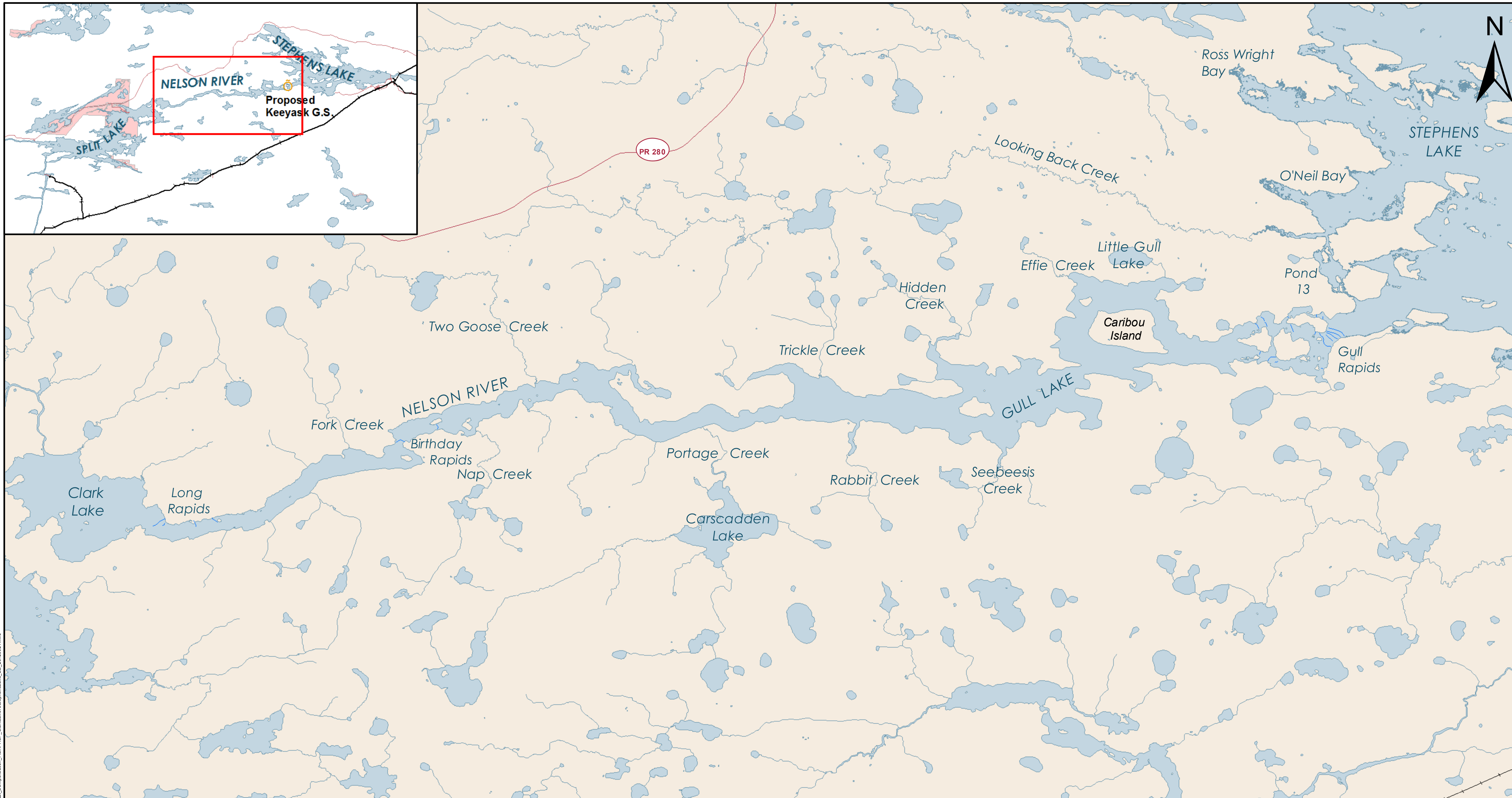



0 2.5 5 7.5 10 Kilometres

0 1.25 2.5 3.75 5 Miles

**Projection: UTM Zone 15, NAD 83**
**Data Source: NTS base 1:50 000**
**Stephens Lake Shoreline - Quickbird@Digitalglobe, 2006**
**Nelson River Shoreline modelled by Manitoba Hydro**
**Shows 95th percentile inflow.**

# Clark Lake to Stephens Lake

Existing Environment

### 2.5.3 Requirement for Habitat Compensation

With ongoing and routine prevention of debris accumulation there will be no requirement for fish habitat compensation measures.

## 2.6 WINTER ENTRAPMENT OF FISH IN LITTLE GULL LAKE AREA

### 2.6.1 Description

Dissolved oxygen (DO) levels in inundated Little Gull Lake are expected to decrease to less than 2 mg/L over winter, limiting its ability to support fish (AE SV Section 2.5.2.2.2; maps 2-18 to 2-21). Post-impoundment, large-bodied fish are expected to move into this area as it will be connected to the reservoir.

### 2.6.2 Potential Effects and Mitigation

Fish that remain in the Little Gull Lake area following freeze-up would be susceptible to winterkill when the shallow connecting waterways between the former Little Gull Lake and the main body of the reservoir freeze to the bottom and DO levels in the lake decline to near zero.

The excavation of two 5 m base-width channels that would allow fish to escape into areas of the reservoir with more suitable DO levels is proposed as a means of mitigating potential winterkill of fish (AE SV Appendix 1A-Part 1). The provision of escape channels to other parts of the reservoir is expected to result in an oxygen gradient that fish would detect, thus enabling avoidance of lower than preferred or tolerable DO levels. Channel design will facilitate connectivity for fish throughout the winter ice-cover period. The channels will be excavated "in the dry" before reservoir impoundment and spring surveys will be conducted during the first three years following reservoir impoundment to FSL to confirm that winterkill of fish does not occur in the Little Gull Lake area (see Section 5.2.3.6 of the AEMP for monitoring details).

### 2.6.3 Requirement for Habitat Compensation

The creation of fish escape channels is expected to fully mitigate the potential for winterkill in this portion of the Keeyask reservoir. Consequently, there is no requirement for the development of fish habitat compensation measures.

## 2.7 ALTERATION OF LAKE STURGEON SPAWNING HABITAT AT BIRTHDAY RAPIDS

Birthday Rapids is a known lake sturgeon spawning location. Five variable habitat suitability index (HSI) modelling indicates that 0.43 ha (Weighted Usable Area [WUA]) of spawning habitat (HSI=0.5–1.0; high to very high suitability habitat) exists at the rapids under 50th percentile flow conditions (AE SV Appendix 6D).

### 2.7.1 Description

Impoundment of the Keeyask reservoir will lead to increased water levels that will submerge Birthday Rapids (PE SV), converting them into fast-flowing habitat without visible white water. Despite a 1–2 m/s reduction in water velocities at Birthday Rapids following impoundment (depending on discharge), velocities will still be high enough for the habitat in this location to be classified as "fast-flowing" (PE SV Section 4.4, Map 4.4-10). During the open-water season, Long Rapids will remain unaffected by the Project.

### 2.7.2 Potential Effects and Mitigation

Lake sturgeon prefer to spawn at sites where white water is present. It is unknown whether lake sturgeon will continue to spawn at the Birthday Rapids location post-impoundment. Spawning habitat currently present at Long Rapids (upstream of Birthday Rapids) will continue to be available post-impoundment and it is expected that lake sturgeon will continue to use this area for spawning as depth, velocity and substrate will remain suitable (AE SV Section 3.4.2.2; maps 3-28, 3-31 and 3-34). Monitoring (Section 4.4.1) will be implemented to determine the success of lake sturgeon spawning in the reach of the Nelson River between and including Long Rapids and Birthday Rapids following impoundment of the reservoir.

### 2.7.3 Requirement for Habitat Compensation

Should monitoring indicate poor or no spawning success, contingency works to create suitable spawning habitat for the maintenance of lake sturgeon in the reservoir would be implemented (Section 4.4.1).

## 2.8 ALTERATION OF LAKE STURGEON YOUNG-OF-THE YEAR REARING HABITAT IN GULL LAKE

### 2.8.1 Description

Lake sturgeon young-of-the-year (YOY) habitat (40.3 ha of highly suitable habitat; AE SV Appendix 6D) currently exists north of Caribou Island in Gull Lake. This habitat is characterized (AE SV Section

6.3.2.3.1) as having a "sand with some silt/clay" substrate with generally planar topography, a low to moderate slope, and slower water velocities (0.2-0.5 m/s).

### 2.8.2 Potential Effects and Mitigation

Changes in water velocity and flow regimes resulting from reservoir creation are expected to render the existing YOY rearing area unavailable to YOY lake sturgeon. Mitigation for the hydraulic changes is not feasible.

Predictions of post-impoundment changes to water velocity and related sediment transport conditions (AE SV Section 3.4.2.2; Map 3-31) suggest there may not be suitable sand-type bottom substrates available at locations where drifting YOY lake sturgeon are predicted to become bottom oriented.

Monitoring (Section 4.5.1) will be implemented to assess the post-impoundment availability and quality of YOY lake sturgeon habitat and YOY use of those habitats.

### 2.8.3 Requirement for Habitat Compensation

Should monitoring indicate an inadequate quality and quantity of habitat and poor YOY habitat utilization following impoundment, a YOY rearing habitat enhancement plan will be implemented (Section 4.5.1).

Stocking of lake sturgeon will also be undertaken to address the potential lack of YOY rearing habitat that might otherwise affect lake sturgeon population growth in the reservoir.

## 2.9 REDUCED FISH ACCESS TO STEPHENS LAKE

### 2.9.1 Description

Currently, a low level of incidental movement of adult fish occurs in the downstream direction over Gull Rapids (AE SV Section 5.3.2.6). Once the Keeyask GS is built, it will alter these movements as fish moving downstream will need to pass downstream via the turbines or the spillway when it is in operation.

### 2.9.2 Potential Effects and Mitigation

Downstream passage for fish will be provided via the turbines and the spillway. Considerable effort has gone into optimizing the Keeyask turbine design to reduce fish mortality and allow fish to move downstream (AE SV Appendix 1A-Part 1, Section 1A.3.2.2.2). The spillway does not include features that are associated with increased fish mortality (PD SV Table 6.3).

### 2.9.3 Requirement for Habitat Compensation

Features will be incorporated into the design of the turbines to reduce the risk of injury and mortality to fish. Monitoring will be conducted to assess the requirement for additional measures to effectively mitigate the potential for negative effects on downstream fish movement (see Section 5.2.3.3 of the AEMP for monitoring details). At this time, no requirement for additional compensation measures to offset potential negative residual effects has been identified.

## 2.10 DEWATERED AND ALTERED HABITAT IN GULL RAPIDS

### 2.10.1 Description

The Project will require the installation of a north dyke, north dam, powerhouse, a central dam, a spillway structure, a south dam and a south dyke across the Nelson River at Gull Rapids (PD SV). Placement of the principal structures at the GR-4 axis location will result in the dewatering of a portion of south channel of Gull Rapids.

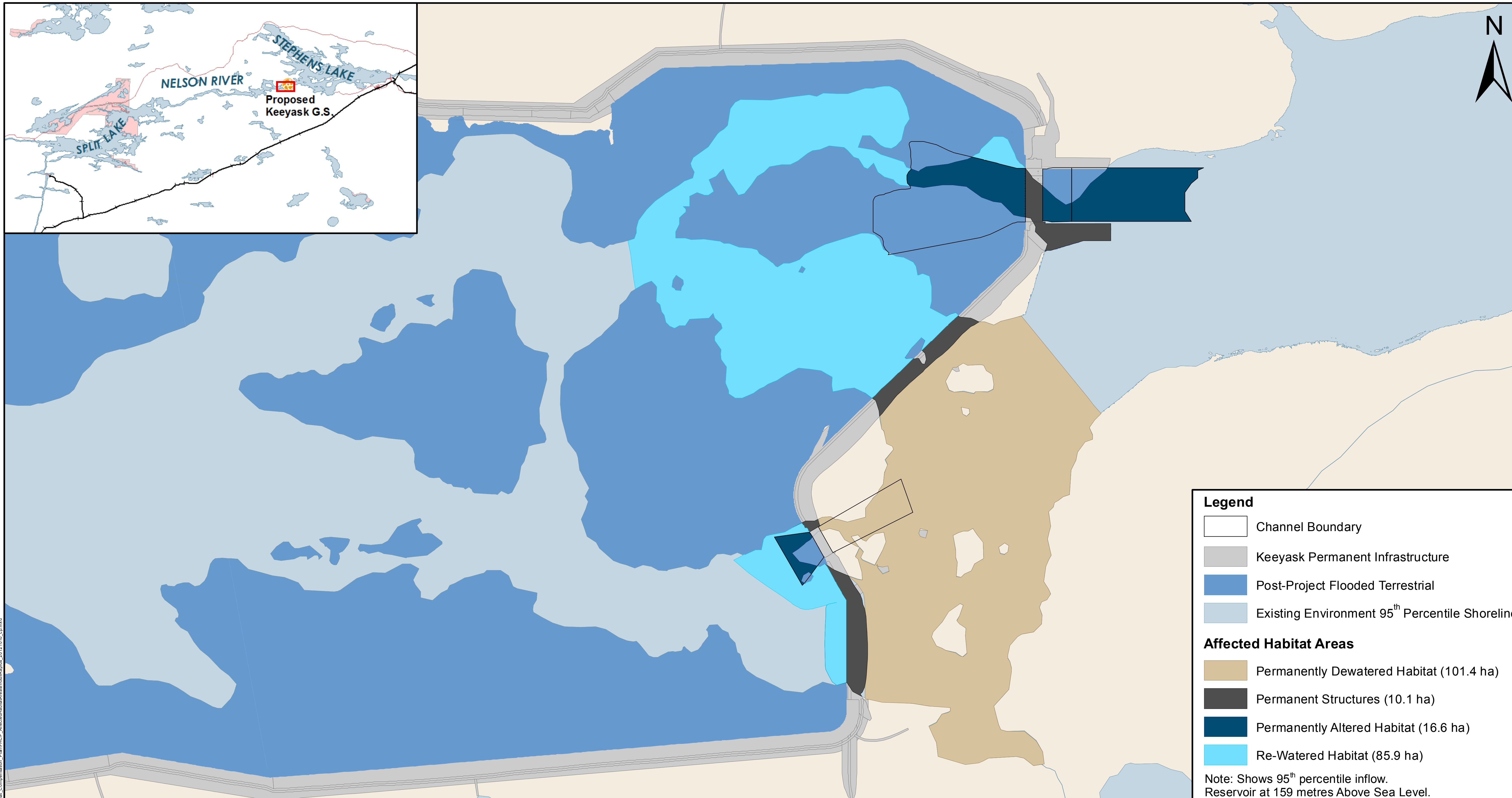
While the habitat disruptions and alterations associated with construction cofferdams were already considered in Section 2.1, the predicted habitat destruction and alterations associated with the footprints of permanent structures, the dewatering of Gull Rapids habitat downstream of the central and south dam, and areas of severe habitat alteration (powerhouse and spillway intake channels and the tailrace channel) are discussed below in Section 2.10.2. Compensation plans for habitat disruption, alteration and loss in Gull Rapids as a result of the Project are presented in Section 2.10.3.

### 2.10.2 Potential Effects and Mitigation

Construction of the principle structures and transmission tower spur will result in the permanent loss of 10.1 ha of Gull Rapids due to the footprints of these structures (Map 5). Excavation of the tailrace channel and the intake channels for both the powerhouse and the spillway structure will result in the alteration of 16.6 ha of Gull Rapids habitat.

Once the principal structures are in place and the station is commissioned for operation, an additional 101.4 ha of Gull Rapids downstream of the central and south dams will be dewatered except under circumstance when the spillway is in operation. During spill events some portion of the rapids will be re-watered depending on spillway flows and Stephens Lake elevation.

Of the total amount of pre-development habitat lost to structure footprints and dewatering (10.1+101.4=111.5 ha), 6.53 ha is currently not available to fish due to high (greater than 3.0 m/s) water velocity, resulting in a total potential unavoidable loss of 105.0 ha of seasonal use habitat. Habitat losses include 1.19 ha of rapids habitat that was classified as potential lake sturgeon spawning habitat (i.e., spawning habitat HSI values equal or exceed 0.5).




KEEYASK
Hydropower Limited Partnership

0 0.5 1 Kilometres
0 0.25 0.5 Miles

**Projection: UTM Zone 15, NAD 83**
**Data Source: NTS base 1:50 000**
**Stephens Lake Shoreline-Quickbird@Digitalglobe, 2006**
**Nelson River Shoreline modelled by Manitoba Hydro**

# Affected Habitat Areas In Gull Rapids
Operation Phase

### 2.10.3 Requirement for Habitat Compensation

Although it is not possible to avoid the loss of 111.5 ha[2] of open-water season habitat to the footprints of the principal structures and dewatering downstream of the central and south dams, and the alteration of 16.6 ha of habitat at excavated channel locations, habitat compensation measures to minimize potential effects on lake sturgeon, walleye and lake whitefish spawning success in the area have been, or are currently being, developed. These include:

- Construction of a lake sturgeon spawning structure (which will also likely provide spawning habitat for other species such as walleye and lake whitefish) in the tailrace area of the GS (Section 4.6); and
- Construction of a lake whitefish spawning reef downstream of the GS (Section 4.7).

It is expected that the construction of spawning habitat structures for lake sturgeon, lake whitefish and walleye downstream of the GS will, in the long term, fully compensate for the loss of spawning habitat associated with the Project. Monitoring will be implemented to determine the effectiveness of the proposed spawning structures.

A lake sturgeon stocking program (AE SV Appendix 1A-Part 2) will be implemented to enhance the currently diminished lake sturgeon population in Stephens Lake and achieve adult numbers that are sufficient to sustain a viable population.

Compensation measures for the loss of seasonal use habitat in Gull Rapids resulting from dewatering of a portion of Gull Rapids will be developed using a fund for the development of a habitat works in addition to the spawning structures identified above.

## 2.11 LOSS OF FISH ACCESS FROM STEPHENS LAKE TO UPSTREAM HABITATS

### 2.11.1 Description

With the construction of the Keeyask GS, fish in Stephens Lake will lose access to potential spawning and foraging habitat upstream of Gull Rapids (AE SV Section 5.4.2.3.5).

### 2.11.2 Potential Effects and Mitigation

Based on biological and life history evaluations of those fish species that do incidentally move upstream over Gull Rapids (lake sturgeon, lake whitefish, northern pike and walleye), the provision of access between Stephens Lake and Gull Lake does not appear important to maintaining either upstream or downstream populations, provided that sufficient suitable habitat exists or will be created in the post-Project upstream (AE SV sections 5.4.2.1, 5.4.2.2, 6.4.2.1 and 6.4.2.2) and downstream (AE SV sections

[2] 6.5 ha of the dewatered rapids habitat has velocities greater than suitable for use by fish.

5.4.2.3 and 6.4.2.3) environments. Nevertheless, an extensive review (AE SV Appendix 1A-Part 1) was conducted to evaluate available means of facilitating upstream passage for fish.

Following review and discussions with DFO, it was concluded that the Project would commit to the implementation of upstream fish passage. Details of the program will be developed in consultation with DFO and MCWS.

Fish passage will be implemented with consideration of the Provincial Fisheries Management Objectives developed for this area, which recognize the importance of developing and/or maintaining sustainable populations of lake sturgeon, walleye, northern pike and lake whitefish upstream and downstream of the GS. Populations of these species should be capable of supporting fisheries managed to reflect expected productivity of the system.

The initial phase of fish passage will be an experimental catch and transport program. The duration of this phase would be adjusted to recognize periods of rapid change in the environment. For example, during the initial 10 years of impoundment, habitat in the reservoir will change considerably and fish responses to translocation within various parts of the reservoir may also change in response to habitat availability. Similarly, stocking of lake sturgeon will alter the size and age structure of the population and may result in more fish seeking to move to upstream waterbodies in the future.

The monitoring program that will be associated with the experimental catch and transport program is described in detail in the AEMP (Section 5.2.3.5) and is summarized below. The first phase of the experimental catch and transport program will initially be conducted for a three-year period after the reservoir is impounded to the FSL. During this period, fish exhibiting behaviour that may indicate intent to move upstream will be tagged with acoustic transmitters and released at different locations in the Keeyask reservoir. The intent of the study is to provide information to assist in the design of a long-term fish passage system for the GS, by addressing the following questions:

- What species and ages of fish congregate below the GS in areas that may indicate a desire to move upstream?
- Are fish that are congregating below the GS cuing in on habitats that are fulfilling a specific life history function at that location (e.g., use of high velocity habitat for spawning)?
- Does capture and transport negatively affect fish (e.g., evidence of stress, mortality)?
- What are the preferred habitats in the reservoir for fish that are transported upstream (expected to vary among species and life stage)?
- How long do fish remain upstream before returning downstream, if at all?

Fish that will be targeted for upstream transport are those exhibiting behaviour consistent with an intent to move upstream. For example, fish that aggregate in off-current areas near the GS after having passed through high-velocity habitat in the river are exhibiting behaviour consistent with an intent to move upstream, although it is recognized that these fish may simply be aggregating in an area with habitat for a specific life history requirement (e.g., spawning).

Key elements of the study will include:

- Identify timing, location, species, condition, and size of fish staging in high-velocity areas below the GS.
- Assess staged fish to determine whether or not they are appropriate to transport upstream. In particular, fish staging during spawning periods may be intending to use spawning habitat rather than seeking to move upstream.
- Identify locations where fish that are staging could be captured to be moved upstream. Capture method would be designed in consideration of human safety and to minimize risk of injury and stress to fish. It should be noted that during the initial three years of study, only some of the turbine units at the GS will be functional and locations of fish staging downstream would change with operation of the station.
- Capture fish to transport upstream. Selection of fish would be based on discussions with DFO and MCWS and would include consideration of:
    - Avoiding detrimental effects to the Stephens Lake fish population.
        - Adult lake sturgeon would not be transported if the number of spawning fish is limiting reproduction within Stephens Lake.
        - Fish of other species that are aggregating to spawn would not be transported if removal of spawners may negatively affect the population.
    - Number and size range of fish that are sufficient to provide scientifically defensible information on fish behavior following upstream transport. It is anticipated that the fish selected for upstream transport would change over time as additional information is acquired.
- Release fish at various locations in the reservoir and track their subsequent movements. Selection of locations would be based on discussion with DFO and MCWS and would include consideration of:
    - Determining survival of fish from catch and transport.
    - Testing fish response to different habitats e.g., lower reservoir, riverine reach of reservoir, Birthday Rapids, Long Rapids to Birthday Rapids reach.
    - Testing fish for long-distance movements post-release (e.g., do fish move upstream out of the reservoir, return downstream to Stephens Lake?).
- Tracking of fish movements following release and interpreting data to determine best long-term plan to address Provincial Fisheries Management Objectives. Interpretation of results would be done in discussion with DFO and MCWS.
- Developing a recommended long-term approach to fish passage based on biological criteria including the number, age and season of each species to transport upstream and the location(s) for release.

After the initial three years of monitoring, results of the program will be reviewed and further studies will be developed to assist in the development of a long-term fish passage program. It is expected that studies in the second phase of the experimental catch and transport program will include:

- Detailed studies of the movements of fish immediately downstream of the GS to facilitate planning for a fish collection facility;
- Continued assessment of the fish response to upstream transport, in particular focusing on the lower reservoir as it evolves post-impoundment. These studies would assess the response of fish to release at specific locations that might be exit points for specific methods of fish passage;
- Assessment of fish movements immediately upstream of the GS if previous studies have indicated that options for downstream passage, other than via the turbines and spillway, may need to be considered; and
- Periodic conduct of the experimental catch and transport program initiated in the first three years post-impoundment to determine whether fish responses to upstream transport change as conditions in the reservoir and fish populations change.

The design of the station will be such that options are maintained for fish passage. Design features to maintain flexibility for long-term fish passage options include:

- Construction of structures suitable for the installation of fish collection facilities at several locations in the tailrace where fish may aggregate when the station is in operation, to support a trap and transport or constructed fishway;
- Protection of lands along a planned wetland enhancement project adjacent to Gull Rapids Creek with an opening near the base of the spillway channel, so that this could be modified to become a nature-like bypass channel; and
- Protection of lands along a potential route of a nature-like bypass channel north of the GS, with an opening near the tailrace of the GS.

### 2.11.3 Requirement for Habitat Compensation

The implementation of upstream fish passage will mitigate the potential for negative effects on upstream fish movement. There will be no requirement for compensation measures to offset potential negative residual effects.

# 2.12 POTENTIAL FISH STRANDING AFTER SPILLWAY USE

## 2.12.1 Description

Changes to water levels downstream of the spillway and the central and south dams following cessation of a spill, or from changes in Stephens Lake water levels, have the potential to strand fish in isolated pools (AE SV Section 3.4.2.3).

## 2.12.2 Potential Effects and Mitigation

A channel or series of channels to connect isolated pools to the spillway discharge channel and ultimately Stephens Lake has been proposed to permit aquatic organisms to move out of this area. Construction of these channels cannot occur until the spillway is closed, which will first occur when the station enters into full service, four years after impoundment of the reservoir to FSL.

## 2.12.3 Requirement for Habitat Compensation

The construction of an escape channel (or channels) will avoid the potential for fish stranding. There will be no requirement for habitat compensation plans to offset potential negative residual effects.

# 3.0 SUMMARY OF COMPENSATION REQUIREMENTS

The effects, mitigation, and requirements for compensation plans to offset negative residual effects from the construction and operation of the Keeyask GS are summarized below. In addition, due to the sensitivity of lake sturgeon, two additional measures not direclty related to a specific habitat effect are planned:( i) stocking of lake sturgeon at locations where population recovery appears to be limited by population size rather than habitat availability; and (ii) financial support for lake sturgeon conservation and enhancement measures in the lower Nelson River (see Section 4.9).

| Keeyask Construction/Operation Component or Activity | Potential Effect | Duration | Waterbodies | Mitigation Measures | Compensation Plan |
|---|---|---|---|---|---|
| **1. Construction and Removal of Cofferdams** | Disruption and alteration of fish habitat. | Up to 5.5 years | Stephens Lake<br>Gull Rapids | Restrict timing of in-water work as per operational statement.<br>Construct and remove (sequence and method) to minimize sediment release. | Permanent losses are addressed with in conjunction with dewatering of Gull Rapids. See #10. |
| **2. Temporary Causeways to N-5 and G-3 Deposits** | Disruption and alteration of fish habitat.<br>N-5 Causeway: Low to Medium risk assessment<br>G-3 Causeway: Low risk assessment. | 6 years | Stephens Lake | Restrict timing of in-water work as per operational statement.<br>Construct and remove (sequence and method) to minimize sediment release. | Construct rocky shoal habitat (Section 4.2.1).<br>Construct “run/pool” channel habitat (Section 4.2.2). |

| Keeyask Construction/Operation Component or Activity | Potential Effect | Duration | Waterbodies | Mitigation Measures | Compensation Plan |
|---|---|---|---|---|---|
| **3. Fish Community Foraging Habitat** | Reservoir creation will alter the suitability and quantity of forage habitat in Gull Lake. Reservoir habitats will evolve and change overtime. Weighted Suitable Habitat Area will increase for all fish species and Weighted CPUE will increase for most species within five years. | Permanent | Outlet of Clark Lake to Gull Rapids including Gull Rapids | Mitigation to avoid or minimize specific and localized fish community habitat concerns will be implemented as described in items 3, 4, 7, 8, and 9 below. | None required. |
| **4. Fish Community Spawning Habitat** | Reservoir creation will alter the suitability and quantity of spawning habitat in the Keeyask area. | Permanent | Outlet of Clark Lake to Gull Rapids including Gull Rapids | Not possible. | Spawning shoals will be created at selected locations in the Keeyask reservoir to enhance spawning success (Section 4.3). |

| Keeyask Construction/Operation Component or Activity | Potential Effect | Duration | Waterbodies | Mitigation Measures | Compensation Plan |
|---|---|---|---|---|---|
| **5. Access to Tributary Streams** | Following impoundment, woody debris has the potential to accumulate in the mouths of creeks, thus creating barriers to fish movements. | Long-term | Keeyask reservoir | Avoid and minimize potential effects by removing debris source before flooding (Forebay Clearing Plan) and with ongoing debris prevention and removal (Waterways Management Plan). | None required. |
| **6. Winter Entrapment of Fish in Little Gull Lake Area** | Fish that remain in the Little Gull Lake area following freeze-up would be susceptible to winterkill because of low DO. | Long-term | Keeyask reservoir | Construct channels to permit fish escape in response to decreasing DO levels. | None required. |
| **7. Alteration of Lake Sturgeon Spawning Habitat at Birthday Rapids** | Increase in water depth at Birthday Rapids will reduce suitability of existing spawning habitat. | Permanent | Keeyask reservoir | Monitoring to assess effects of flooding on lake sturgeon spawning success. | Immediate implementation of lake sturgeon stocking program (Section 4.4.2).<br>If required, create suitable spawning habitat at Birthday Rapids (Section 4.4.1). |

| Keeyask Construction/Operation Component or Activity | Potential Effect | Duration | Waterbodies | Mitigation Measures | Compensation Plan |
|---|---|---|---|---|---|
| **8. Alteration of Lake Sturgeon YOY Habitat** | Changes in water velocity regimes accompanying reservoir creation will make the existing lake sturgeon YOY rearing habitat unavailable. | Permanent | Keeyask reservoir | Monitoring to assess whether other suitable habitat is available. | Immediate implementation of lake sturgeon stocking program (Section 4.5.2).<br>If required, create YOY habitat at a suitable location (Section 4.5.1). |
| **9. Reduced Fish Access from Upstream to Stephens Lake Habitats** | Downstream fish movements to Stephens Lake may be reduced because of the Keeyask GS. Fish that do move downstream may be injured or killed. | Permanent | Stephens Lake | Turbines designed to reduce potential for injury/mortality during downstream passage. | None required.<br>Note: habitat creation and enhancement projects will allow fish habitat requirements both up- and downstream of the GS to be met. |
| **10. Dewatered and Altered Habitat in Gull Rapids** | Loss and alteration of seasonal-use habitat (including lake sturgeon spawning habitat). | Permanent | Stephens Lake | None possible. | Create spawning habitat below and adjacent to the tailrace (Section 4.6).<br>Create lake whitefish spawning shoal downstream towards Stephens Lake (Section 4.7).<br>Stocking lake sturgeon in Stephens Lake (Section 4.8). |
| | Dewatering of seasonal use foraging habitat. | Permanent | Stephens Lake | None possible. | Establish funding and support for local and regional fish and fish habitat improvement projects. |

| Keeyask Construction / Operation Component or Activity | Potential Effect | Duration | Waterbodies | Mitigation Measures | Compensation Plan |
|---|---|---|---|---|---|
| **11. Loss of Fish Access from Stephens Lake to Upstream Habitats** | Keeyask GS will act as a barrier to incidental movements from Stephens Lake to upstream habitats. | Permanent | Stephens Lake and Keeyask reservoir | Provide upstream fish passage. The initial phase of fish passage will be an experimental catch and transport program. | None required.<br>Note: habitat creation and enhancement projects will allow that fish habitat requirements both up- and downstream of the GS to be met. |
| **12. Potential Fish Stranding after Spillway Use and Following Changes in Stephens Lake Water Level** | Fish may become stranded in isolated pools following spillway use and changes in Stephens Lake water levels. | Permanent | Stephens Lake | Construct channels to allow fish to escape to Stephens Lake. | None required. |

# 4.0 HABITAT COMPENSATION PLANS

## 4.1 FISH AND FISH HABITAT IMPROVEMENT FUND

To compensate for disruptions from cofferdam placement and removal and permanently lost habitat due to the GS structures and dewatering of the south channel of Gull Rapids, the KHLP will set aside funds for creating/enhancing fish habitat. One option is to increase flows through wetlands in Gull Rapids Creek and create a series of weirs and fishways that would create pool/riffle habitat in a portion of the dewatered river bed (see Appendix B of this report). This measure would directly benefit northern pike, though lake sturgeon, lake whitefish and walleye would indirectly benefit through increased inputs of aquatic invertebrates and forage fish into Stephens Lake. Other suitable options that could directly benefit all the target species will be identified in discussions with DFO and MCWS. Selection of the measures will be based on evaluation of: a) likely benefit to target species in terms of the FMOs; and b) proximity to the Project site.

## 4.2 HABITAT CREATION – POND 13 AREA

Habitat disruptions associated with the construction and removal of the temporary causeways for accessing Deposits N-5 and G-3 will be offset by the construction of rocky shoals and by the habitat gain that will result from the channel constructed to mitigate potential fish stranding associated with G-3 causeway construction.

### 4.2.1 Rocky Shoal Construction – N-5 and G-3 Causeway Locations

To offset the temporary loss of 0.29 ha of fish habitat at the N-5 causeway location, approximately 80% of the rockfill material will be removed when access to deposit N-5 is no longer required; the remaining 20% of the Class C1 causeway construction material (2,200 $m^3$) will be spread out locally over an approximate area of 0.4 ha to create shallow rocky shoal habitat for fish and other aquatic species. The newly created habitat will provide habitat diversity at this otherwise low diversity bedrock substrate habitat.

Similarly, the temporary loss of 0.84 ha of fish habitat at the G-3 causeway location will be offset by using approximately 20% of the Class C1 rockfill (6,340 $m^3$) to create 1.3 ha of shallow rocky shoal habitat for fish and other aquatic species. The newly created habitat will provide habitat diversity at this otherwise low diversity silty substrate habitat.

The causeways to deposits N-5 and G-3 are scheduled for removal during the first year following reservoir impoundment to FSL, and fish use of the rocky shoal habitat will be monitored annually for three years.

### 4.2.2 Channel Construction – Pond 13

To avoid the potential for stranding fish in the confined portion of the bay to the west of the causeway, a channel will be constructed between the isolated bay and Pond 13 to permit fish passage between the bay and Pond 13 under the full range of Stephens Lake water levels. The channel will have a 2 m base width, 4H:1V side slopes, and will be excavated from an elevation of 142 m ASL to 137.5 m ASL. Depending on water surface elevation, the channel will provide between 0.5 and 1.0 ha of year-round pool and run fish habitat. Fish use of habitat in the channel will be assessed in conjunction with rocky shoal habitat monitoring.

## 4.3 SPAWNING SHOAL CONSTRUCTION – KEEYASK RESERVOIR

The construction of rocky shoals within lacustrine portions of the reservoir would increase the certainty that lake whitefish and walleye spawning habitat is available early in the development of the reservoir environment. The creation of boulder/cobble/gravel habitat would, in addition to providing spawning habitat, also provide rearing and foraging habitat, thereby improving habitat diversity within the newly-formed reservoir.

Biological design criteria for the construction of rocky shoals are provided in Table 1. Potential sites were selected at locations where post-Project bottom depths ranged between 3–4 m ("shallow sites"). Additional "deeper" sites were identified at locations where post-Project water depths would be greater than 4 m. These deep locations would not provide optimal lake whitefish spawning habitat, but could provide feeding areas.

Twenty sites (AE SV Table 1A-5, Map 1A-2) were identified for the potential development of shoals (minimum surface area of 1,000 $m^2$). Site selection was subsequently refined according to the following criteria:

- Whether its location is adjacent to known or suspected present-day spawning habitats;
- How likely it is to be exposed to fine particulate sedimentation post-impoundment (AE SV Map 1A-3); and
- Whether it is a minimum distance of 3 km upstream of the proposed locations of the GS and spillway intake structures so as to minimize entrainment and downstream transport of newly-hatched fish.

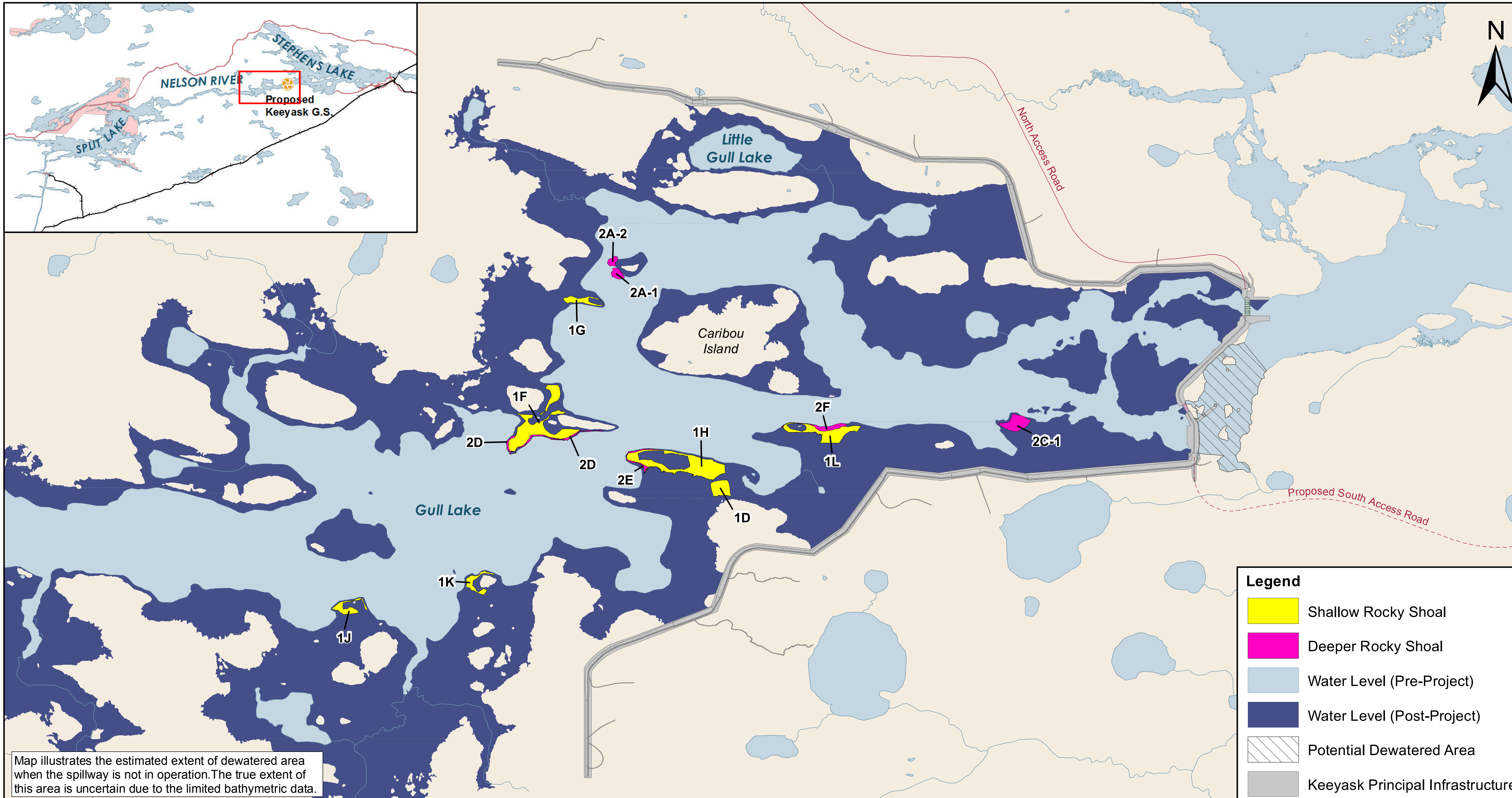
**Table 1. Biological design criteria for the construction of rocky shoals.**

| Parameter | Design Criteria | Additional Considerations |
|---|---|---|
| Substrate | A mix of coarse materials as follows:<br>25% boulder (750-500 mm);<br>35% cobble (256-64 mm);<br>25% large gravel (64-32 mm); and<br>15% small gravel (32-8 mm). | Substrate layer should have minimum thickness of 0.75 m, and substrate material should be free of silt and clay. Important that there be ample interstitial space for egg incubation and larval development. |
| Velocity and/or Exposure | At sites with flowing water, the velocity should be between 0.2 and 1.0 m/s.<br>If water velocity is less than 0.2 m/s, then location requires wave generated circulation (i.e., exposure to northeast - northwest winds). | |
| Depth | Crest of spawning shoal:<br>Walleye = 0.3–0.8 m below MOL; and<br>Lake whitefish = 2.0–2.5 m below MOL. | Lake whitefish eggs incubate over winter; eggs deposited at depths less than 1.5 m below MOL will be vulnerable to freezing at maximum ice thickness. |
| Size of Spawning Area | Minimum crest area at preferred depth should not be less than 1000 $m^2$. | Shape of shoal should maximize surface area (long and rectangular as opposed to round or square). |
| Slope | Slope of spawning area should not exceed 10%. | |
| Location | Select areas where mineral soil is present, areas adjacent to bedrock, or where organic soil is thin (*i.e.*, peat veneer). Where placement occurs over organic soils, gabion basket wire should be laid over the soil prior to placement. | At standing water sites, orient shoals to maximize exposure to wave action. Locations that meet depth, velocity/exposure, and soils criteria are provided in AE SV Map 1A-2. |
| Critical Annual Period | Walleye – Early May to mid-June.<br>Lake whitefish – Late October to late-April. | |

Note: Rocky shoal biological design criteria were based on spawning shoal development criteria described in Kerr *et al.* 1997 and Geiling *et al.* 1996, and based on species ecology descriptions provided in AE SV Appendix 5A.

Thirteen sites met these criteria (seven 3–4 m depth sites and six greater than 4 m depth [Table 2, Map 6]). Development of the seven shallow sites is currently planned to provide a minimum of 0.7 ha of spawning habitat for walleye and lake whitefish.

Construction of spawning habitat at the seven shallow sites will occur "in the dry" prior to reservoir impoundment. Monitoring to determine fish use of the shoal habitat will be conducted annually for the first three years following impoundment of the reservoir to FSL, and then at least once every three years until 10 years post-impoundment.




KEEYASK Hydropower Limited Partnership

0 1 2 3 4 Kilometres
0 0.5 1 1.5 2 Miles

**Projection: UTM Zone 15, NAD 83**
**Data Source: NTS base 1:50 000**
**Stephens Lake Shoreline - Quickbird@Digitalglobe, 2006**
**Nelson River Shoreline modelled by Manitoba Hydro**
**Extents of dewatered area are estimated based on the existing environment 95th percentile flow.**

# Preferred Habitat Development Locations in the Keeyask Reservoir

**Table 2. Preferred spawning shoal development zones.**

| Development Site | Post-impoundment Location Characteristics | Comment |
|---|---|---|
| | **< 4 m Bottom Depth at Shoal Development Site** | |
| **1D** | Good velocity and exposure attributes and adjacent to a potential mineral shelf development zone. | Suitable for shoal development |
| **1F** | Possesses good velocity and exposure attributes, and is adjacent to existing known or suspected walleye spawning habitat and a deep-water shoal development site (2D). The more downstream area may be subject to mineral sediment deposition (see Map 6) suggesting that the focus should be on the upstream portion. | Above-average suitability |
| **1G** | Possesses good velocity and exposure attributes and is adjacent to existing known or suspected walleye spawning habitat. No concerns regarding sediment deposition are apparent. | Above-average suitability |
| **1H** | Possesses good velocity and exposure attributes. The downstream portion is adjacent to potential mineral shelf development area and the upstream is adjacent to a deep-water shoal development site (2E). It is also adjacent to existing known or suspected walleye spawning habitat. No concerns regarding sediment deposition are apparent. | Above-average suitability |
| **1J** | This site is in a location with good velocity and exposure attributes and adjacent to existing known or suspected walleye spawning habitat. However, post-Project sediment deposition may be at an unacceptably high level (see Map 6). | Suitable for shoal development |
| **1K** | This site is in a location with good velocity and exposure attributes and adjacent to existing known or suspected walleye spawning habitat. However, post-Project sediment deposition may be at an unacceptably high level (see Map 6). | Suitable for shoal development |
| **1L** | Possesses good velocity and exposure attributes, and is adjacent to a deep-water shoal development site (2F). No concerns regarding sediment deposition are apparent. | Suitable for shoal development |
| | **> 4 m Bottom Depth at Shoal Development Site** | |
| **2A-1 and 2A-2** | The sites possess good velocity attributes. However, there is a possible sedimentation concern at this location (See Map 6). | Suitable location |
| **2C-1** | Located at the 3 km exclusion zone boundary, thus potentially exposing emerging fish larvae to downstream transport out of the reservoir. No concerns regarding sediment deposition are apparent. | Suitable for shoal development |
| **2D** | Possesses good velocity and exposure attributes, and is adjacent to an existing lake whitefish spawning area and a proposed site for shallow-water shoal construction (1F). No concerns regarding sediment deposition are apparent. | Above-average suitability |
| **2E** | Possesses good velocity and exposure attributes and is adjacent to an existing lake whitefish spawning area and a shallow-water shoal construction site (1H). No concerns regarding sediment deposition are apparent. | Above-average suitability |
| **2F** | Possesses good velocity and exposure attributes and is adjacent to shallow-water shoal construction site (1L). No concerns regarding sediment deposition are apparent. | Above-average suitability |

## 4.4 COMPENSATION PLANS FOR IMPOUNDMENT EFFECTS ON LAKE STURGEON SPAWNING AT BIRTHDAY RAPIDS

Plans to compensate for potential effects of reservoir impoundment on lake sturgeon spawning at Birthday Rapids include implementing a habitat enhancement plan (Section 4.4.1) and a lake sturgeon stocking program (Section 4.4.2).

### 4.4.1 Spawning Habitat Enhancement

Monitoring will be implemented to determine the success of lake sturgeon spawning in the reach of the Nelson River between and including Long Rapids and Birthday Rapids (see Section 6.2.3 of the AEMP for monitoring details). Should annual monitoring during the first three years following reservoir impoundment to FSL indicate poor or no spawning success, contingency works to create suitable spawning habitat for the maintenance of lake sturgeon in the reservoir would be implemented. One option currently being considered is the addition of large boulders/structures at locations slightly upstream of the current spawning site at Birthday Rapids to create white water to attract spawning fish. Placement of large boulders in this area would be difficult during the construction phase due to lack of access. However, access would be improved during the operation phase. The design would be such that the structures could not be removed by ice.

### 4.4.2 Lake Sturgeon Stocking

Concerns have been raised regarding the sustainability of lake sturgeon populations in the Keeyask area given current abundance estimates, and it is thought that the Project could add further stress to populations that may already be declining (AE SV Section 6.3.2.1). As monitoring will be required before determining whether lake sturgeon continue to spawn at Birthday Rapids post-impoundment (Section 4.4.1), there is the potential for a temporary reduction in lake sturgeon spawning rates in the reservoir during the initial operation of the Keeyask GS. Stocking the Keeyask reservoir with YOY and sub-adult lake sturgeon would help to compensate for any such decrease.

Stocking rates for three lake sturgeon life history stages (early fry, fall fingerlings and yearlings) were developed as described in the Lake Sturgeon Stocking Strategy (AE SV Appendix 1A-Part 2). Plans for the Keeyask reservoir include the stocking of both fall fingerlings and spring yearlings. Stocking in the area upstream of Gull Rapids will begin during the construction phase and will continue into the operation phase until a sustainable population has been established. Monitoring will be undertaken to evaluate the relative success of each life stage stocked and to modify stocking rates to maximize recruitment (see Section 6.1.2.3 of the AEMP for monitoring details). Lake sturgeon fry would also be stocked in years where hatchery fry production exceeds rearing capacity.

As discussed in Section 4.9, stocking will also assist in the recovery of this currently depleted population.

## 4.5 COMPENSATION PLANS FOR IMPOUNDMENT EFFECTS ON LAKE STURGEON YOY REARING HABITAT IN GULL LAKE

Plans to compensate for potential effects of reservoir impoundment on YOY lake sturgeon access to rearing habitat include implementing a habitat creation plan (Section 4.5.1) and a lake sturgeon stocking program (Section 4.5.2).

### 4.5.1 Lake Sturgeon YOY Habitat Creation – Keeyask Reservoir

Predictions of post-impoundment changes to water velocity and related sediment transport conditions (AE SV Section 3.4.2.2.3; AE SV Map 3-34) suggest there will be a requirement to create compensatory YOY habitat. The initial selection of the preferred location for the construction of a sand blanket (Map 7) was based on the most likely area where, in the post-impoundment setting, YOY lake sturgeon that emerge from spawning locations upstream (i.e., in the Birthday Rapids to Long Rapids reach) would settle to the bottom (i.e., in the transition zone of the river and the reservoir [AE SV Section 6.4.2.2; AE SV Map 3-31 and Map 3-32]). The selected areas are located in areas of minimal sediment deposition (PE SV Section 7.4.2.1.5) to maximize the success of the sand blanket as YOY lake sturgeon habitat.

*Phased Approach*

Prior to constructing the sand blanket, a monitoring program will be undertaken to determine with greater certainty whether or not YOY lake sturgeon find sufficient and suitable rearing conditions in the near-term post-impoundment environment. Monitoring will include determination of YOY and sub-adult lake sturgeon distribution and abundance in conjunction with the key parameters of substrate, depth and velocity. It should be noted that although sand is widely believed to be an important substrate for YOY lake sturgeon, other substrates might also be suitable. Monitoring will also provide more precise post-impoundment substrate and velocity data to supplement the modelled results. This information would be used to refine locations where sand should be placed, if required. A three-year monitoring program would provide sufficient information to determine whether sand placement should be implemented (see Section 6.2.2 of the AEMP for additional monitoring details).

If monitoring indicates that sand placement is necessary to create YOY lake sturgeon habitat, Phase I of a pilot program would see the placement of a sand blanket to create a 20 ha area of sandy habitat. This area represents approximately one-half of the existing high suitability area north of Caribou Island (Section 2.8.1). Subsequent monitoring over one or more years to determine the success of the Phase I pilot placement would be necessary before implementing a Phase II sand placement (up to an additional 20 ha), which may or may not be adjacent to the Phase I placement (Map 7).