

Keeyask Generation Project
North Channel Rock Groin – Request for In-stream Work

Manitoba Hydro, in its delegated authority to manage construction of the Keeyask Generation Project on behalf of the Keeyask Hydropower Limited Partnership, is requesting to undertake the following;

- Increase the footprint of the North Channel Rock Groin (NCRG) by approximately 1000 m²;
- Conduct work on the NCRG during the restricted activity timing window for in-stream work up until April 15, or 15 days after receiving regulatory approval;
- Remove material from the NCRG during the summer restricted activity timing window (May 15 – July 15) if the water elevation at the NCRG reaches 156.5 m and there is a forecast for even higher flows. There is a very low probability for this situation to occur; and
- If portions of the NCRG are removed (by either controlled or un-controlled overtopping), rebuild the NCRG in the summer or fall of 2017 (potentially during the fall restricted activity timing window).

The Lower Nelson River is currently experiencing unprecedented high inflows for this time of year. These record high inflows are forecasted to continue to climb as the spring freshet starts to arrive in May and could continue through the summer months to August/September depending on future precipitation and weather patterns across the watershed. At this time, a forecasted upper limit for the peak flow in 2017 is approximately 7000 cms (would be highest flow on record, 100th percentile) which would result in a water elevation at the NCRG that approaches 156.5-157.0 m. A water level at this elevation, with no pre-emptive mitigative efforts, will overtop the North Channel Rock Groin, which has a design crest elevation of 156.2 m.

The NCRG is an integral part of the infrastructure in place to promote the formation of a stable ice cover upstream of the Keeyask construction site and must be fully functional by November of any given year in time for freeze-up conditions. Uncontrolled overtopping of this structure could result in a breach of an unknown size and at an unknown location along the NCRG. This breach would need to be repaired prior to fall freeze-up in order to promote ice cover formation. Controlled overtopping of the structure, by preemptive removal of material, would also require reinstallation to the original crest elevation prior to freeze up.

The NCRG is the only structure that requires mitigative measures to address the predicted water flows and related water elevations for 2017. All other Keeyask river management structures have been topped up to levels required during a significant winter ice event (i.e., delayed upstream ice cover) and are well above the crest elevations required for this anticipated open water event.

Description of Work

The proposed plan allows for controlled overtopping of the NCRG which is more desirable from an engineering and environmental perspective when compared to the alternatives. A portion of the NCRG

will be raised to a crest elevation of 157.2 m with class C1 rockfill, in addition class C3 rockfill will be added to armour the downstream side of the structure at this location, see sketch KS-278 Zone 3 and Zone 2. This will widen a portion of the NCRG by approximately 4 m and will increase the footprint by approximately 1000 m². In the locations where the NCRG was constructed with C3/C4 materials the crest will remain at approximately 156.2 m to act as a broad crested weir and allow for some excess flow to pass over the top when water levels at the NCRG approach 156.2 m, see sketch KS-278. To note, the plan is currently being finalized by the design engineer and there may be minor modifications.

The sizes of the rockfill are as follows:

Class C1 – 0.3 m mean diameter

Class C2 – 0.5 m mean diameter

Class C3 – 1.0 m mean diameter

Rock material will be sourced from existing Keeyask quarries. It is anticipated that this work will commence at the beginning of April and be completed prior to April 15 (or 15 days after receiving regulatory approval).

The Nelson River is contained in its banks to the limit of the lowest surrounding topographical feature. In the areas around the Keeyask construction site the lowest topographical features are on the south side of the river and approach an elevation of 156-156.5 m. In 2015, the South Side Containment Dykes were constructed through these low areas and protection is in place to an elevation of approximately 157.0 m at the NCRG. Water levels above this elevation have the potential to create a new flow path into the low areas to the south of the Nelson River. Should the water elevation rise to 156.5 m and the flow is forecasted to increase during either the spring and/or summer seasons, there is the risk that the water elevation at the NCRG would exceed 157 m. There is a very low probability for this situation to occur as flows would need to be greater than 7000 cms (and forecasted to go even higher) which would already be the highest flow on record for the Nelson River at Keeyask and is currently greater than the upper limit of the current 3-month inflow forecasts (inflow forecasts will be continually revised going forward). However, if this situation does occur, a portion (Zone 3 location on sketch KS278) of the NCRG will have the elevation reduced to the full reach of the arm of a large excavator (approximately 4m). This will allow for the structure to pass additional flow at this location which will keep the NCRG water elevation below 157.0 m for all foreseeable flood conditions.

The removal of this rock may need to occur during the summer restricted activity timing window (May 15 – July 15). It would mitigate effects that would result from an uncontrolled overflow of the NCRG structure (i.e., more erosion of the peat material on the island etc).

As per the original plan, the entire NCRG (including the proposed top-up) would be lowered to elevation 151.0 m prior to impoundment and the river channel portion of the NCRG remnant would be submerged under 8 m of water after impoundment.

Potential Environmental Effects

Surface water

The Lower Nelson River is currently experiencing unprecedented high inflows for this time of year which are likely to extend into the spring and summer seasons. With the planned mitigative efforts, water levels upstream of the NCRG will stay below 157 m. This will create Gull Lake water levels that are higher than the existing environment (as well as the construction period to date) but these water levels will be at least 2 m below the future impounded water level and will be near the limits of the current containment structures in place. The forecasted water levels are as expected during these unprecedented inflow conditions. Upstream of Gull Lake, water level impacts will be minimal.

Erosion and Suspended Sediments

During these unprecedented inflow conditions, erosion and mobilization of sediment will occur throughout the entire Nelson River reach. The planned mitigative measures will introduce minimal amounts of sediment into the water as the rock that is being placed, and possibly removed, will be rockfill material (i.e., very little to no fine material). In addition, one goal of these measures is to reduce the potential for large amounts of erosion that could occur on the island if the NCRG was allowed to experience water levels greater than 157 m. There will be no detectable increases in Total Suspended Solids (TSS) during any of the proposed activities.

Aquatic Environment

Refer to attached North/South Consultants memo.

Summary

The proposed plan allows for controlled overtopping of the NCRG which is more desirable from an engineering and environmental perspective when compared to the alternatives. Potential environmental effects are anticipated to be negligible beyond those occurring in conjunction with the Keeyask Generation Project.



North Access Road

Helipad

Main Camp

Borrow G-3

Causeway

North Dyke

Work Areas

Batch Plant

Borrow N-5

Causeway

Construction Phase
Boat Launch & Barge Landing
Access Trail

Construction
Power Substation

Work Area

Quarry Q-7

Wastewater
Treatment Plant

Ice Boom

North Channel
Cofferdam

North Channel
Rock Groin

Island
Cofferdam

Quarry
Cofferdam

Powerhouse
Cofferdam

Central Dam
Cofferdam
North Extension

Central Dam
Cofferdam

Construction Power
Transmission Lines

Ice Boom

Ice Boom

Containment Dyke

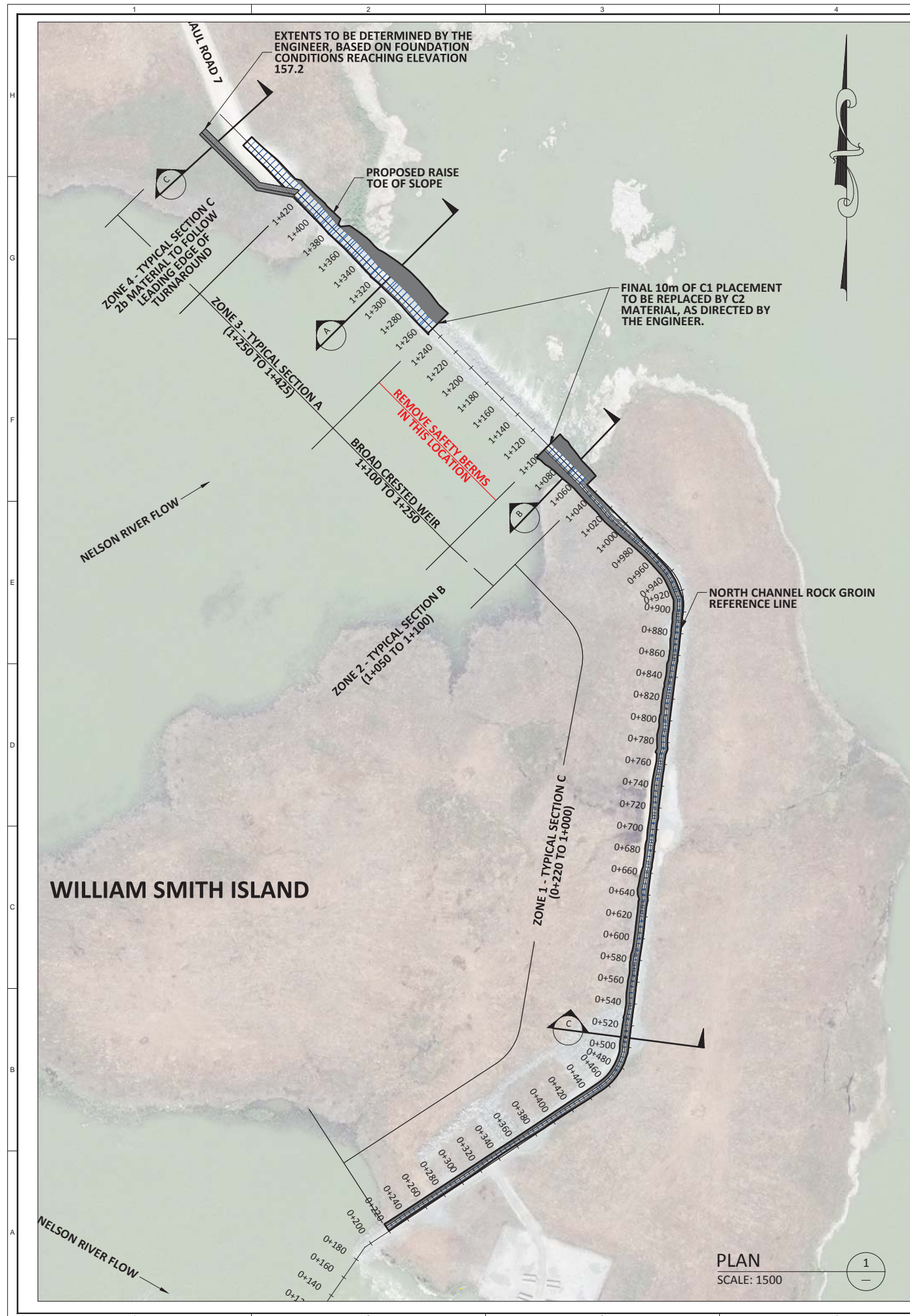
Spillway
Cofferdam

SATELLITE IMAGE - SEPTEMBER 21, 2016

South Dyke

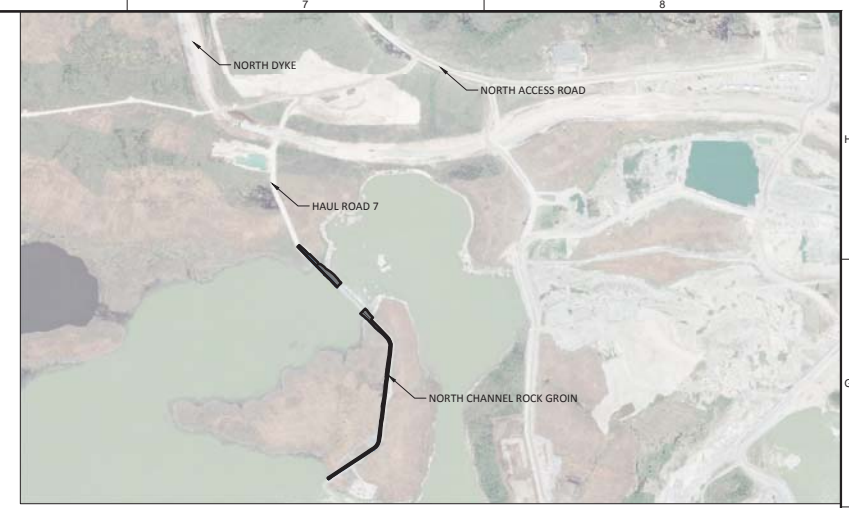
Containment Dyke

South Access Road



PLAN
SCALE: 1500

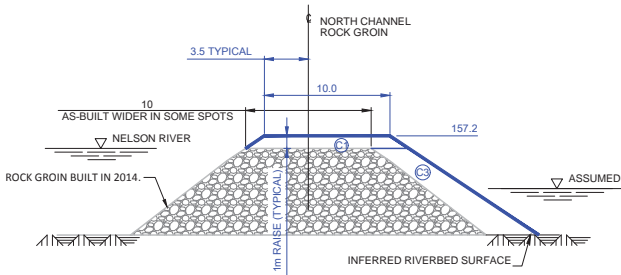
- LEGEND:**
- CONTOURS (1m INTERVALS)
 - WATER LEVEL
 - ROCKFILL
 - MODIFIED CLASS 2B FILL
 - PROPOSED 1m RAISE FILL DESIGN
 - EXISTING CONSTRUCTION
 - NEW CONSTRUCTION



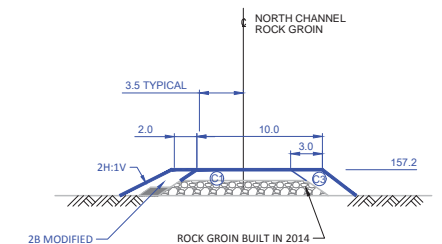
LOCATION PLAN
SCALE: NTS

- NOTE:**
1. TYPICAL SECTIONS AND NOTES EXTRACTED FROM "STAGE 1 COFFERDAMS NORTH CHANNEL ROCK GROIN EXTENSION PLAN AND SECTIONS" 1-00195-DE-21600-0013 AND MODIFIED BY MANITOBA HYDRO.
 2. DIMENSIONS AND ELEVATIONS ARE IN METERS
 3. ELEVATION ARE BASED ON CGVD28, 1929 ADJUSTMENT
 4. TOPOGRAPHIC INFORMATION FROM VARIOUS SOURCES.
 5. LOCATIONS OF SHORELINES ARE APPROXIMATE AND ARE BASED ON WATER ELEVATION FROM THE LIDAR SURVEY, 2010.
 6. FILL FOR THE ROCK GROIN THAT IS PLACED IN WATER SHALL BE ALLOWED TO FALL TO ITS ANGLE OF REPOSE CLASS C (ROCKFILL) PLACED ABOVE WATER ELEVATION SHALL BE PLACED AT 1V:1.5H, UNLESS NOTED OTHERWISE.
 7. THE ENGINEER WILL PROVIDE FORECASTED WATER ELEVATIONS AS REQUIRED.
 8. BACKGROUND AERIAL DATED SEPTEMBER, 2016.
 9. TOP-UP MATERIAL TO BE BLENDED INTO EXISTING ACCESS ROADS TO ALLOW VEHICLE TRAFFIC ACCESS.
 10. UPSTREAM GRANULAR BLANKET FROM STATION 1+080 TO 0+220 MAY BE MODIFIED 2b OR 2b DEPENDING ON AVAILABILITY.
 11. QUANTITIES REQUIRED:

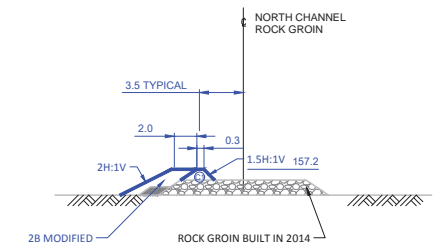
- NOTE: QUANTITIES COULD VARY BASED ON EXTENTS OF ZONE 4
- C1 = 4,700 m³
 - C3 = 2,700 m³
 - C2 = 200 m³
 - 2b MODIFIED = 3,200 m³



SECTION A
SCALE 1:200



SECTION B
SCALE 1:200



SECTION C
SCALE 1:200

Disclaimer:
This document has been prepared by Hatch Ltd. for Manitoba Hydro ("MH") and the Keeyask Hydropower Limited Partnership ("KHL") for use in construction of the Keeyask Hydroelectric Generating Station Project ("Project"). Any claims for delays or for costs by contractors and suppliers ("Third Parties") in correcting or re-performing work for the Project and resulting from the use of, and from errors or omissions in, this document ("Claims") shall be solely against MH and/or KHL, and subject to the terms of the applicable contracts between the Third Parties and MH and/or KHL, and Hatch Ltd. disclaims any and all liability to Third Parties for such Claims.

| REV. | DATE | DESCRIPTION | BY | CHKD. | APP./P. ENG. |
|------|------------|-----------------------------------|-----|-------|--------------|
| 4 | 2017-03-27 | REMOVAL OF "FUSE PLUG" | AES | SC | TA |
| 3 | 2017-03-27 | ADDITION OF C2 TO SECTION B | AES | SC | TA |
| G | 2017-03-26 | ADDITION ZONE 4, SECTION C REV | AES | SC | TA |
| F | 2017-03-26 | SECTION C REVISED, QTY REVISED | AES | SC | TA |
| E | 2017-03-26 | SECTION B REVISED, QTY REVISED | AES | SC | TA |
| D | 2017-03-26 | VOLUMES ADDED, NOTES CHANGED | AES | SC | TA |
| C | 2017-03-25 | RANGES MODIFIED, SECTION C ADDED | AES | SC | BB |
| 2 | 2017-03-20 | RANGES MODIFIED AND 2B SEAL ADDED | BRP | SC | BB |
| 1 | 2017-03-20 | LENGTH OF RAISE LIMITS DECREASED | BRP | SC | BB |

HATCH

DESIGNED: HATCH
DATE: 2017/03/27

STAGE 1 COFFERDAMS
NORTH CHANNEL ROCK GROIN
1 METER RAISE
PLAN AND SECTION

DRAWING NUMBER: **KS-278**
SHEET: **01**
REVISION: **04**



KEEYASK GENERATION PROJECT TECHNICAL MEMORANDUM

Subject: Proposed Alteration to the North Channel Rock Groin

To: Carlyne Northover
Manitoba Hydro

From: Friederike Schneider-Vieira
North/South Consultants Inc.

Date: March 27, 2017

Background

Manitoba Hydro is planning to conduct the following activities to address the risk of the North Channel Rock Groin (NCRG) overtopping as a result of extremely high discharge on the Nelson River:

- Increase the footprint of the NCRG by approximately 1000 m²;
- Conduct work (rock placement) on the NCRG during the fall/winter restricted activity timing window for in-stream work, up until April 15 or 15 days after receiving regulatory approval;
- Remove material from the NCRG during the spring restricted activity timing window (May 15 – July 15) if water elevation at the NCRG is 156.5 m and there is a forecast for higher flows with the risk of breaching the NCRG. There is a low probability for this situation; and
- If portions of the NCRG are removed (by either controlled or un-controlled overtopping), rebuild the NCRG in summer or fall 2017 (potentially during the fall restricted activity timing window).

Assessment

The NCGR is located in the former north channel of Gull Rapids, in a wetted area with no flow (Map 1). Fish use of habitat at the NCGR has not been documented since impoundment, but based on fish salvages conducted in other channels of Gull Rapids after impoundment and dewatering, juvenile Longnose Sucker and Longnose Dace are likely the most abundant species. These fish were thought to have drifted in as larvae and the Longnose Sucker are thought to move downstream after they reach a certain size (the catch was almost only small juveniles). Acoustic telemetry studies conducted on adult and juvenile Lake Sturgeon, Walleye and Lake Whitefish indicate that it is unlikely that large bodied fish are moving into the vicinity of the NCGR from either upstream in Gull Lake or downstream in Stephens Lake. The location of acoustic receivers closest to Gull Rapids are shown as stars on Map 1. Apart from fish moving downstream past Gull Rapids (which is an unusual event), almost no fish are detected on the receivers upstream of the NCGR. Fish are frequently detected at the receivers set immediately downstream of Gull Rapids, but since the start of construction in 2014, no tagged fish from Stephens Lake have moved upstream.

The assessment of specific components of the proposed work is as follows:

- Increase the footprint of the NCGR by approximately 1000 m².

As noted above, the area of the NCGR is currently thought to provide habitat to a local assemblage of fish and is not used by fish from either Gull or Stephens Lakes. The extension of the footprint of the structure will not affect this local fish assemblage as abundant habitat is available, and fish are able to move downstream if habitat becomes limiting.

Following impoundment, the NCGR, like the remnants of cofferdams, will be flooded within the reservoir and provide some structure to the deep water environment.

- Conduct work (rock placement) on the NCRG during the fall/winter restricted activity timing window for in-stream work, up until April 15 (or 15 days after receiving regulatory approval), and potentially repair the NCRG during the fall restricted activity window (fall 2017).

No fall spawning species are expected to use this area for spawning; therefore conduct of work during the in-stream timing window is not expected to adversely affect fish spawn. Only rock will be placed on the NCRG as the structure is not sealed with fine material.

Therefore, spawning habitat in the lower section of Gull Rapids is not expected to be affected.

- Potential removal of material from the NCRG during the spring restricted activity timing window (May 15 – July 15).

As for the fall-spawning species, no spring spawning species are expected to use the area of the NCRG for spawning, therefore work (removal of rock) during the instream timing window is not expected to adversely affect fish spawn.

Conclusion

Given that the area of the NCRG is not expected to provide habitat to large-bodied fish from either Gull Lake or Stephens Lake, and that effects to fish habitat will be restricted to the site, no effect to the productive capacity of fish and fish habitat in either Gull Lake or Stephens Lake is anticipated.



Map 1. Stars indicate approximate locations of acoustic receivers used to track fish movements during open water.