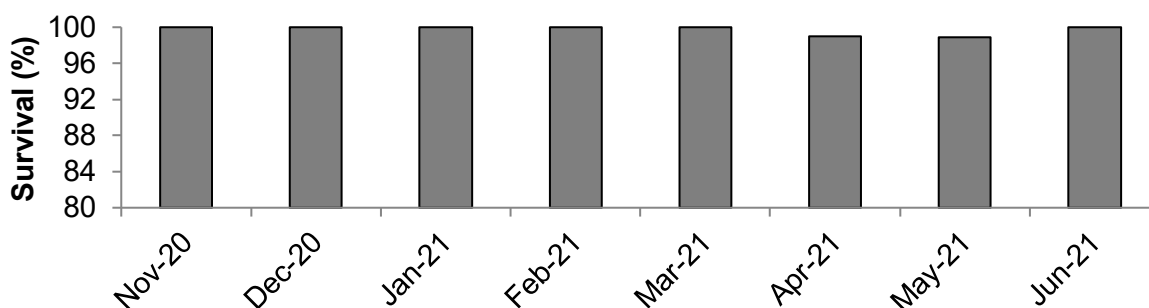
## 2.2 PRODUCTION

### 2.2.1 WINTER

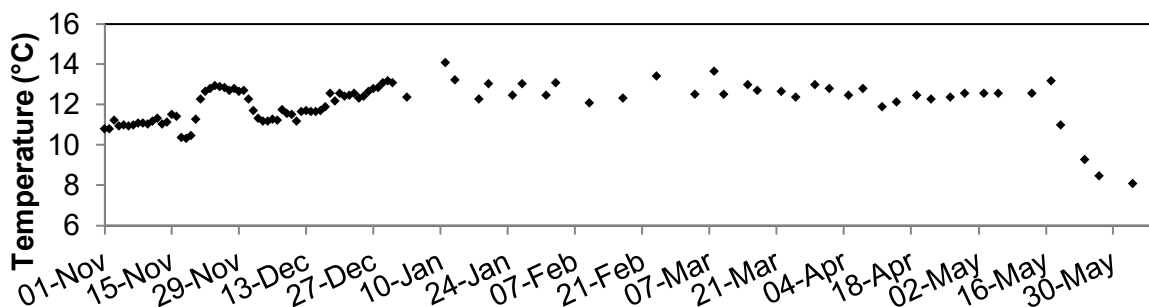
A total of 192 Lake Sturgeon fingerlings were held at GRFH over the 2020/21 winter season for further grow-out (M1M2 = 64, M3M4 = 63, M5M6 = 65). Prior to January 2021, offspring from the different family groups were held in separate rearing troughs located in the main hatchery building; however, all groups were contained within the same water recirculation system. Following the transfer of fish to Pickerel Place in late December 2020, offspring from the different families were held in the same tanks but separated using dividers. Water entering tanks was UV disinfected. Well water was used exclusively in both buildings to avoid potential contact with pathogens (e.g., viruses) that could be present in surface water. During the winter grow-out, sturgeon were fed frozen bloodworm twice daily to satiation in the morning and afternoon.

Overwinter survival for the 2019 year-class was 98% (Figure 1; Table A1-1). Four fish were euthanized (two in April and two in May) due to fish health concerns.

Average water temperature was 12.0°C (range: 8.1°C to 14.1°C) from November 1, 2020 to June 5, 2021 (Figure 2).

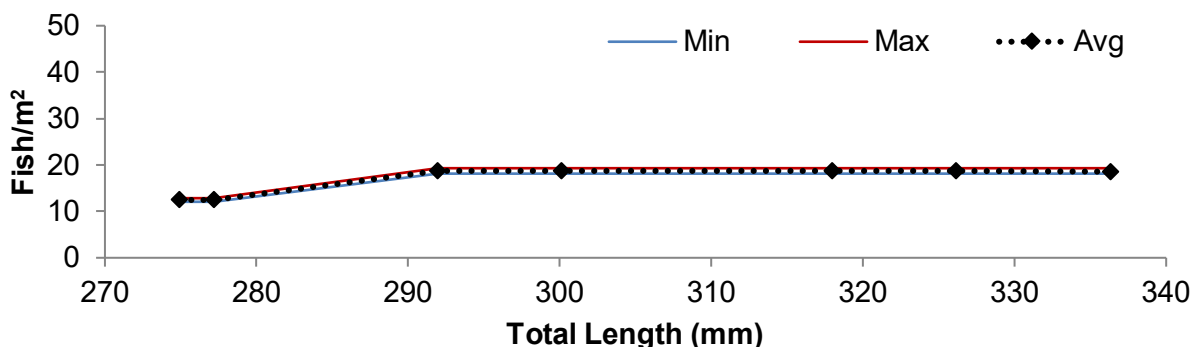


**Figure 1: Monthly survival (%) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021**



**Figure 2: Water temperatures (°C) in rearing troughs holding Burntwood River (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021**

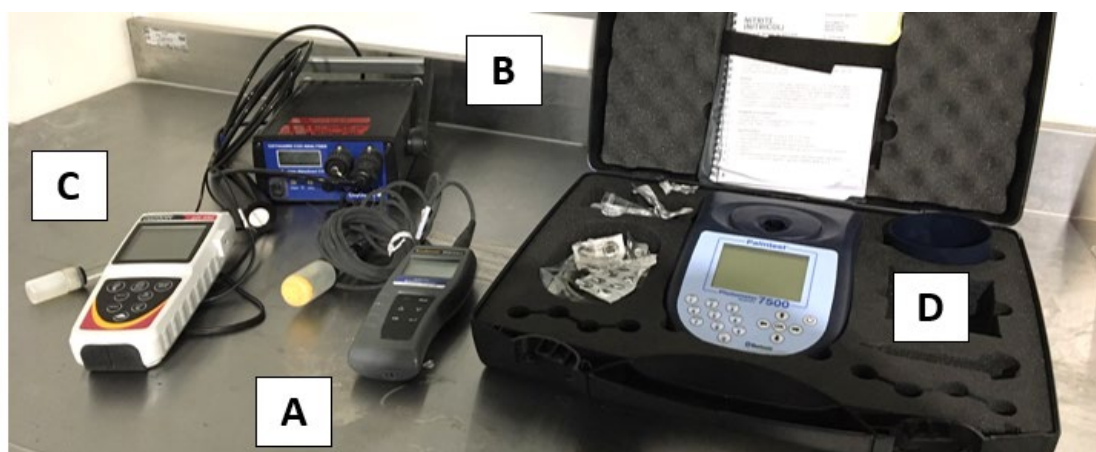




**Figure 3: Average, minimum and maximum rearing density (fish per m<sup>2</sup>) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021**

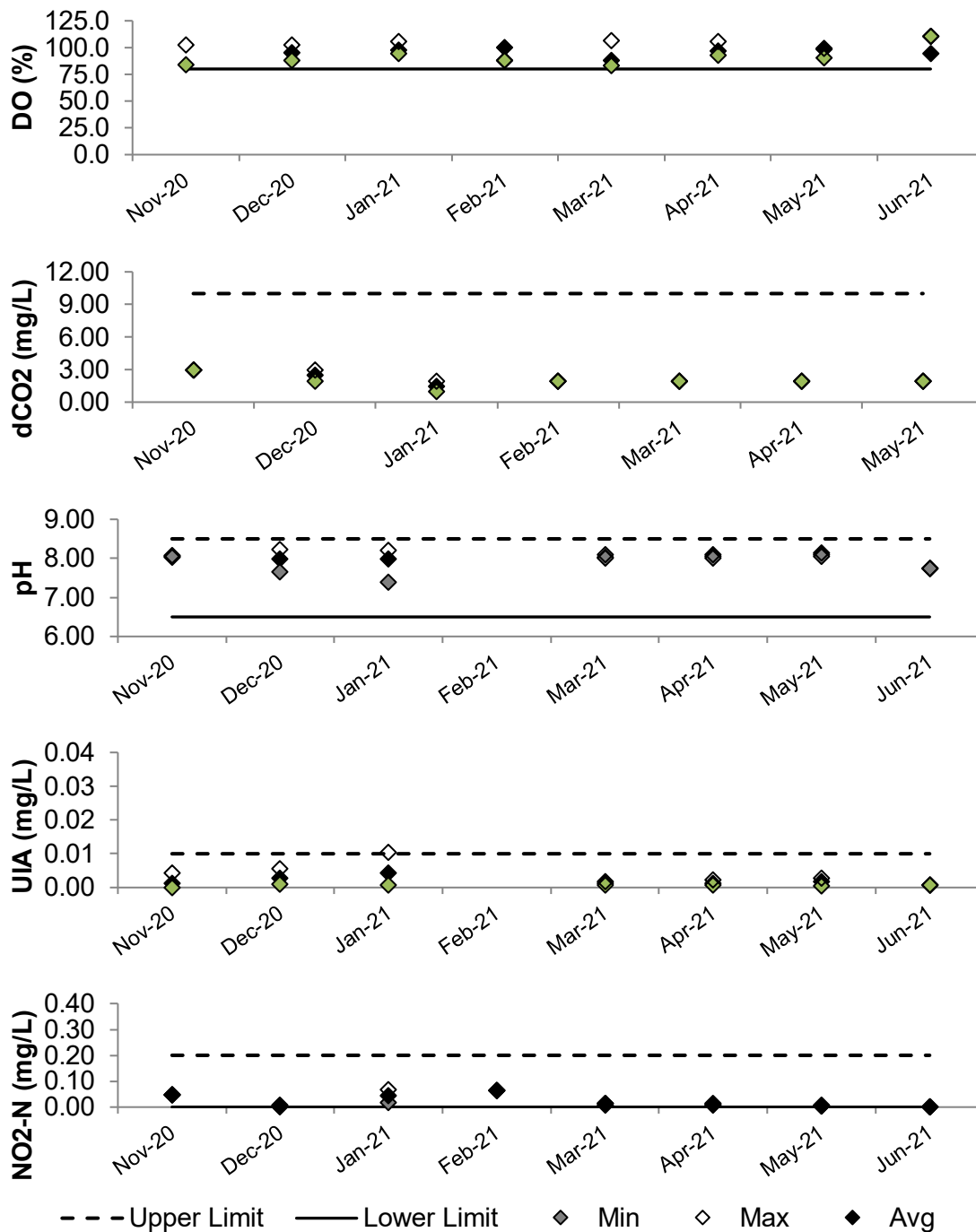
Prior to transferring sturgeon to Pickerel Place, densities were approximately 12 fish/m<sup>2</sup>. After the transfer, densities increased slightly to approximately 18 fish/m<sup>2</sup> (Figure 3).

Water quality samples were tested weekly from each rearing trough prior to moving operations to Pickerel Place and at the system level following the transfer. Measurements included dissolved oxygen (DO; EcoSense DO 200A, Pentair), dissolved carbon dioxide (dCO<sub>2</sub>; GO2P, Oxygaord International), pH (pH450, Oakton Instruments), total ammonia nitrogen (TAN; Photometer 7500, Palintest), un-ionized ammonia (UIA; Calculated by multiplying TAN with a multiplication factor based on temperature and pH, Emerson et al. 1975) and nitrite-nitrogen (NO<sub>2</sub>-N; Photometer 7500, Palintest; Photo 3).



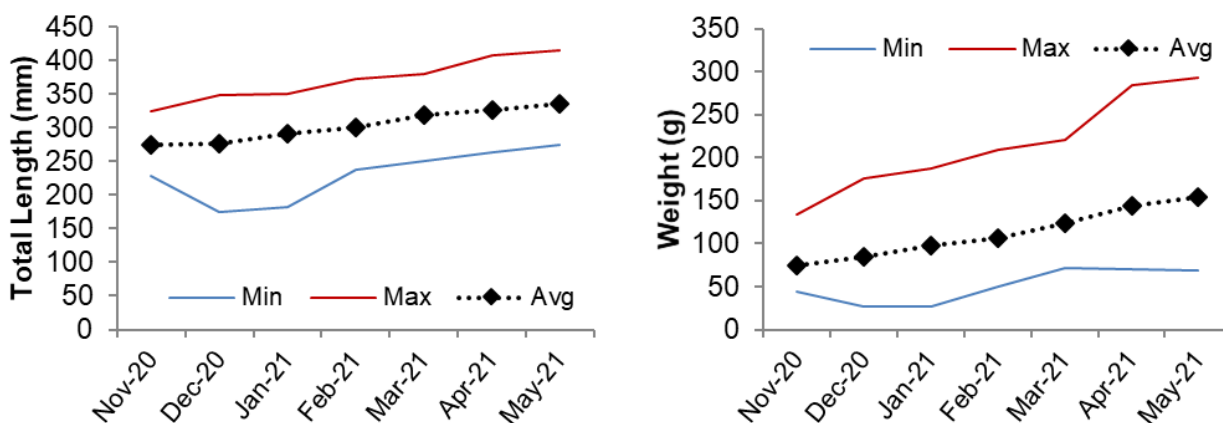
**Photo 3: Equipment used to test dissolved oxygen (A), dissolved carbon dioxide (B), pH (C), total ammonia nitrogen (D) and nitrite-nitrogen (D) at GRFH**

Average, minimum and maximum monthly water quality values, with the exception of TAN, are plotted in Figure 4. A detailed summary of monthly values is presented in Table A1-2. Recommended threshold values for sturgeon production are listed in Table A3-1.



**Figure 4:** Average, minimum and maximum monthly dissolved oxygen (DO), dissolved carbon dioxide (dCO<sub>2</sub>), pH, un-ionized ammonia (UIA) and nitrite-nitrogen (NO<sub>2</sub>-N) values in rearing systems holding Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021

Average monthly values for DO (>80%), dCO<sub>2</sub> (<10 mg/L), pH (6.5 to 8.5), UIA (<0.01 mg/L) and NO<sub>2</sub>-N (<0.2 mg/L) were at or within acceptable limits during winter production. Installation of new water treatment equipment as part of the hatchery's upgrade and expansion project improved water quality, particularly UIA, which has been difficult to manage in the past.



**Figure 5: Average, minimum and maximum total length (mm) and weight (g) for Burntwood River sturgeon (2019 year-class) at GRFH from November 2020 to the end of May 2021**

At the end of each month, 15 Burntwood River sturgeon were randomly selected and measured from each rearing tank in the main hatchery building and from each tank section following transfer to Pickerel Place. All fish were measured prior to the spring stocking. There was a gradual but steady increase in growth among fish over winter (Figure 5). As is typically observed, there was a noticeable size range among fish.

At the time of the spring stocking yearlings had reached an overall average fork length of 288 mm (range: 230 to 354 mm), average total length of 336 mm (range: 274 to 415 mm) and average weight of 46 g (range: 69 to 293 g; Figure 5; Table A1-3).

## 2.3 STOCKING

### 2.3.1 SPRING

All Burntwood River sturgeon were marked with uniquely numbered Passive Integrated Transponder (PIT) tags (8 mm long x 1.4 mm diameter) by inserting the tag into the muscle along the fish's back. This was completed by GRFH staff between March 9-11, 2020 when fish were large enough to undergo the procedure. A PIT tag scanner held over the fish detects the tag and displays the unique number on a screen. This marking technique helps to identify hatchery-reared

fish caught in the river and can be used to assess the movement and growth of individual fish following stocking.

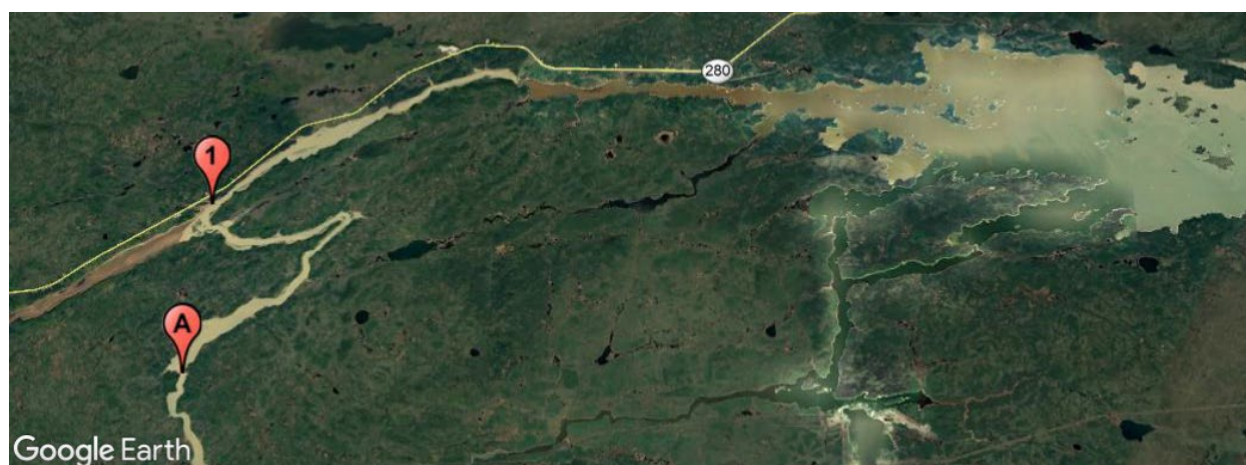
Tissue samples (pectoral fin) were collected from 30 Burntwood River sturgeon on April 17, 2021 and sent to RPC Science & Engineering in Fredericton, New Brunswick. All samples tested negative for Namao Virus using a virus specific qPCR test. Yearlings were cleared by the provincial fish health officer for stocking.

**Table 2: Number of Burntwood River sturgeon (2019 year-class) released into the Burntwood River in 2021**

Family	Stocking				
	Date	Number	Age (Mth)	Waterbody	Site ID
F2xM1M2	03-Jun-20	31	24	Burntwood River	1
F2xM3M4	03-Jun-20	31	24	Burntwood River	1
F2xM5M6	03-Jun-20	33	24	Burntwood River	1
F2xM1M2	05-Jun-20	31	24	Burntwood River	1
F2xM3M4	05-Jun-20	31	24	Burntwood River	1
F2xM5M6	05-Jun-20	31	24	Burntwood River	1
<b>Total (spring)</b>		<b>188</b>			

On June 3, a total of 95 sturgeon aged 2 years old were transported by truck to the Orr Creek boat launch. Following a period of acclimation, the sturgeon were released from shore into the Burntwood River at site 1 (Map 2; Table 2; Table A1-4). The river temperature at shore was 16.8°C.

On June 5, another 93 sturgeon were transported by truck to the Orr Creek boat launch. The two-year old sturgeon were released from shore into the Burntwood River, following a period of acclimation, at Site 1 (Map 2; Table 2; Table A1-4). The river temperature at shore was 14.0°C.



**Map 2: Stocking location for Burntwood River sturgeon (2019 year-class) released into the Burntwood River in spring 2021. First Rapids is marked 'A'**

## 3.0 BIRTHDAY RAPIDS POPULATION (2021 YEAR-CLASS)

### 3.1 SPAWN CAMP

#### 3.1.1 BROODSTOCK COLLECTION

Lake Sturgeon adults were captured from the Nelson River downstream of Birthday Rapids with assistance from North South Consultants (Map 3). One female was injected with a primer dose (20%) of Gonadotropin Releasing Hormone (GnRH; Product No. H-4070, Bachem Americas, Inc., Torrance, CA, USA) on June 9. The remaining dose (80%) was administered 12 hours later on June 10. Eight males were injected using a similar protocol; however, the amount of hormone used per kg was less than half that used for females (Table 3).

**Table 3: Broodstock tag numbers, weight and GnRH dose used during gamete collection on the Nelson River downstream of Birthday Rapids, June 2021**

Floy Tag ID	Hatchery ID	Body Mass (Kg)	Injection Date	Injection Time	Injection Temp	GnRH (µg/Kg)	Solution		
							GnRH (µl) <sup>1</sup>	Ringer's (µl) <sup>2</sup>	Total (µl)
<i>Females</i>									
120802	F1	19.5	9-Jun-19	19:03	12.0	4.2	81.9	308.1	390.0
			10-Jun-19	7:00	11.2	17.8	347.1	42.9	390.0
<i>Males</i>									
111770	M1	7.3	9-Jun-19	19:05	12.2	1.6	11.7	134.3	146.0
			10-Jun-19	7:02	11.2	6.8	49.6	96.4	146.0
117045	M2	11.4	9-Jun-19	19:08	12.2	1.6	18.2	209.8	228.0
			10-Jun-19	7:04	11.2	6.8	77.5	150.5	228.0
106985	M3	6.4	9-Jun-19	19:09	12.2	1.6	10.2	117.8	128.0
			10-Jun-19	7:05	11.2	6.8	43.5	84.5	128.0
80222	M4	13.0	9-Jun-19	19:20	12.2	1.6	20.8	239.2	260.0
80223			10-Jun-19	7:05	11.2	6.8	88.4	171.6	260.0
117038	M5	6.8	9-Jun-19	19:11	12.2	1.6	10.9	125.1	136.0
			10-Jun-19	7:06	11.2	6.8	46.2	89.8	136.0
117037	M6	8.2	9-Jun-19	19:14	12.2	1.6	13.1	150.9	164.0
			10-Jun-19	7:07	11.2	6.8	55.8	108.2	164.0
80299	M7	12.3	9-Jun-19	19:16	12.2	1.6	19.7	226.3	246.0
80300			10-Jun-19	7:07	11.2	6.8	83.6	162.4	246.0
117047	M8	10.5	9-Jun-19	19:18	12.2	1.6	16.8	193.2	210.0
			10-Jun-19	7:08	11.2	6.8	71.4	138.6	210.0

<sup>1</sup> GnRH solution = 1 $\mu$ g GnRH per  $\mu$ l; <sup>2</sup> Saline solution used to transport GnRH into fish muscle during injections



Administration of GnRH is useful for conservation aquaculture programs because it stimulates the production of sex steroids (estradiol and testosterone) necessary for maturation and production of eggs and milt. Research on the use of GnRH during Lake Sturgeon gamete collection suggests no lasting negative effects on broodstock health or human consumption complications (Genz et al. 2014).

Males and females were held separately using two tanks set up on shore (photo 4). Average water temperature from the time adults were first injected with hormone to the time of egg/milt collection was 12.3°C (range: 11.2 to 13.5°C) for the females and 12.2°C (range: 11.2 to 13.0°C) for the males.



**Photo 4: Broodstock holding tanks at the Birthday Rapids spawn camp, June 2021**

### **3.1.2 EGG AND MILT COLLECTION**

Eggs were first observed at 06:30 June 11 at the expected timeline of 36 hours following first hormone injection.

Prior to egg collection, milt was collected at approximately 07:30 and stored on ice in separate containers until fertilization. M1 did not express any milt, M2 and M7 expressed watery milt and unfortunately M4 jumped out of the holding tank the previous night and did not survive (refer to section 3.1.3).

Approximately 200 ml of eggs (unfertilized) were collected from F1 at 08:15. She was returned to the holding tank and field staff collected another 200 ml of eggs from her at 09:00. No abdominal incision was attempted. During egg collection damp towels were placed over the female's head to reduce stress and she was returned to the holding tank within 10 minutes.

Eggs from F1 were fertilized with the milt from 4 males at 10:00 to create four families (F1xM3, F1xM5, F1xM6, F1xM8). Milt was mixed with the eggs for approximately 90 seconds at a volume of 25 ml per liter of eggs (or 2.5 ml per 100 ml of eggs). The milt was first activated by mixing it with 200 ml water. Eggs were then rinsed with fresh water and mixed with bentonite clay for approximately 40 min to prevent egg clumping. They were bagged and placed in coolers by 11:20.

Eggs were transported by float plane to Thompson, arriving at approximately 15:30. From there they were driven to GRFH, arriving at approximately 19:30.

### 3.1.3 BROODSTOCK HEALTH

To ensure the short and long-term health of broodstock, field crew members discussed roles and responsibilities the day before egg and milt collection activities. For example, one individual timed how long the female was out of the water and called out to the other field staff every minute. A second individual was dedicated to female recovery efforts immediately following egg collection. Egg collection is kept to a maximum time of 10 min and a submersible pump is used to run water over the female's gills.

F1 recovered following egg collection and was actively swimming in the holding tank. All broodstock, with the exception of M4, were released back into the river within 24 hours of gamete collection. Unfortunately, M4 jumped out of the holding tank during the night and did not survive. This event was reported to the provincial Wildlife and Fisheries Branch Head Office as outlined in the Live Fish Handling (IT) Permit issued for spawn take activities.

Milt, ovarian fluid and fin tissue (pectoral) from broodstock were tested for Namao Virus. The Namao Virus has been detected in sturgeon throughout the Nelson River and appears to be endemic (Clouthier et al. 2015). All samples tested negative for the virus, with the exception of M5. A Ct value of 29.94 was reported for the fin tissue of M5 while no virus was detected in the milt. No offspring tested positive for the virus (see Section 3.3.1).

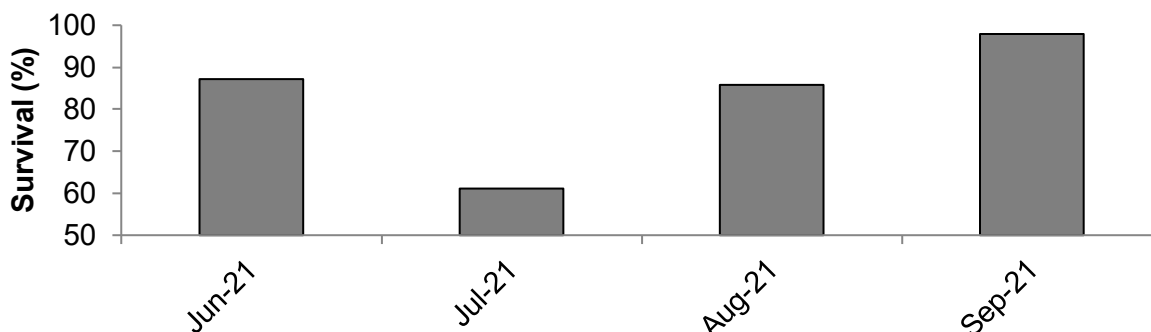
*Polypodium hydriforme*, a sturgeon and paddlefish parasite (Raikova 2002), was observed within the eggs of Burntwood River broodstock in 2015 and 2017. There were no signs of this parasite in 2021.

## 3.2 PRODUCTION

### 3.2.1 EGG INCUBATION AND HATCH

There were an estimated 40,750 eggs from the F1 crosses with an average of 54 eggs/ml (M3 = 56, M5 = 56, M6 = 54, M8 = 50). Eggs were placed into McDonald hatching jars for incubation. The four family groups were incubated in separate hatching jars but distributed across two rearing troughs within Pickerel Place due to renovations taking place in the main hatchery building. Troughs were contained within the same water recirculation system. Well water was used exclusively during this period and following hatch.

Five days after egg collection, egg viability was assessed. The proportion of viable eggs within a jar was calculated from three samples collected containing at least 100 eggs. The average proportion of viable eggs from each jar was then multiplied by the total egg volume of that jar to estimate hatch success. The overall percentage of viable eggs was estimated to be 35% (M3 = 64%, M5 = 1%, M6 = 34%, M8 = 51%) with an estimated hatch of 14,414 larvae. However, closer to hatch all viable eggs were counted and actual hatch was 5,250 larvae. The majority of eggs hatched on June 21.



**Figure 6: Monthly survival (%) of Birthday Rapids sturgeon (2021 year-class) at GRFH from June 21 to the end of September, 2021. Fish euthanized due to sampling events were excluded from monthly survival rates.**

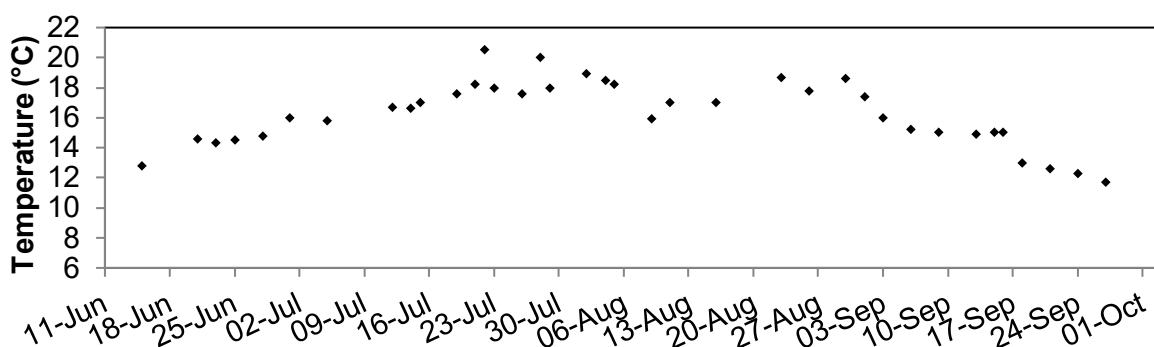
### 3.2.2 LARVAE AND FINGERLINGS

Monthly survival rates remained at or above 60% prior to the fall stocking (Figure 6; Table A2-1). The greatest number of mortalities occurred during the month of July, a period when fish were started on a diet of brine shrimp and later transitioned onto chopped bloodworm. Poor hatch was observed among the M5 family and no offspring survived past July 13. Interestingly, M5 tested positive for Namao Virus (refer to section 3.1.3).

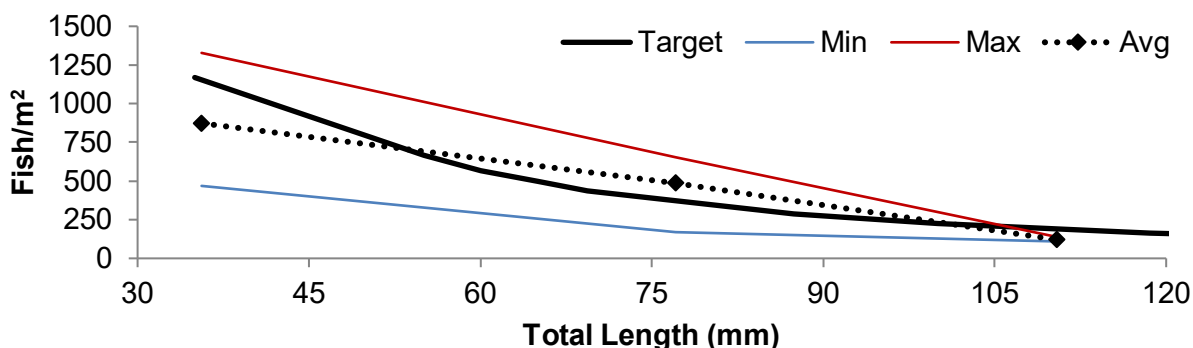
Larvae were first introduced to brine shrimp on June 29, 2021 with the majority of sturgeon feeding by July 3. Chopped bloodworm was first offered on July 12 and whole bloodworm on August 6. Sturgeon were feeding on whole bloodworm exclusively by August 8. Fish were fed to satiation

three times daily in the morning, afternoon and evening until September 9, at which time evening feedings were stopped.

Average water temperature was 16.4°C (range: 11.7°C to 22.0°C) from hatch until the fall stocking activities (Figure 7). Average densities remained close to or below target levels from July to the end of September (Figure 8).

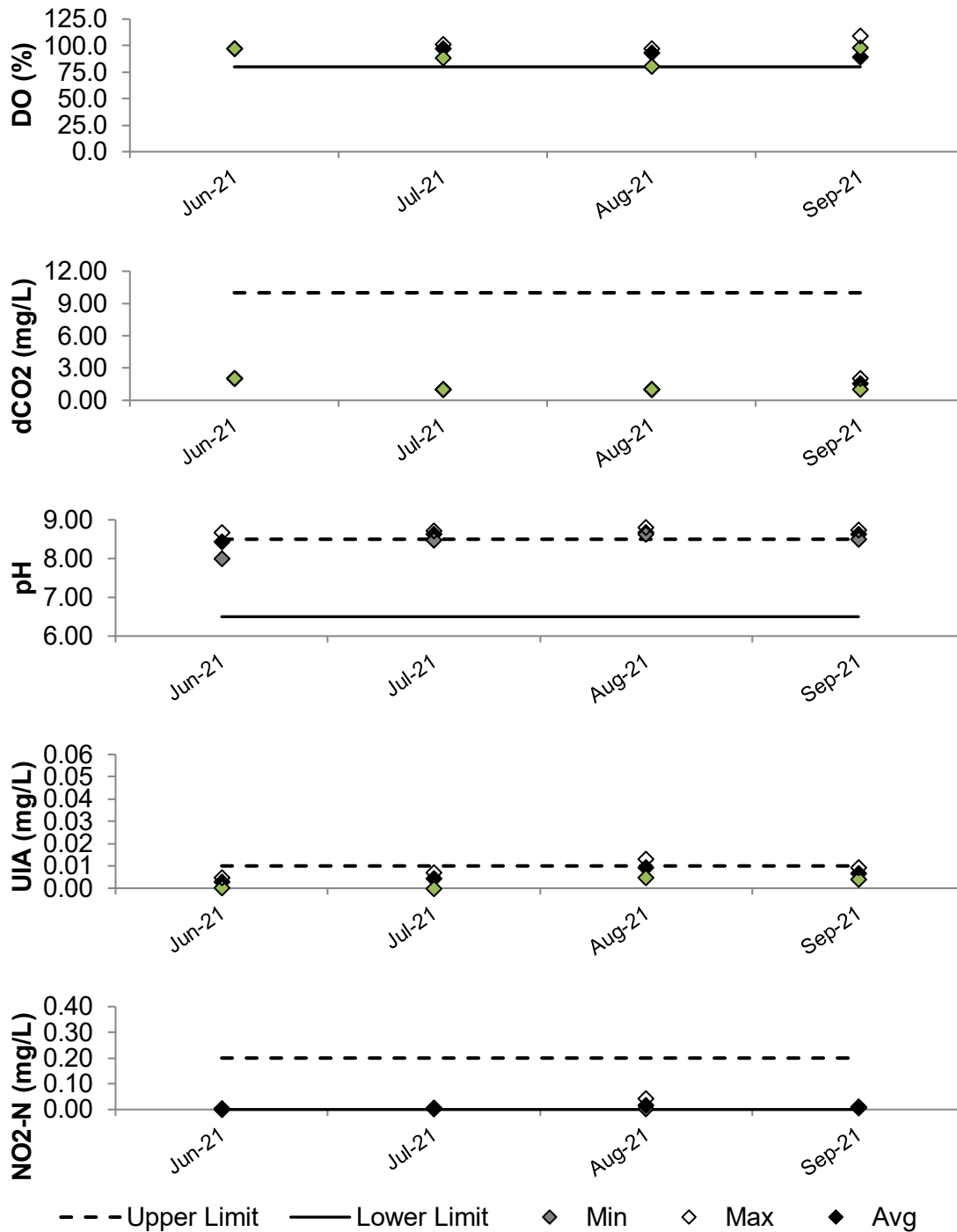


**Figure 7: Water temperature (°C) in rearing troughs holding Birthday Rapids sturgeon (2021 year-class) at GRFH from June 11 to the end of September, 2021**



**Figure 8: Average, minimum and maximum rearing density (fish per m²) of Birthday Rapids sturgeon (2021 year-class) at GRFH from the end of July to the end of September, 2021**

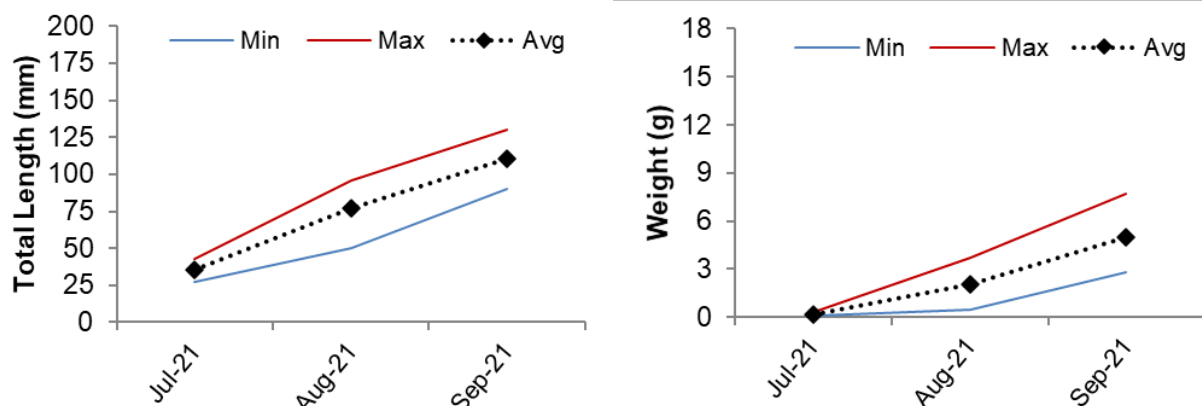
Water quality samples were tested weekly at a system level throughout summer. Parameters assessed included dissolved oxygen (DO), dissolved carbon dioxide (dCO<sub>2</sub>), pH, total ammonia nitrogen (TAN), un-ionized ammonia (UIA) and nitrite-nitrogen (NO<sub>2</sub>-N; refer to section 2.2.1 for methods).



**Figure 9: Average, minimum and maximum monthly dissolved oxygen (DO), dissolved carbon dioxide (dCO<sub>2</sub>), pH, un-ionized ammonia (UIA) and nitrite-nitrogen (NO<sub>2</sub>-N) values in rearing troughs holding Birthday Rapids sturgeon (2021 year-class) at GRFH from June to the end of September, 2021**



Recommended threshold values for sturgeon production are listed in Table A3-1. Average monthly water quality values, with the exception of TAN, are plotted in Figure 9 and were at or within accepted limits for DO (>80%), dCO<sub>2</sub> (<10 mg/L), pH (6.5 to 8.5), UIA (<0.01 mg/L) and NO<sub>2</sub>-N (<0.2 mg/L). A detailed summary of monthly values is presented in Table A2-2.



**Figure 10: Average, minimum and maximum total length (mm) and weight (g) for Birthday Rapids sturgeon (2021 year-class) at GRFH from July to the end of September, 2021**

At the end of each month, 15 Birthday Rapids sturgeon were randomly selected and measured from each family group. By the end of September fingerlings had reached an overall average total length of 110 mm (range: 90 to 130 mm) and average weight of 5.0 g (range: 2.8 to 7.7 g; Figure 10; Table A2-3).

## 3.3 STOCKING

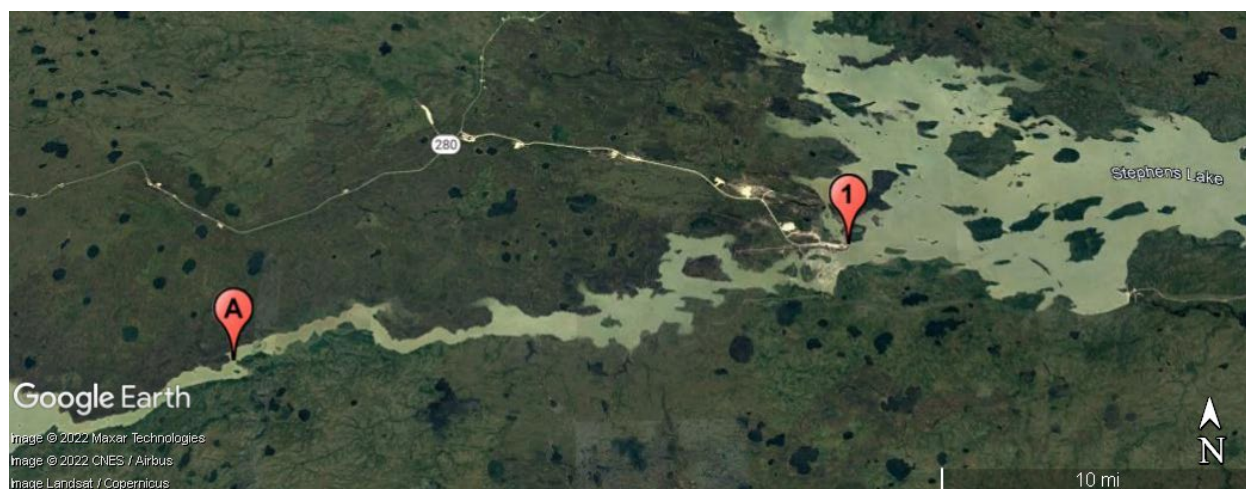
### 3.3.1 FALL

On August 22, sixty whole body samples representing the three remaining family groups (M3, M6, M8) were collected and sent to RPC Science and Engineering in Fredericton, New Brunswick. All samples tested negative for Namao Virus using a virus specific qPCR test. Fingerlings were cleared by the provincial fish health officer for stocking.

On September 28, a total of 1,050 fingerlings were transported by truck to the downstream boat launch located at Keeyask. Following a period of acclimation, the fingerlings were released from shore into Stephens Lake at Site 1 (Photo 5; Map 3; Table 4). The river temperature was 11.8°C.

**Table 4: Number of Birthday Rapids sturgeon (2021 year-class) released into Stephens Lake in 2021**

Family	Stocking				
	Date	Number	Age	Waterbody	Site ID
F1xM3	28-Sep-21	325	3 months	Stephens Lake	1
F1xM8	28-Sep-21	725	3 months	Stephens Lake	1
<b>Total (Site 1)</b>		<b>1,050</b>			

**Map 3: Stocking locations for Birthday Rapids sturgeon (2021 year-class) released into Stephens Lake in fall 2021. Birthday Rapids is marked 'A'****Photo 5: Fingerlings prior to being released in fall, 2021**

## 4.0 POST-STOCKING RECAPTURES

A total of 4,931 Age-1+ Lake Sturgeon have been stocked into the lower Nelson and Burntwood rivers since 2014 (Burntwood River = 2,119; Keeyask Reservoir = 1,284; Stephens Lake = 1,528). PIT tags injected into the sturgeon prior to release has allowed identification of 550 hatchery-reared fish from post-stocking monitoring in the Keeyask Study Area since 2014 (Table 5).

**Table 5: Number of PIT tagged hatchery-reared Lake Sturgeon stocked into the lower Nelson and Burntwood rivers and number recaptured between 2014 and 2021**

Sample Year	Location <sup>a</sup>	Number Stocked	Number Recaptured								TOTAL
			Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	
2021	STL	0	0	0	51	0	9	0	9	0	<b>69</b>
	GL/KR	0	0	0	24	1	8	0	21	3	<b>57</b>
	BWR/SPL	188	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<b>n/a</b>
2020	STL	0	0	25	1	5	0	18	0	n/a	<b>49</b>
	GL/KR	0	0	17	0	12	0	6	1	n/a	<b>36</b>
	BWR/SPL	574	1	0	12	0	2	0	6	n/a	<b>21</b>
2019	STL	390	84	0	13	0	20	1	n/a	n/a	<b>118</b>
	GL/KR	398	27	1	16	0	12	1	n/a	n/a	<b>57</b>
	BWR/SPL	0	0	8	0	0	0	2	n/a	n/a	<b>10</b>
2018	STL	0	0	7	0	10	0	n/a	n/a	n/a	<b>17</b>
	GL/KR	0	1	8	0	8	1	n/a	n/a	n/a	<b>18</b>
	BWR/SPL	739	0	0	0	0	1	n/a	n/a	n/a	<b>1</b>
2017	STL	720	33	0	18	0	n/a	n/a	n/a	n/a	<b>51</b>
	GL/KR	463	9	0	11	1	n/a	n/a	n/a	n/a	<b>21</b>
	BWR/SPL	0	0	0	0	3	n/a	n/a	n/a	n/a	<b>3</b>
2016	STL	0	0	5	0	n/a	n/a	n/a	n/a	n/a	<b>5</b>
	GL/KR	0	0	7	0	n/a	n/a	n/a	n/a	n/a	<b>7</b>
	BWR/SPL	23	0	0	1	n/a	n/a	n/a	n/a	n/a	<b>1</b>
2015	STL	418	4	0	n/a	n/a	n/a	n/a	n/a	n/a	<b>4</b>
	GL/KR	423	2	1	n/a	n/a	n/a	n/a	n/a	n/a	<b>3</b>
	BWR/SPL	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	<b>0</b>
2014	STL	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<b>0</b>
	GL/KR	0	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<b>1</b>
	BWR/SPL	595	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<b>1</b>
<b>TOTAL</b>		<b>4,931</b>	<b>163</b>	<b>79</b>	<b>147</b>	<b>40</b>	<b>53</b>	<b>28</b>	<b>37</b>	<b>3</b>	<b>550</b>

<sup>a</sup> STL = Stephens Lake; GL/KR = Gull Lake/Keeyask Reservoir; BWR/SPL = Burntwood River/Split Lake

The majority of hatchery-reared sturgeon have been recaptured in Stephens Lake (57%,  $n = 313$ ). Most of these fish were originally stocked into Stephens Lake (2015 = 70; 2017 = 54, 2019 = 144), with the exception of 44 individuals. Of these 44 fish, 42 sturgeon were stocked into the future Keeyask reservoir (2015 = 14; 2017 = 13; 2019 = 15) and 2 sturgeon were stocked into the Burntwood River (2014 = 1; 2018 = 1). The stocking location of one hatchery-reared fish recaptured in Stephens Lake during the 2019 monitoring program is unknown and was either stocked into Stephens Lake or the future Keeyask reservoir in 2019. Annual survival of hatchery-reared sturgeon stocked as yearlings in Stephens Lake is currently estimated to be 78% (Burnett et al. 2022).

The second most hatchery-reared fish have been recaptured in the Keeyask reservoir (36%,  $n = 200$ ). Of these fish, 188 sturgeon were originally stocked into the future Keeyask reservoir (2015 = 67; 2017 = 53; 2019 = 68) with 12 having been stocked upstream in the Burntwood River (2014 = 9; 2018 = 3). Annual survival of hatchery-reared sturgeon stocked as yearlings in the Keeyask reservoir is currently estimated to be 92% (Burnett et al. 2022).

The least number of hatchery-reared fish recaptured to date has been in the Upper Split Lake area (7%,  $n = 37$ ). All were stocked into the Burntwood River (2014 = 14; 2016 = 2; 2018 = 20; 2020 = 1). Juvenile monitoring studies were not conducted in the Upper Split Lake area in 2021. Annual survival of hatchery-reared sturgeon stocked as yearlings in the Upper Split Lake area from previous monitoring is estimated to be 91% (Burnett et al. 2021).

Individuals from all year-classes produced at the Grand Rapids Fish Hatchery (aged 1+) have been recaptured. Over the course of the monitoring program:

- 4% ( $n = 24$ ) were from the 2013 year-class,
- 27% ( $n = 151$ ) from the 2014 year-class,
- <1% ( $n = 2$ ) from the 2015 year-class,
- 22% ( $n = 120$ ) from the 2016 year-class,
- 4% ( $n = 24$ ) from the 2017 year-class,
- 42% ( $n = 228$ ) from the 2018 year class, and
- <1% ( $n = 1$ ) from the 2019 year-class.

At the time of recapture:

- 30% ( $n = 163$ ) were age-1,
- 14% ( $n = 79$ ) were age-2,
- 27% ( $n = 147$ ) were age-3,
- 7% ( $n = 40$ ) were age-4,
- 10% ( $n = 53$ ) were age-5,
- 5% ( $n = 28$ ) were age-6,
- 7% ( $n = 37$ ) were age-7, and
- <1% ( $n = 3$ ) were age-8.

Additional information about recaptured hatchery-reared sturgeon can be found in Henderson et al. (2015), Burnett et al. (2016; 2017; 2018; 2021; 2022), and Burnett and Hrenchuk (2019; 2020).

## **5.0 PRODUCTION AND STOCKING ACTIVITIES IN 2021/22**

A total of 799 Birthday Rapids fingerlings were kept for the 2021/22 winter grow-out period and are currently being held in Pickerel Place. Fish will be released as yearlings in spring 2022, pending provincial approval. Specific stocking locations will be determined at that time.

The new water recirculating systems in the main hatchery building were commissioned in fall 2021; however, issues with the source well water (e.g., iron and calcium scale) has prevented operations from moving back into the main hatchery building. Additional water treatment options are currently being assessed by the project team.



## 6.0 SUMMARY AND CONCLUSIONS

The Grand Rapids Fish Hatchery did not produce a 2020 year-class for the Keeyask Hydropower Limited Partnership due to the cancellation of spring field activities as a result of Covid-19. Yearlings from the 2019 year-class were kept at the hatchery for a second year and a total of 188 individuals aged 2 years old were stocked into the Burntwood River in spring 2021.

Egg collection activities resumed in spring 2021 at the Birthday Rapids spawn camp. Only 1 female with ripe eggs was captured during the two-week program. Unfortunately, one of the eight males held for milt collection did not survive after jumping out of the holding tank during the night. Approximately 40,000 eggs were fertilized with the milt from 4 males and transported to GRFH. Despite a poor hatch rate (~13%), a total of 1,050 fingerlings were released into Stephens Lake in fall 2021 and a total of 799 fingerlings were kept for release in spring 2022, pending provincial approval.

Stocking activities for the construction and operation of the Keeyask Generating Station will continue until self-sustaining populations are present in the Keeyask and upper Split Lake areas. Assessment of the program is on-going in order to meet this objective. Results from juvenile monitoring programs indicate high survival of the hatchery-reared sturgeon stocked as yearlings but there is little evidence to support survival of the released fingerlings. As such the program will continue to focus on the production and release of yearlings. Upgrades to the Grand Rapids Fish Hatchery will allow for greater numbers of yearling sturgeon to be produced for stocking.

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## **APPENDIX 1: BURNTWOOD RIVER (2019 YEAR-CLASS)**

- Table A1-1: Survival (%) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021**
- Table A1-2: Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Burntwood River (2019 year-class) reared at Grand Rapids Fish Hatchery**
- Table A1-3: Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Burntwood River Lake Sturgeon (2019 year-class) reared at Grand Rapids Fish Hatchery**
- Table A1-4: Biological and PIT tag information for hatchery-reared Lake Sturgeon aged 2-years released into the Burntwood River in 2021**



**Table A1-1:** Survival (%) of Burntwood River sturgeon (2019 year-class) at GRFH from November 1, 2020 to June 5, 2021

LOT	Tanks	Month-Year	Start of Month Total	Mortality			Transfer		Recount Adjustment	End of Month Total	Monthly Survival (%)
				Natural	Accidental	Euthanized	Stocking	Other			
LKST-BWR-19	6 <sup>a</sup>	Nov-20	192	0	0	0	0	0	0	192	100.0
LKST-BWR-19	6 <sup>a</sup>	Dec-20	192	0	0	0	0	0	0	192	100.0
LKST-BWR-19	2 <sup>b</sup>	Jan-21	192	0	0	0	0	0	0	192	100.0
LKST-BWR-19	2 <sup>b</sup>	Feb-21	192	0	0	0	0	0	0	192	100.0
LKST-BWR-19	2 <sup>b</sup>	Mar-21	192	0	0	0	0	0	0	192	100.0
LKST-BWR-19	2 <sup>b</sup>	Apr-21	192	0	0	2 <sup>c</sup>	0	0	0	190	99.0
LKST-BWR-19	2 <sup>b</sup>	May-21	190	0	0	2 <sup>c</sup>	0	0	0	188	98.9
LKST-BWR-19	2 <sup>b</sup>	Jun-21	188	0	0	0	188 <sup>d</sup>	0	0	0	100.0
<b>Total (BDR-19)</b>			<b>192</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>188</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>97.9</b>

a. Main Hatchery: 10A (F2xM1M2), 10B (F2xM1M2), 11A (F2xM3M4), 11B (F2xM3M4), 12A (F2xM5M6), 12B (F2xM5M6)

b. Pickerel Place: PP3 (A: F2xM1M2, B: F2xM3M4, C: F2xM5M6); PP4 (A: F2xM1M2, B: F2xM3M4, C: F2xM5M6)

c. Euthanized due to fish health concerns

d. Stocked into Burntwood River at Orr Creek boat launch

**Table A1-2:** Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Burntwood River sturgeon (2019 year-class) reared at Grand Rapids Fish Hatchery

Parameter	Mth-Yr	N <sup>a</sup>	Avg	$\pm$ SD	Min	Max
<b>Dissolved O2 (%)</b>	Nov-20	12	95.06	6.97	84.00	102.30
	Dec-20	4	97.18	6.77	87.60	102.60
	Jan-21	4	99.58	5.70	94.50	105.50
	Feb-21	1	87.50	0.00	87.50	87.50
	Mar-21	4	96.48	9.99	82.80	106.50
	Apr-21	4	98.53	6.07	92.90	105.80
	May-21	2	94.60	6.36	90.10	99.10
	Jun-21	1	110.30	0.00	110.30	110.30
<b>Dissolved CO2 (mg/L)</b>	Nov-20	12	3.00	0.00	3.00	3.00
	Dec-20	4	2.50	0.58	2.00	3.00
	Jan-21	2	1.50	0.71	1.00	2.00
	Feb-21	1	2.00	0.00	2.00	2.00
	Mar-21	4	2.00	0.00	2.00	2.00
	Apr-21	4	2.00	0.00	2.00	2.00
	May-21	3	2.00	0.00	2.00	2.00
	Jun-21	1	2.00	0.00	2.00	2.00
<b>pH</b>	Nov-20	12	8.05	0.01	8.02	8.07
	Dec-20	4	7.98	0.25	7.66	8.22
	Jan-21	4	7.98	0.39	7.40	8.20
	Feb-21	0				
	Mar-21	4	8.03	0.05	8.00	8.10
	Apr-21	3	8.06	0.05	8.00	8.10
	May-21	3	8.10	0.05	8.05	8.14
	Jun-21	1	7.74	0.00	7.74	7.74
<b>Total Ammonia (mg/L)</b>	Nov-20	12	0.068	0.059	0.000	0.230
	Dec-20	4	0.113	0.040	0.080	0.170
	Jan-21	4	0.148	0.087	0.080	0.270
	Feb-21	1	0.040	0.000	0.040	0.040
	Mar-21	4	0.050	0.022	0.020	0.070
	Apr-21	4	0.045	0.017	0.030	0.070
	May-21	3	0.060	0.026	0.030	0.080
	Jun-21	1	0.080	0.000	0.080	0.080
<b>UIA (mg/L)</b>	Nov-20	12	0.001	0.001	0.000	0.004
	Dec-20	4	0.003	0.002	0.001	0.006
	Jan-21	4	0.004	0.004	0.001	0.010
	Feb-21	0				
	Mar-21	4	0.001	0.000	0.001	0.002
	Apr-21	3	0.001	0.001	0.001	0.002
	May-21	3	0.002	0.001	0.001	0.003
	Jun-21	1	0.001	0.000	0.001	0.001
<b>Nitrite Nitrogen (mg/L)</b>	Nov-20	12	0.05	0.00	0.05	0.05
	Dec-20	4	0.01	0.00	0.00	0.01
	Jan-21	4	0.05	0.02	0.02	0.07
	Feb-21	1	0.07	0.00	0.07	0.07
	Mar-21	4	0.01	0.00	0.01	0.02
	Apr-21	4	0.01	0.00	0.01	0.02
	May-21	3	0.01	0.00	0.01	0.01
	Jun-21	1	0.00	0.00	0.00	0.00

a. Number of water samples per month

**Table A1-3:** Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Burntwood River Lake Sturgeon (2019 year-class) reared at Grand Rapids Fish Hatchery

Measurement	Mth-Yr	N <sup>a</sup>	Avg	$\pm$ SD	Min	Max
<b>Fork Length (mm)</b>	Nov-20	90	232	18	194	275
	Dec-20	192	236	25	127	295
	Jan-21	90	249	24	160	305
	Feb-21	90	257	24	203	318
	Mar-21	90	272	25	220	328
	Apr-21	90	278	25	222	349
	May-21	187	288	27	230	354
<b>Total Length (mm)</b>	Nov-20	90	275	22	228	325
	Dec-20	192	277	29	175	349
	Jan-21	90	292	29	183	350
	Feb-21	90	300	28	238	372
	Mar-21	90	318	29	251	379
	Apr-21	90	326	29	264	408
	May-21	187	336	31	274	415
<b>Weight (g)</b>	Nov-20	90	75.2	18.6	43.8	133.3
	Dec-20	192	84.0	25.5	26.4	175.1
	Jan-21	90	98.2	30.5	27.4	187.1
	Feb-21	90	107.0	33.1	49.5	208.7
	Mar-21	90	124.0	36.3	71.5	220.7
	Apr-21	90	144.2	42.9	70.7	284.6
	May-21	187	154.0	46.1	69.1	292.5

a. Number of fish measured

**Table A1-4:** Biological and PIT tag information for hatchery-reared Lake Sturgeon aged 2-years released into the Burntwood River in 2021

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000107981	BWR19_F2M1M2	PP4-a	30-May-21	274	319	148.68	05-Jun-21	Burntwood River	1
900.067000107982	BWR19_F2M3M4	PP3-b	30-May-21	345	405	223.33	3-Jun-21	Burntwood River	1
900.067000107984	BWR19_F2M1M2	PP4-a	30-May-21	305	361	170.91	05-Jun-21	Burntwood River	1
900.067000107994	BWR19_F2M1M2	PP3-a	30-May-21	315	367	215.33	3-Jun-21	Burntwood River	1
900.067000107995	BWR19_F2M1M2	PP3-a	30-May-21	250	295	104.50	3-Jun-21	Burntwood River	1
900.067000108000	BWR19_F2M1M2	PP3-a	30-May-21	265	311	108.72	3-Jun-21	Burntwood River	1
900.067000108001	BWR19_F2M1M2	PP3-a	30-May-21	310	363	205.57	3-Jun-21	Burntwood River	1
900.067000108005	BWR19_F2M1M2	PP4-a	30-May-21	264	304	100.48	05-Jun-21	Burntwood River	1
900.067000108007	BWR19_F2M1M2	PP3-a	30-May-21	320	371	205.49	3-Jun-21	Burntwood River	1
900.067000108011	BWR19_F2M1M2	PP3-a	30-May-21	312	367	205.76	3-Jun-21	Burntwood River	1
900.067000108014	BWR19_F2M1M2	PP4-a	30-May-21	329	379	229.15	05-Jun-21	Burntwood River	1
900.067000108015	BWR19_F2M1M2	PP4-a	30-May-21	296	343	163.57	05-Jun-21	Burntwood River	1
900.067000108019	BWR19_F2M1M2	PP4-a	30-May-21	280	324	129.34	05-Jun-21	Burntwood River	1
900.067000108022	BWR19_F2M1M2	PP4-a	30-May-21	274	319	134.94	05-Jun-21	Burntwood River	1
900.067000108023	BWR19_F2M1M2	PP4-a	30-May-21	271	314	127.26	05-Jun-21	Burntwood River	1
900.067000108025	BWR19_F2M1M2	PP4-a	30-May-21	284	328	138.20	05-Jun-21	Burntwood River	1
900.067000108026	BWR19_F2M1M2	PP3-a	30-May-21	275	320	121.99	3-Jun-21	Burntwood River	1
900.067000108028	BWR19_F2M1M2	PP3-a	30-May-21	275	315	135.49	3-Jun-21	Burntwood River	1
900.067000108031	BWR19_F2M1M2	PP3-a	30-May-21	275	324	127.99	3-Jun-21	Burntwood River	1
900.067000108032	BWR19_F2M1M2	PP4-a	30-May-21	298	347	154.80	05-Jun-21	Burntwood River	1
900.067000108033	BWR19_F2M1M2	PP4-a	30-May-21	289	339	139.63	05-Jun-21	Burntwood River	1
900.067000108036	BWR19_F2M3M4	PP3-b	30-May-21	320	372	215.41	3-Jun-21	Burntwood River	1
900.067000108037	BWR19_F2M1M2	PP3-a	30-May-21	240	275	97.75	3-Jun-21	Burntwood River	1
900.067000108039	BWR19_F2M1M2	PP4-a	30-May-21	320	370	213.57	05-Jun-21	Burntwood River	1
900.067000108043	BWR19_F2M1M2	PP4-a	30-May-21	309	363	191.44	05-Jun-21	Burntwood River	1
900.067000108047	BWR19_F2M1M2	PP3-a	30-May-21	305	360	166.67	3-Jun-21	Burntwood River	1
900.067000108048	BWR19_F2M1M2	PP4-a	30-May-21	329	379	230.04	05-Jun-21	Burntwood River	1

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000108049	BWR19_F2M1M2	PP4-a	30-May-21	272	313	120.17	05-Jun-21	Burntwood River	1
900.067000108052	BWR19_F2M1M2	PP3-a	30-May-21	260	305	125.92	3-Jun-21	Burntwood River	1
900.067000108053	BWR19_F2M1M2	PP4-a	30-May-21	261	309	109.26	05-Jun-21	Burntwood River	1
900.067000108065	BWR19_F2M1M2	PP3-a	30-May-21	338	391	225.30	3-Jun-21	Burntwood River	1
900.067000108069	BWR19_F2M1M2	PP4-a	30-May-21	298	347	158.78	05-Jun-21	Burntwood River	1
900.067000108072	BWR19_F2M1M2	PP3-a	30-May-21	280	333	132.81	3-Jun-21	Burntwood River	1
900.067000108075	BWR19_F2M1M2	PP3-a	30-May-21	250	291	96.57	3-Jun-21	Burntwood River	1
900.067000108076	BWR19_F2M1M2	PP3-a	30-May-21	258	306	92.72	3-Jun-21	Burntwood River	1
900.067000108077	BWR19_F2M1M2	PP4-a	30-May-21	260	300	97.30	05-Jun-21	Burntwood River	1
900.067000108078	BWR19_F2M1M2	PP3-a	30-May-21	285	342	137.85	3-Jun-21	Burntwood River	1
900.067000108081	BWR19_F2M3M4	PP4-b	30-May-21	345	398	235.47	05-Jun-21	Burntwood River	1
900.067000108084	BWR19_F2M3M4	PP3-b	30-May-21	299	344	160.21	3-Jun-21	Burntwood River	1
900.067000108089	BWR19_F2M3M4	PP4-b	30-May-21	345	396	239.66	05-Jun-21	Burntwood River	1
900.067000108140	BWR19_F2M3M4	PP4-b	30-May-21	290	341	165.31	05-Jun-21	Burntwood River	1
900.067000108151	BWR19_F2M3M4	PP3-b	30-May-21	235	281	91.83	3-Jun-21	Burntwood River	1
900.067000108169	BWR19_F2M3M4	PP3-b	30-May-21	304	355	171.47	3-Jun-21	Burntwood River	1
900.067000108682	BWR19_F2M5M6	PP4-c	30-May-21	259	297	103.72	05-Jun-21	Burntwood River	1
900.067000108684	BWR19_F2M5M6	PP3-c	30-May-21	258	300	113.97	3-Jun-21	Burntwood River	1
900.067000108685	BWR19_F2M5M6	PP3-c	30-May-21	298	343	161.89	3-Jun-21	Burntwood River	1
900.067000108687	BWR19_F2M5M6	PP3-c	30-May-21	230	275	73.61	3-Jun-21	Burntwood River	1
900.067000108688	BWR19_F2M5M6	PP4-c	30-May-21	256	302	111.95	05-Jun-21	Burntwood River	1
900.067000108689	BWR19_F2M5M6	PP4-c	30-May-21	269	312	119.41	05-Jun-21	Burntwood River	1
900.067000108695	BWR19_F2M5M6	PP4-c	30-May-21	303	348	176.54	05-Jun-21	Burntwood River	1
900.067000108696	BWR19_F2M5M6	PP3-c	30-May-21	293	344	160.36	3-Jun-21	Burntwood River	1
900.067000108697	BWR19_F2M5M6	PP4-c	30-May-21	277	319	124.40	05-Jun-21	Burntwood River	1
900.067000108699	BWR19_F2M5M6	PP3-c	30-May-21	337	396	254.36	3-Jun-21	Burntwood River	1
900.067000108700	BWR19_F2M5M6	PP4-c	30-May-21	280	320	125.03	05-Jun-21	Burntwood River	1
900.067000108702	BWR19_F2M5M6	PP3-c	30-May-21	259	297	107.62	3-Jun-21	Burntwood River	1
900.067000108703	BWR19_F2M5M6	PP3-c	30-May-21	295	348	151.85	3-Jun-21	Burntwood River	1



Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000108704	BWR19_F2M5M6	PP3-c	30-May-21	289	333	147.54	3-Jun-21	Burntwood River	1
900.067000108705	BWR19_F2M5M6	PP3-c	30-May-21	285	344	172.13	3-Jun-21	Burntwood River	1
900.067000108706	BWR19_F2M5M6	PP4-c	30-May-21	299	347	177.04	05-Jun-21	Burntwood River	1
900.067000108707	BWR19_F2M5M6	PP3-c	30-May-21	290	335	149.72	3-Jun-21	Burntwood River	1
900.067000108709	BWR19_F2M5M6	PP4-c	30-May-21	339	395	281.63	05-Jun-21	Burntwood River	1
900.067000108710	BWR19_F2M5M6	PP4-c	30-May-21	303	348	184.90	05-Jun-21	Burntwood River	1
900.067000108712	BWR19_F2M5M6	PP4-c	30-May-21	270	323	116.46	05-Jun-21	Burntwood River	1
900.067000108715	BWR19_F2M5M6	PP3-c	30-May-21	266	312	105.49	3-Jun-21	Burntwood River	1
900.067000108718	BWR19_F2M5M6	PP4-c	30-May-21	258	300	101.30	05-Jun-21	Burntwood River	1
900.067000108719	BWR19_F2M5M6	PP3-c	30-May-21	290	335	156.93	3-Jun-21	Burntwood River	1
900.067000108720	BWR19_F2M5M6	PP3-c	30-May-21	285	331	134.21	3-Jun-21	Burntwood River	1
900.067000108721	BWR19_F2M5M6	PP3-c	30-May-21	275	318	125.82	3-Jun-21	Burntwood River	1
900.067000108722	BWR19_F2M5M6	PP4-c	30-May-21	277	321	133.85	05-Jun-21	Burntwood River	1
900.067000108723	BWR19_F2M5M6	PP3-c	30-May-21	299	348	172.96	3-Jun-21	Burntwood River	1
900.067000108724	BWR19_F2M5M6	PP3-c	30-May-21	230	276	69.13	3-Jun-21	Burntwood River	1
900.067000108726	BWR19_F2M5M6	PP4-c	30-May-21	293	344	151.55	05-Jun-21	Burntwood River	1
900.067000108727	BWR19_F2M5M6	PP3-c	30-May-21	245	294	93.72	3-Jun-21	Burntwood River	1
900.067000108730	BWR19_F2M5M6	PP4-c	30-May-21	270	320	127.03	05-Jun-21	Burntwood River	1
900.067000108733	BWR19_F2M5M6	PP4-c	30-May-21	344	400	251.56	05-Jun-21	Burntwood River	1
900.067000108737	BWR19_F2M5M6	PP4-c	30-May-21	261	305	94.27	05-Jun-21	Burntwood River	1
900.067000108738	BWR19_F2M5M6	PP4-c	30-May-21	295	345	162.89	05-Jun-21	Burntwood River	1
900.067000108740	BWR19_F2M5M6	PP3-c	30-May-21	340	385	233.04	3-Jun-21	Burntwood River	1
900.067000108741	BWR19_F2M5M6	PP3-c	30-May-21	277	322	122.84	3-Jun-21	Burntwood River	1
900.067000108742	BWR19_F2M5M6	PP3-c	30-May-21	320	374	235.36	3-Jun-21	Burntwood River	1
900.067000108743	BWR19_F2M5M6	PP4-c	30-May-21	272	317	109.25	05-Jun-21	Burntwood River	1
900.067000108744	BWR19_F2M5M6	PP4-c	30-May-21	255	295	94.57	05-Jun-21	Burntwood River	1
900.067000108745	BWR19_F2M5M6	PP3-c	30-May-21	314	356	191.59	3-Jun-21	Burntwood River	1
900.067000108748	BWR19_F2M5M6	PP4-c	30-May-21	267	295	115.69	05-Jun-21	Burntwood River	1
900.067000108751	BWR19_F2M5M6	PP4-c	30-May-21	284	329	160.96	05-Jun-21	Burntwood River	1

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000108752	BWR19_F2M5M6	PP4-c	30-May-21	271	315	129.37	05-Jun-21	Burntwood River	1
900.067000108754	BWR19_F2M5M6	PP3-c	30-May-21	296	355	164.57	3-Jun-21	Burntwood River	1
900.067000108756	BWR19_F2M5M6	PP4-c	30-May-21	255	294	112.24	05-Jun-21	Burntwood River	1
900.067000108758	BWR19_F2M5M6	PP4-c	30-May-21	280	327	147.01	05-Jun-21	Burntwood River	1
900.067000108765	BWR19_F2M5M6	PP3-c	30-May-21	280	319	136.44	3-Jun-21	Burntwood River	1
900.067000108769	BWR19_F2M5M6	PP4-c	30-May-21	264	306	105.57	05-Jun-21	Burntwood River	1
900.067000108770	BWR19_F2M5M6	PP3-c	30-May-21	275	319	128.58	3-Jun-21	Burntwood River	1
900.067000108775	BWR19_F2M5M6	PP3-c	30-May-21	283	334	136.87	3-Jun-21	Burntwood River	1
900.067000108776	BWR19_F2M5M6	PP4-a	30-May-21	240	282	99.94	05-Jun-21	Burntwood River	1
900.067000108777	BWR19_F2M5M6	PP3-c	30-May-21	266	315	122.96	3-Jun-21	Burntwood River	1
900.067000108778	BWR19_F2M5M6	PP3-c	30-May-21	260	305	116.49	3-Jun-21	Burntwood River	1
900.067000109081	BWR19_F2M3M4	PP4-b	30-May-21	260	307	111.15	05-Jun-21	Burntwood River	1
900.067000109082	BWR19_F2M3M4	PP4-b	30-May-21	277	325	133.74	05-Jun-21	Burntwood River	1
900.067000109083	BWR19_F2M3M4	PP3-b	30-May-21	277	325	138.43	3-Jun-21	Burntwood River	1
900.067000109085	BWR19_F2M3M4	PP3-b	30-May-21	298	349	156.01	3-Jun-21	Burntwood River	1
900.067000109086	BWR19_F2M3M4	PP4-b	30-May-21	279	328	127.03	05-Jun-21	Burntwood River	1
900.067000109087	BWR19_F2M3M4	PP4-b	30-May-21	316	369	202.52	05-Jun-21	Burntwood River	1
900.067000109088	BWR19_F2M3M4	PP3-b	30-May-21	297	340	147.30	3-Jun-21	Burntwood River	1
900.067000109089	BWR19_F2M3M4	PP3-b	30-May-21	304	345	155.74	3-Jun-21	Burntwood River	1
900.067000109094	BWR19_F2M3M4	PP3-b	30-May-21	294	340	156.39	3-Jun-21	Burntwood River	1
900.067000109096	BWR19_F2M3M4	PP3-b	30-May-21	341	397	233.19	3-Jun-21	Burntwood River	1
900.067000109099	BWR19_F2M3M4	PP4-b	30-May-21	274	324	121.32	05-Jun-21	Burntwood River	1
900.067000109100	BWR19_F2M3M4	PP3-b	30-May-21	304	358	149.31	3-Jun-21	Burntwood River	1
900.067000109101	BWR19_F2M3M4	PP4-b	30-May-21	278	326	139.45	05-Jun-21	Burntwood River	1
900.067000109103	BWR19_F2M3M4	PP3-b	30-May-21	345	398	276.05	3-Jun-21	Burntwood River	1
900.067000109104	BWR19_F2M3M4	PP3-b	30-May-21	303	348	173.48	3-Jun-21	Burntwood River	1
900.067000109106	BWR19_F2M3M4	PP4-b	30-May-21	263	307	117.76	05-Jun-21	Burntwood River	1
900.067000109108	BWR19_F2M3M4	PP3-b	30-May-21	308	355	162.47	3-Jun-21	Burntwood River	1
900.067000109109	BWR19_F2M3M4	PP4-b	30-May-21	343	397	257.13	05-Jun-21	Burntwood River	1

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000109111	BWR19_F2M3M4	PP3-b	30-May-21	255	296	105.37	3-Jun-21	Burntwood River	1
900.067000109112	BWR19_F2M3M4	PP3-b	30-May-21	305	365	178.05	3-Jun-21	Burntwood River	1
900.067000109113	BWR19_F2M3M4	PP3-b	30-May-21	282	345	161.11	3-Jun-21	Burntwood River	1
900.067000109118	BWR19_F2M3M4	PP3-b	30-May-21	285	330	158.72	3-Jun-21	Burntwood River	1
900.067000109124	BWR19_F2M3M4	PP3-b	30-May-21	285	335	147.19	3-Jun-21	Burntwood River	1
900.067000109125	BWR19_F2M3M4	PP3-b	30-May-21	260	298	99.61	3-Jun-21	Burntwood River	1
900.067000109128	BWR19_F2M3M4	PP3-b	30-May-21	297	348	165.55	3-Jun-21	Burntwood River	1
900.067000109129	BWR19_F2M3M4	PP4-b	30-May-21	354	415	292.51	05-Jun-21	Burntwood River	1
900.067000109130	BWR19_F2M3M4	PP4-b	30-May-21	243	282	86.93	05-Jun-21	Burntwood River	1
900.067000109133	BWR19_F2M3M4	PP4-b	30-May-21	259	310	111.59	05-Jun-21	Burntwood River	1
900.067000109140	BWR19_F2M3M4	PP3-b	30-May-21	295	338	146.39	3-Jun-21	Burntwood River	1
900.067000109145	BWR19_F2M3M4	PP3-b	30-May-21	320	370	211.67	3-Jun-21	Burntwood River	1
900.067000109148	BWR19_F2M3M4	PP4-b	30-May-21	315	376	204.59	05-Jun-21	Burntwood River	1
900.067000109150	BWR19_F2M3M4	PP3-b	30-May-21	274	326	129.45	3-Jun-21	Burntwood River	1
900.067000109154	BWR19_F2M3M4	PP3-b	30-May-21	315	358	168.62	3-Jun-21	Burntwood River	1
900.067000109156	BWR19_F2M3M4	PP4-b	30-May-21	290	342	135.67	05-Jun-21	Burntwood River	1
900.067000109157	BWR19_F2M3M4	PP4-b	30-May-21	267	308	119.04	05-Jun-21	Burntwood River	1
900.067000109160	BWR19_F2M3M4	PP4-b	30-May-21	254	292	96.38	05-Jun-21	Burntwood River	1
900.067000109163	BWR19_F2M3M4	PP4-b	30-May-21	290	333	142.48	05-Jun-21	Burntwood River	1
900.067000109165	BWR19_F2M3M4	PP4-b	30-May-21	275	318	128.11	05-Jun-21	Burntwood River	1
900.067000109168	BWR19_F2M3M4	PP4-b	30-May-21	307	361	178.66	05-Jun-21	Burntwood River	1
900.067000109169	BWR19_F2M3M4	PP3-b	30-May-21	305	361	194.13	3-Jun-21	Burntwood River	1
900.067000109170	BWR19_F2M3M4	PP4-b	30-May-21	284	337	154.98	05-Jun-21	Burntwood River	1
900.067000109180	BWR19_F2M3M4	PP3-b	30-May-21	282	323	140.02	3-Jun-21	Burntwood River	1
900.067000109393	BWR19_F2M1M2	PP4-a	30-May-21	267	306	113.01	05-Jun-21	Burntwood River	1
900.067000109398	BWR19_F2M1M2	PP4-a	30-May-21	280	332	136.23	05-Jun-21	Burntwood River	1
900.067000109402	BWR19_F2M1M2	PP3-a	30-May-21	310	361	185.54	3-Jun-21	Burntwood River	1
900.067000109406	BWR19_F2M1M2	PP3-a	30-May-21	320	378	208.37	3-Jun-21	Burntwood River	1
900.067000109408	BWR19_F2M1M2	PP4-a	30-May-21	280	322	128.81	05-Jun-21	Burntwood River	1

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000109418	BWR19_F2M1M2	PP4-a	30-May-21	253	300	96.60	05-Jun-21	Burntwood River	1
900.067000109432	BWR19_F2M1M2	PP3-a	30-May-21	310	354	187.96	3-Jun-21	Burntwood River	1
900.067000109433	BWR19_F2M1M2	PP3-a	30-May-21	295	345	160.53	3-Jun-21	Burntwood River	1
900.067000109437	BWR19_F2M1M2	PP3-a	30-May-21	275	322	120.81	3-Jun-21	Burntwood River	1
900.067000109439	BWR19_F2M1M2	PP3-a	30-May-21	310	360	174.87	3-Jun-21	Burntwood River	1
900.067000109444	BWR19_F2M1M2	PP4-a	30-May-21	330	381	237.40	05-Jun-21	Burntwood River	1
900.067000109445	BWR19_F2M1M2	PP4-a	30-May-21	299	346	178.68	05-Jun-21	Burntwood River	1
900.067000109447	BWR19_F2M1M2	PP3-a	30-May-21	260	305	113.21	3-Jun-21	Burntwood River	1
900.067000109453	BWR19_F2M1M2	PP4-a	30-May-21	303	360	172.20	05-Jun-21	Burntwood River	1
900.067000109454	BWR19_F2M1M2	PP4-a	30-May-21	317	364	196.67	05-Jun-21	Burntwood River	1
900.067000109456	BWR19_F2M1M2	PP3-a	30-May-21	315	364	207.88	3-Jun-21	Burntwood River	1
900.067000109462	BWR19_F2M1M2	PP3-a	30-May-21	262	301	117.67	3-Jun-21	Burntwood River	1
900.067000109467	BWR19_F2M1M2	PP3-a	30-May-21	322	378	236.48	3-Jun-21	Burntwood River	1
900.067000109470	BWR19_F2M1M2	PP3-a	30-May-21	290	340	147.74	3-Jun-21	Burntwood River	1
900.067000109479	BWR19_F2M1M2	PP4-a	30-May-21	292	336	150.02	05-Jun-21	Burntwood River	1
900.067000110788	BWR19_F2M5M6	PP3-c	30-May-21	255	297	101.98	3-Jun-21	Burntwood River	1
900.067000110799	BWR19_F2M5M6	PP4-c	30-May-21	269	311	141.71	05-Jun-21	Burntwood River	1
900.067000110803	BWR19_F2M5M6	PP3-c	30-May-21	280	330	140.55	3-Jun-21	Burntwood River	1
900.067000110808	BWR19_F2M5M6	PP3-c	30-May-21	290	339	139.69	3-Jun-21	Burntwood River	1
900.067000110822	BWR19_F2M5M6	PP4-c	30-May-21	247	295	95.66	05-Jun-21	Burntwood River	1
900.067000110825	BWR19_F2M5M6	PP3-c	30-May-21	250	293	88.50	3-Jun-21	Burntwood River	1
900.067000110841	BWR19_F2M5M6	PP3-c	30-May-21	265	310	115.40	3-Jun-21	Burntwood River	1
900.067000111399	BWR19_F2M3M4	PP4-b	30-May-21	337	388	233.34	05-Jun-21	Burntwood River	1
900.067000111400	BWR19_F2M3M4	PP4-b	30-May-21	280	329	127.61	05-Jun-21	Burntwood River	1
900.067000111406	BWR19_F2M3M4	PP4-b	30-May-21	242	284	91.73	05-Jun-21	Burntwood River	1
900.067000111413	BWR19_F2M3M4	PP4-b	30-May-21	314	367	205.34	05-Jun-21	Burntwood River	1
900.067000111420	BWR19_F2M3M4	PP3-b	30-May-21	343	403	259.88	3-Jun-21	Burntwood River	1
900.067000111442	BWR19_F2M3M4	PP4-b	30-May-21	332	391	245.83	05-Jun-21	Burntwood River	1
900.067000111452	BWR19_F2M3M4	PP4-b	30-May-21	292	340	153.34	05-Jun-21	Burntwood River	1

Lake Sturgeon			Final Hatchery Measurement				Stocking Activity		
PIT Tag ID	LOT_Family	Tank	Date	FL (mm)	TL (mm)	Wt (g)	Date	Waterbody	Site
900.067000111455	BWR19_F2M3M4	PP4-b	30-May-21	310	360	177.39	05-Jun-21	Burntwood River	1
900.067000111466	BWR19_F2M3M4	PP4-b	30-May-21	299	350	152.81	05-Jun-21	Burntwood River	1
900.067000111476	BWR19_F2M3M4	PP3-b	30-May-21	285	331	134.41	3-Jun-21	Burntwood River	1
900.067000113284	BWR19_F2M5M6	PP4-c	30-May-21	264	315	116.76	05-Jun-21	Burntwood River	1
900.067000113299	BWR19_F2M1M2	PP3-a	30-May-21	320	371	216.51	3-Jun-21	Burntwood River	1
900.067000113321	BWR19_F2M5M6	PP4-c	30-May-21	277	331	126.84	05-Jun-21	Burntwood River	1
900.067000113322	BWR19_F2M1M2	PP4-a	30-May-21	294	341	180.81	05-Jun-21	Burntwood River	1
900.067000113329	BWR19_F2M5M6	PP4-c	30-May-21	n/a	n/a	n/a	05-Jun-21	Burntwood River	1
900.067000113349	BWR19_F2M1M2	PP3-a	30-May-21	325	376	215.51	3-Jun-21	Burntwood River	1
900.067000113367	BWR19_F2M5M6	PP3-c	30-May-21	230	274	75.83	3-Jun-21	Burntwood River	1
900.067000113395	BWR19_F2M3M4	PP3-b	30-May-21	310	363	184.54	3-Jun-21	Burntwood River	1
900.067000113816	BWR19_F2M1M2	PP4-a	30-May-21	327	378	212.32	05-Jun-21	Burntwood River	1
900.067000113823	BWR19_F2M1M2	PP4-a	30-May-21	274	317	129.77	05-Jun-21	Burntwood River	1
900.067000113866	BWR19_F2M3M4	PP4-b	30-May-21	299	346	177.85	05-Jun-21	Burntwood River	1
900.067000113867	BWR19_F2M1M2	PP4-a	30-May-21	315	365	190.83	05-Jun-21	Burntwood River	1



## **APPENDIX 2: BIRTHDAY RAPIDS (2021 YEAR-CLASS)**

**Table A2-1: Survival (%) of Birthday Rapids sturgeon (2021 year-class) at GRFH from June 21 (hatch) to September 30, 2021. Month survivals do not include euthanized fish in June and August or recount adjustments.**

**Table A2-2: Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Birthday Rapids (2021 year-class) reared at Grand Rapids Fish Hatchery**

**Table A2-3: Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Birthday Rapids sturgeon (2021 year-class) reared at Grand Rapids Fish Hatchery**

**Table A2-1:** Survival (%) of Birthday Rapids sturgeon (2021 year-class) at GRFH from June 21 (hatch) to September 30, 2021. Monthly survivals do not include euthanized fish in June and August or recount adjustments.

LOT	Tank s	Month-Year	Start of Mont h Total	Mortality			Transfer		Recount Adjustme nt	End of Mont h Total	Monthl y Surviva l (%)
				Natura l	Accident al	Euthanize d	Stockin g	Other			
LKST- BDR-21	2 <sup>a</sup>	Jun-21	5,250	671	0	20 <sup>d</sup>	0	0	0	4,559	87.2
LKST- BDR-21	2 <sup>a</sup>	Jul-21	4,559	1,771	0	0	0	0	302(-)	2,486	61.2
LKST- BDR-21	2 <sup>b</sup>	Aug-21	2,486	351	0	60 <sup>e</sup>	0	0	184(-)	1,891	85.9
LKST- BDR-21	2 <sup>c</sup>	Sep-21	1,891	3	0	36 <sup>f</sup>	1,050 <sup>g</sup>	3 <sup>h</sup>	0	799	97.9
<b>Total (BDR-21)</b>			<b>5,250</b>	<b>2,796</b>	<b>0</b>	<b>116</b>	<b>1,050</b>	<b>3</b>	<b>486(-)</b>	<b>799</b>	<b>44.5</b>

a. Pickerel Place: PP3 (A: F1xM3, C: F1xM5), PP4 (B: F1xM6, D: F1xM8)

b. Pickerel Place: PP3 (A: F1xM3), PP4 (B: F1xM6, D: F1xM8)

c. Pickerel Place: PP3 (B/C: F1xM3), PP4 (B: F1xM6, C/D: F1xM8)

d. DNA samples (5 per family)

e. Namao Virus samples (20 per family)

f. Euthanized due to presence of white spots (12 submitted to DFO)

g. Stocked into Stephens Lake

h. Transferred to York Landing for KSNC school aquarium

**Table A2-2:** Monthly average ( $\pm$ SD), minimum and maximum Dissolved Oxygen (%), Dissolved Carbon Dioxide (mg/L), pH, Total Ammonia-Nitrogen (mg/L), Un-Ionized Ammonia (mg/L) and Nitrite Nitrogen (mg/L) values for Birthday Rapids sturgeon (2021 year-class) reared at Grand Rapids Fish Hatchery

Parameter	Mth-Yr	N <sup>a</sup>	Avg	$\pm$ SD	Min	Max
<b>Dissolved O2 (%)</b>	Jun-21	2	97.10	0.14	97.00	97.20
	Jul-21	4	93.40	5.53	88.10	100.80
	Aug-21	5	89.52	6.51	80.30	97.30
	Sep-21	4	102.65	5.12	97.80	109.00
<b>Dissolved CO2 (mg/L)</b>	Jun-21	3	2.00	0.00	2.00	2.00
	Jul-21	4	1.00	0.00	1.00	1.00
	Aug-21	5	1.00	0.00	1.00	1.00
	Sep-21	4	1.50	0.58	1.00	2.00
<b>pH</b>	Jun-21	3	8.43	0.37	8.00	8.67
	Jul-21	4	8.64	0.11	8.48	8.72
	Aug-21	5	8.68	0.07	8.63	8.80
	Sep-21	4	8.63	0.10	8.50	8.75
<b>Total Ammonia (mg/L)</b>	Jun-21	3	0.037	0.023	0.010	0.050
	Jul-21	4	0.030	0.022	0.000	0.050
	Aug-21	5	0.076	0.032	0.040	0.110
	Sep-21	4	0.068	0.026	0.040	0.090
<b>UIA (mg/L)</b>	Jun-21	3	0.003	0.002	0.000	0.005
	Jul-21	4	0.004	0.003	0.000	0.007
	Aug-21	5	0.009	0.003	0.005	0.013
	Sep-21	4	0.007	0.002	0.004	0.009
<b>Nitrite Nitrogen (mg/L)</b>	Jun-21	3	0.00	0.00	0.00	0.00
	Jul-21	4	0.00	0.00	0.00	0.01
	Aug-21	5	0.02	0.02	0.00	0.04
	Sep-21	4	0.01	0.00	0.01	0.01

a. Number of water samples per month

**Table A2-3:** Monthly average ( $\pm$ SD), minimum and maximum fork length (mm), total length (mm) and weight (g) for Birthday Rapids sturgeon (2021 year-class) reared at Grand Rapids Fish Hatchery

Measurement	Mth-Yr	N <sup>a</sup>	Avg	$\pm$ SD	Min	Max
<b>Fork Length (mm)</b>	Jul-21	0				
	Aug-21	45	71	9	44	90
	Sep-21	45	96	7	77	113
<b>Total Length (mm)</b>	Jul-21	45	36	4	27	43
	Aug-21	45	77	9	50	96
	Sep-21	45	110	8	90	130
<b>Weight (g)</b>	Jul-21	45	0	0	0	0
	Aug-21	45	2.0	0.7	0.5	3.7
	Sep-21	45	5.0	1.1	2.8	7.7

a. Number of fish measured

## **APPENDIX 3: WATER QUALITY THRESHOLDS**

**Table A3-1: Reported Lake Sturgeon threshold values for Dissolved Oxygen, Dissolved Carbon Dioxide, pH, Ammonia-Nitrogen and Nitrite Nitrogen**



**Table A3-1:** Reported Lake Sturgeon threshold values for Dissolved Oxygen, Dissolved Carbon Dioxide, pH, Ammonia-Nitrogen and Nitrite Nitrogen

Parameter	Threshold Values	References
<b>Dissolved O<sub>2</sub> (%)</b>	> 80	Gwangseok et al 2019
	> 60	Chebanov and Galich 2011
<b>Dissolved O<sub>2</sub> (mg/L)</b>	> 6.0	Hochleithner and Gessner 2012
	> 4.0	Chebanov and Galich 2011
	> 5.0	Mims et al 2002
	> 6.0	Dettlaff et al 1993
<b>Dissolved CO<sub>2</sub> (mg/L)</b>	< 10.0	Hochleithner and Gessner 2012
	< 10.0	Chebanov and Galich 2011
<b>pH</b>	6.5 to 8.0	Hochleithner and Gessner 2012
	6.5 to 7.5	Chebanov and Galich 2011
	6.5 to 8.5	Mims et al 2002
	6.5 to 8.0	Dettlaff et al 1993
<b>Ammonia NH<sub>3</sub>-N (mg/L)</b>	< 0.010	Hochleithner and Gessner 2012
	< 0.003	Chebanov and Galich 2011
	< 0.010	Mims et al 2002
<b>Nitrite Nitrogen (mg/L)</b>	0.1 to 0.2	Chebanov and Galich 2011
	< 0.1	Mims et al 2002

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