8.0 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION

8.1 Introduction

This chapter identifies the interactions between the Project and the environment. The potential environmental effects are identified and, where required, general mitigation measures are discussed and identified for the physical, aquatic, terrestrial and socio-economic components of the environment. Where potential residual environmental effects are anticipated after the application of the mitigation measures, the significance of the residual environmental effects has been determined. Refer to Chapter 6.0 for a detailed description on the approach to the environmental assessment.

As discussed in Chapters 2.0 and 3.0 of this EIS, effort was made to incorporate design features into the Project to minimize potential environmental effects, these are summarized in Section 8.3.

An **Environmental Protection Plan** (EnvPP) will be developed and implemented for the Project which will provide detailed mitigation measures to be implemented once work activities begin. Further information on the EnvPP and other management/monitoring plans is contained in Chapter 11.0 of this EIS.

8.2 Significance

The characterization of the significance of the residual environmental effects (after application of mitigation) considered scientific study, professional judgment and local knowledge. The characterization related to all phases of the Project–construction, operation and maintenance and decommissioning (of existing facilities). The assessment approach considered the nature and magnitude of any residual effect along with its temporal characteristics and spatial boundaries. The characterization also included the likelihood of potential effects occurring and any associated uncertainty with the prediction of the effect. The factors and definitions used to assess environmental effects are outlined in Table 6.4.

The combination of three of the factors (magnitude, geographic extent, duration) used to determine significance of any residual effect is outlined in Table 6.5.

8.3 Environmental Design Features

During the design of the principal structures and the associated construction infrastructure, environmental effects that may result from project work were identified. In many cases, aspects of the Project could be designed to minimize or avoid the adverse environmental effects before they occur.

The general arrangement for the Project was created balancing dam safety, lake sturgeon habitat, stakeholder effects, constructability, the potential for a future powerhouse, and

cost. The balancing of these considerations provided for a number of general environment design features. These features include the following:

- Primary spillway;
- Secondary spillway;
- Material sources;
- Water regime;
- Construction power;
- Local access improvement; and
- General arrangement.

8.3.1 Primary Spillway

The configuration of the Primary spillway was significantly influenced by the desire to maintain a healthy habitat for lake sturgeon spawning habitat downstream of the Pointe du Bois spillway shelf. The aquatic monitoring undertaken for the Project determined that a region on the east side of the spillway shelf was currently being utilized by lake sturgeon for spawning. The intent of the Project design process was to create an environment that maintained or enhanced this area. The following features of the primary spillway are noted:

- **Primary spillway location and orientation**–the location and orientation of the primary spillway was chosen to provide flow characteristics that are similar to the existing spillway. The flow from the existing spillway plunges from the spillway shelf over substrate materials that are currently being utilized by lake sturgeon. The flow from the new spillway plunges from the spillway shelf over the same region of substrate and with similar flow characteristics with the intent to maintain the spawning habitat required for lake sturgeon. If the primary spillway was located in the center of the spillway or near the downstream edge of the spillway, there would have been a greater change to the flow pattern over the existing lake sturgeon spawning habitat;
- **Discharge channel elevation**–the discharge channel elevation was chosen to be above the normal Pointe du Bois tailrace elevation. This decision provides the benefit that no cofferdam is required for construction downstream of the spillway shelf (in lake sturgeon habitat) and preserves the plunging characteristics of the existing spillway. Detriments associated with this decision are the costs associated with the need for an increased number of bays and/or wider bay width.

8.3.2 Secondary Spillway

The secondary spillway provides the ability to cost-effectively provide supplemental spillway capacity in the event of large floods (above approximately 3,420 m^3/s). Similar to the primary spillway, its configuration was located to provide an opportunity to direct flow that cascades over the spillway shelf in a similar fashion as the existing spillway. Its location at the upper portion of the spillway shelf was seen to maintain similar flow characteristics and provide aesthetic benefits to cottagers downstream by maintaining the spillway shelf. An adaptive management approach will be taken regarding potential effects to lake sturgeon. The Project as designed is not expected to effect the successful spawning of lake sturgeon. However, lake sturgeon spawning post-construction will be monitored to verify this prediction (to be described in the aquatic effects monitoring plan). If it is determined that the Project has resulted in a decrease to successful lake sturgeon spawning, one of the opportunities to improve the lake sturgeon spawning habitat would be the operation of the secondary spillway during the spawning period.

8.3.3 Material Sources

Material source areas have been identified on the east side of the Winnipeg River (BR-6 and CL-1). The use of these materials will reduce the amount of traffic on PR 313 and other public roadways.

8.3.4 Water Regime

The Project provides the ability for the Pointe du Bois GS to maintain the historic level and variation of the forebay. The Pointe du Bois forebay elevation variation is characterized as being very stable. The design of the spillway bay width and the spillway gate and hoisting mechanisms provide the means to manage the forebay level within the same levels as has been experienced in the past.

To maintain the flood capacity of the existing spillway during the construction of the Project without the potential to increase the forebay level, it is necessary to create a general arrangement where construction activities do not interfere with normal operation of the existing spillway. The location of the primary spillway downstream of the existing rock fill dam meets this criteria and therefore preserves the ability of the Pointe du Bois GS to maintain historic forebay levels throughout construction.

Stakeholders downstream of the Pointe du Bois GS were concerned that the flow patterns past their cottages would change and cause concerns with water based recreation activities. The design team incorporated these thoughts in the design process and confirmed that the flow pattern past the cottage owners post-construction will generally be similar to existing conditions.

8.3.5 Construction Power

Horizontal directional drilling from the west shore to the east shore will occur underneath the Winnipeg River to provide a conduit for electric cables. These cables will provide power for construction activities and for operation of the new spillways. This underground method for providing power to the east shore of the river provided aesthetic and aquatic benefits over alternative methods. Alternatives to horizontal direction drilling included overhead cables or a submerged cable placed on the bottom of the Winnipeg River.

8.3.6 Local Access Road Improvement

To facilitate the safety of the public during construction of the Project, the work areas have been designed such that interactions between the public and construction activities are minimized. One feature of the Project that achieves this goal is the construction of a new permanent road that modifies the route of PR 313 and the intersection with Glassco Avenue at Pointe du Bois. The new access road provides a means for the public and non-construction related Manitoba Hydro staff to travel around the work area to reach their destination.

8.3.7 General Arrangement

The footprint of the existing spillway is associated with aesthetic features such as cascading flow over the spillway shelf and an upstream shelf location that minimizes the impact of structural features to the landscape. The general arrangement proposed for the Project maintains the upstream location of all structures and many of the general characteristics of the existing arrangement. The upstream primary and secondary spillway provide flow that cascades from the spillway shelf and plunges into the Pointe du Bois tailrace. The upstream structures and earth fill dam will also minimize the visual impact of the dam downstream when compared to having a structure that is situated lower on the spillway shelf.

8.4 Physical Environment

The physical environment components include: air quality, noise, climate, surface water regime; ice regime, physiography and landscape, erosion and sedimentation, woody debris and groundwater. There were no VECs identified for the physical environment.

8.4.1 Air Quality

8.4.1.1 Construction

The construction activities associated with the Project that have the potential to generate emissions of Particulate Matter (PM), greenhouse gases (GHGs), nitrogen oxides (NO_X), sulphur dioxide (SO_2) and carbon monoxide (CO) include the following:

- Combustion of fuel in diesel and gasoline engines in construction equipment and vehicles, generators and light plants;
- Potential burning of scrub and brush; and
- Dust generated from quarrying/borrowing operations, and concrete batching and crushing operations. Dust emissions will vary during the construction period and will be influenced by the level of construction activity, the specific operations and the local weather conditions.

8.4.1.2 Operation

After construction of the Project, emissions generated are expected to be similar to existing operations.

8.4.1.3 Mitigation Measures

Mitigation measures include the following:

- An Environmental Protection Plan will be developed for the Project outlining practices that should be adopted during Project activities, it will include measures to minimize emissions and dust;
- Limiting unnecessary idling of equipment/machinery;
- Regular vehicle/equipment maintenance; and
- As necessary, application of acceptable dust-control measures on the roadway during the construction period to limit the amount of airborne dust.

8.4.1.4 Residual Effects after Mitigation

Residual effects on local air quality are anticipated during construction. The residual effects related to air quality are small in magnitude, local in geographic extent, short-term in duration, moderate in frequency, **reversible**, and moderate in uncertainty and are considered to be not significant.

8.4.2 Noise

8.4.2.1 Construction

Construction activities associated with the Project will be a source of noise. The activities include the following:

- Heavy truck traffic used to transport materials and equipment;
- Operation of equipment used for construction activities;
- Barging operations required to transport material, equipment and personnel to the east side;
- Rock drilling and blasting operations for the preparation of material use areas and the approach and discharge channels;
- Crushing operations; and
- Other traffic associated with construction.

In general, the construction schedule assumes two ten-hour shifts per day, six days per week with reduced activities in the winter months. However, to manage schedule risk, construction activities will likely require periods of activities occurring 24 hours per day and seven days per week. With this schedule, the Project is anticipated to take approximately five years to complete.

The potential effect of noise to human receptors and wildlife is summarized in their relevant sections.

8.4.2.2 Operation

Noise from the operation of the Project after construction is expected to be similar to the present operation.

8.4.2.3 Mitigation Measures

Mitigation measures include the following:

- An Environmental Protection Plan will be developed for the Project outlining practices that should be adopted during Project activities;
- The usage of the east side material sources will be maximized to reduce the amount of heavy truck traffic on PR 313 and through the townsite;
- Rock drilling and blasting operations will not take place between 10 pm and 7 am; and
- To the extent reasonably possible, activities that generate excessive levels of noise will be scheduled to take place between 7 am and 10 pm.

8.4.2.4 Residual Effects after Mitigation

Residual effects related to noise from construction activities are anticipated. The effects are moderate in magnitude, local in geographic extent, short-term in duration, moderate in frequency, reversible, and low in uncertainty and are considered to be not significant.

8.4.3 Climate

8.4.3.1 Project Effect on Climate Change

The Project is required for dam safety purposes. The Project also supports the on-going operation of the Pointe du Bois powerhouse, which produces an average of 580 GWh of renewable energy per year. This energy contributes to the Manitoba and regional energy supply and displaces fossil fuelled generation, resulting in annual emissions reductions estimated to be 435,000 tonnes (CO_2eq).

A **life-cycle** assessment related to greenhouse gas emissions relayed to the construction of the Project was conducted.

The analysis followed the ISO 14040 life cycle standard[1] and considered construction, operation and decommissioning of the new spillway components as well as the decommissioning of the existing spillway facilities. The life cycle assessment of the Project was divided into phases: construction, operation, and decommissioning. Decommissioning of the current structures was included in the construction phase as the two phases will be carried out concurrently. Activities and materials required for each phase were determined and GHGs for the phases calculated. Table 8.1 summarizes the estimate of GHGs for each Project phase.

[1] ISO, "Environmental Management – Life Cycle Assessment – Principles and Framework," in ISO 14040:2006(E), ed. ISO (2006)

Table 8.1: Summary of Greenhouse Gas Emissions		
Project Phase	**Sub-component**	**Total GHG (tonne CO2eq)**
Construction[1]	Building Material-Manufacture	18,688
	Transportation	2,052
	On-site Construction Activities	15,967
Operation	Maintenance and Operation Activities	1,276
Decommissioning	Decommissioning Activities	1,898
Total GHG Estimate		39,882

[1]Includes decommissioning existing spillway facilities

GHG emissions from the Project are primarily associated with the construction phase, which produces about 92% of the life cycle GHG emissions. The emissions from the construction phase result from building material manufacture, such as steel and cement production, and on-site activities such as burning diesel fuel used in construction equipment (47% from material manufacture, 40% from on-site construction activities, 5% from transportation). Maintenance and operation emissions primarily result from energy required to operate the spillway gates and decommissioning emissions result from diesel fuel use for equipment and material recycling.

The construction phase emissions (36,691 tonnes or 7,338 tonnes/year) will occur over the construction period of five years. The yearly emissions are equivalent to those that would be emitted from use of about 1,200 gas powered automobiles (typical gas powered car emits 5 tonnes CO_2 per year [Manitoba Conservation Climate Change & Green Initiatives-Transportation 2009]). The yearly emissions are also about 2% of the emissions displaced from fossil fuel generation from the operation of the Pointe du Bois GS.

The Manitoba 2008 Greenhouse Gas Inventory indicates a total GHG emissions of 21,898,000 tonnes CO_2eq, with 12,789,000 tonnes of the total attributed to the energy sector (stationary combustion sources, transport, fugitive sources). Total GHG emissions from the Project in comparison to the provincial energy sector total are approximately 0.003%, and therefore are considered to be not significant.

8.4.3.2 Climate Change Effects on the Project

Manitoba Hydro is actively studying climate change to evaluate the potential effects on water supply in river basins that supply hydro-electric generating stations with water.

Watershed models are being developed that will synthesize precipitation and temperature scenarios and trends into stream flow effects. This work is still in development with no specific results available at the present time.

It is currently not known if, or to what extent, a change in average temperature or precipitation would change the flows in the Winnipeg River. However, if flows in the Winnipeg River were to change by plus or minus 10%, there would be no effect on the capability of the spillway to pass the Inflow Design Flood.

8.4.4 Surface Water Regime

Construction of the Project will not affect the operation of the generating station, the powerhouse capacity, frequency of spill, the forebay full supply level or water levels downstream. As well, operation of the Slave Falls GS located downstream of Pointe du Bois will not be influenced by the Project.

The construction activities will affect the water regime mainly within the spillway rapids and the immediate tailrace downstream to Eight Foot Falls as described in the following sections. No effects on the water regime are anticipated downstream of Eight Foot Falls.

To estimate water levels, velocities, flow patterns, and depths, hydraulic models were developed to simulate the 5th (322 cms), 50th (810 cms), and 95th (1,623 cms) percentile open water flow conditions, as well as the annual 1:50 year construction design flood (CDF) (2,610 cms).

8.4.4.1 Construction

As indicated in the project description (Chapter 3.0), there are two construction stages:

- Stage 1 includes the construction activities performed while maintaining the operation of the existing spillway; and
- Stage 2 includes the construction activities performed with the new primary spillway in operation.

Surface Water Levels

The outer forebay will continue to be controlled at or near the target full supply level (FSL) of 299.1 m. Surface water levels (Figure 7.9) and water level variations within the river reaches upstream and downstream of the station will not change as a result of construction of the Project since the spillway replacement does not affect powerhouse operation or frequency of spillage at the Pointe du Bois and Slave Falls generating stations.

Construction of the temporary downstream cofferdam will result in minor training of the waters away from the east bank of the spillway shelf, in order to isolate the primary spillway construction area.

Water Velocities, Flow Patterns and Depths

To determine water velocity and flow patterns, hydraulic models were developed to simulate the 5th, 50th, and 95th percentile flow conditions.

During Stage 1 construction, water velocities, flow patterns, and depths within the river reaches upstream and downstream of the station will not be affected by the Project, as the operation of the existing spillway will be maintained.

During Stage 1 - Phase 2 construction (as indicated in the Project Description Section 3.3.2), the temporary downstream cofferdam will deflect water away from the primary spillway construction area, resulting in localized changes to velocities and flow patterns within the spillway rapids near the east shore (Figure 8.1.) Additionally, the use of spillway bays farther from the construction areas under normal operating conditions may be considered during construction. This would minimize risk to the construction activities but would not affect forebay levels. Depending on inflows, operational and construction requirements, the magnitude of changes to velocities and flow patterns within the spillway rapids would be highly variable. During passage of the construction design flood (CDF), velocities along the east shore of the spillway rapids would be reduced by up to approximately 5 m/s downstream of the cofferdam.

During Stage 2 construction, flows in excess of the powerhouse capacity will be passed through the primary spillway. In the Pointe du Bois forebay, water velocities and flow patterns in a localized area close to the new primary spillway will increase up to 1 m/s, as a result of the redistribution of flows to the new spillway bays. Consequently, outer forebay velocities close to the existing spillway bays will decrease as flows shift over to the new primary spillway. Water velocities, flow patterns, and depths during Stage 2 construction and post-project conditions are shown in Figures 8.2A, 8.2B and 8.2C. The estimated changes to water velocities and depths as a result of the Project are shown in Figures 8.3A and 8.3B.

In the tailrace there will be some differences in certain areas, depending on the magnitude of spill. Immediately downstream of the spillway rapids, velocities change up to 5 m/s due to a shift in the orientation of the spillway outflows under existing conditions to an excavated spillway discharge channel downstream of the new primary spillway. Further downstream, velocity changes are less as flows from the primary spillway interact with the powerhouse outflows. Depending on the magnitude of the spill, the active flow zone either remains in the centre of the river or is pushed towards the east bank.

8.4.4.2 Operation

Surface Water Levels

The surface water levels and water level variations within the river reaches upstream and downstream of the Pointe du Bois GS are not expected to change as a result of the operation of the Project since the spillway replacement does not affect powerhouse

operation or frequency of spillage at the Pointe du Bois and Slave Falls generating stations. The Pointe du Bois GS will continue to be operated in a run-of-river mode and the outer forebay will be controlled within its historical range, at or near the target FSL of elevation 299.1 m.

The Project has been designed to pass, at minimum, all flood flows up to a 1:1,000 year flood (4,280 m^3/s) with no surcharging of the outer forebay above the FSL of 299.1 m. If flows exceed this amount, the water level in the forebay would increase. Under such very infrequent, higher flow conditions, the Project is designed to allow for a modest amount of surcharge while ensuring sufficient freeboard remains on the dams to contain wind generated waves. The Project is designed to safely pass floods under a maximum surcharge of about 0.6 m, at which time the forebay would reach the IDF Level of 299.7 m and the combined discharge capacity of the primary and secondary spillways would be at least equivalent to the inflow design flood (IDF) of 5,040 m^3/s. A nominal temporary surcharge of 0.1 m above FSL (299.1 m) was assumed appropriate to account for difficulties in precisely balancing hourly variations in inflow and outflow.

Water Velocities, Flow Patterns and Depths

During the operational phase of the Project, estimated water velocities and flow patterns for the 5th, 50th, and 95th percentile flow conditions are the same as the conditions during Stage 2 of construction. As characterized above, flows in excess of powerhouse capacity will be passed through the new primary spillway during both the Stage 2 construction and operational phases of the Project.

Downstream of immediate tailrace area below the spillway rapids, as spillway outflows and powerhouse flows converge, flow patterns will generally be similar to existing conditions.

Depths near the bottom of the spillway shelf will be up to 2.5 m shallower, and depths in the area of the primary spillway discharge channel are up to about 2.5 m deeper than existing conditions as flows will be directed down the spillway discharge channel rather than across the spillway shelf, refer to Figures 8.2C and 8.3B.

8.4.4.3 Mitigation Measures

There are no mitigation measures proposed.

8.4.4.4 Residual Effects after Mitigation

There will be no change to water levels in the reaches upstream or downstream of the generating station as a result of the Project.

The Project has been designed to minimize changes to local flow patterns. The residual effect to local flow patterns is small in magnitude, local in geographic extent, long-term in duration, high in frequency, not reversible, low in uncertainty and is considered to be not significant.

The residual effect to water velocities is small in magnitude, local in geographic extent, long-term in duration, high in frequency, not reversible, low in uncertainty and is considered to be not significant.

8.4.5 Ice Regime

8.4.5.1 Construction

Construction will be accomplished in stages as described in the project description. During Stage 1, it is anticipated that ice processes will be similar to past conditions. A stable ice cover will form on the reservoir, and the open water areas will continue to be present in the intake channel (between the access bridge and the powerhouse) and at the rapids immediately downstream of the spillway. Spillage through the existing spillway bays and sluiceways will release turbulent water that may be slightly warmer than 0°C in winter. Consistent with existing conditions, when there is flow through the spillway during the winter, the turbulence and warmth of the water will likely cause the rapids below the spillway to remain ice-free. The downstream cofferdam may potentially result in a minor increase of velocity of water over the spillway rapids immediately downstream of the existing spillway. Subsequently, there could be minor changes to the ice cover adjacent and immediately downstream of the cofferdams. Ice formation processes will not be affected in the other reaches during construction. Ice fog will occur, as it has in the past, due to the exposed turbulent water over the spillway rapids, adjacent to the downstream cofferdam.

During Stage 2, the new primary spillway will be used to convey all flows in excess of the powerhouse capacity. Potential effects are described in operation.

8.4.5.2 Operation

After the primary spillway has been put in operation, it is expected that ice formation will occur in the same manner as it has for more than 100 years with the existing structures. Lake ice will form over the reservoir upstream of the spillways commencing in mid-November. During winters in which the river flow is large enough to require release of flow through the new primary spillway, a localized area of open water will occur immediately upstream as already occurs; however, this will now form closer to the eastern shore in front of the new primary spillway. In the spring, the reservoir ice will typically melt in place, with small quantities breaking up and drifting into the inner forebay area. Major runs of broken ice that could cause problems at the intakes or the new spillways are not expected to occur. The spillway gates have been designed for impact loads from floating surface ice.

The proposed new spillways will likely result in a slight change in locations where ice forms and open water conditions persist over the spillway rapids.

The Project does not change the overall flow volumes. The difference in ice conditions with respect to existing conditions will be small and will not change the well-recognized

unsafe conditions of the ice in the area downstream of the Pointe du Bois GS. After the completion of the proposed work, the area will remain a dangerous area for winter travel by snowmobile or on foot. No changes in winter ice conditions are expected between Eight-Foot Falls and the Slave Falls GS as a result of the Project.

8.4.5.3 Mitigation Measures

There are no mitigation measures proposed.

8.4.5.4 Residual Effects

The residual effect related to ice processes is small in magnitude, local in geographic extent, long-term in duration, high in frequency, not reversible, low in uncertainty and is considered to be not significant.

8.4.6 Physiography and Landscape

8.4.6.1 Construction

Construction will result in changes to the physiography and landscape as a result of the following works associated with the Project:

- Site clearing, preparation and use of work areas, material source areas, access roads and facilities;
- Development and use of material source and material placement areas; and
- A change to the river bottom and shoreline related to the construction and footprint of the new spillways and dams.

Clearing to develop work areas will result in removal and changes to soils including compaction, loss due to erosion, mixing of soil and potential soil contamination as a result of accidental spills.

8.4.6.2 Operation

The operation of the Project will not have any effect on physiography and landscape.

8.4.6.3 Mitigation Measures

Mitigation measures include the following:

- An environmental protection plan and erosion and sediment control plan (ESCP) will be developed for the Project outlining practices that should be adopted during Project activities;
- Clearing of work area sites will be limited to only those areas required for the construction infrastructure;
- If feasible, vegetated buffers (minimum of 30 m) will be maintained between work areas and the river;

- Organic material and overburden will be removed to expose the desired materials and stockpiled for use in site rehabilitation at the end of the Project;
- An **emergency response plan** will be developed for the Project and will include spill response procedures to minimize effects to soil; and
- Sites cleared for work areas, material source and disposal areas and access roads not required for long-term operation of the station will be rehabilitated following construction.

8.4.6.4 Residual Effects after Mitigation

The residual effects of the Project on the landscape as a result of construction of the Project are considered to be moderate in magnitude, site related to geographic extent, long-term in duration, high in frequency, not reversible, low in uncertainty and considered to be not significant.

The residual effects of the Project on soils are considered to be moderate in magnitude, site related to geographical extent, short-term in duration, high in frequency, moderately reversible, low in uncertainty and considered to be not significant.

8.4.7 Erosion and Sedimentation

8.4.7.1 Construction

Several temporary structures will be constructed for the Project that will be exposed to erosive forces and therefore have the potential to increase sedimentation in the Winnipeg River. As well, construction activities associated with the Project may result in erosion and sedimentation in the Winnipeg River.

These construction activities/works include:

- Clearing and utilization of work areas;
- Barge landing construction;
- Rockfill stabilization of the east gravity dam (EGD);
- Cofferdam construction/removal;
- Excavation of the primary spillway approach and discharge channel;
- Commissioning of the primary spillway;
- Construction of permanent earthfill dams and secondary spillway;
- Commissioning of the secondary spillway;
- Decommissioning of the existing spillway and sluiceways; and
- **Effluent** discharge from settling ponds/tanks.

The potential for erosion and TSS loading was estimated for each construction activity based on the amount of earthfill material used and the erosive forces of the expected water levels and flow velocities.

Work Areas

There is a small potential for increases in TSS as a result of overland drainage; however, with the implementation of the erosion and sediment control plan (ESCP), the potential is minimized.

Barge Landing Construction

Construction of the barge landing will take place in the wet and there is the potential for the introduction of sediments into the Winnipeg River. However, the construction area is exposed to low velocities such that sediment management to minimize the release of sediments can be accomplished.

East Gravity Dam Stabilization

Most of the rockfill used to stabilize the east gravity dam will be placed in the dry. However, portions of the rockfill will need to be placed in-water. This area is exposed to low velocities such that sediment management to minimize the release of sediments can be accomplished.

If the curved or high spillways along the easy gravity dam are operated, it may result in increased TSS in the Winnipeg River. This increase would be temporary, approximately 2 hours, and is predicted to result in a daily average TSS concentration increase up to 1 mg/L in Reach 3 and Reach 4 (fully mixed zone). On an hourly basis, the TSS increase is predicted to be between 4 to 6 mg/L in Reach 3 and up to 1 mg/L in Reach 4.

Cofferdam Construction/Removal

Construction of the cofferdams is described in Chapter 3.0. The double rockfill groin method of construction reduces the potential of highly erodible material being subjected to the flow of the Winnipeg River. If the existing spillways are used during placement, there is potential for fines in the rockfill to be washed downstream. Short-term increases of TSS are predicted in the mixing zone (i.e., Reach 3), ranging from 1 mg/L to 5 mg/L for a daily average and up to 10 mg/L above background on an hourly basis. In Reach 4 (fully mixed zone) increases in the daily average TSS concentrations are expected to be less than 1 mg/L.

The exterior sides of the cofferdam that are exposed to fast flowing water will be covered with riprap armouring to prevent erosion during operation.

During removal of the downstream cofferdam, the inner groin and clay will be removed as much as possible using the outer groin for protection from the bulk of the flow from the existing sluiceways and spillway. The outer groin will be removed in flowing water, installation of a silt curtain will not be possible because of the potential velocities from the spillway discharge. It is likely that sediment will be released to the Winnipeg River

during this process. It is difficult to accurately quantify material loss during excavation in the wet. However, as the cofferdam removal is the reverse process of the construction potential, TSS concentration increases were assumed to be similar with an estimated daily average increase in the fully mixed zone of approximately 1 mg/L.

Spillway Approach Channel Excavation

Prior to blasting of the spillway approach channel, either a working rockfill platform or a cofferdam will be constructed to allow drilling and blasting in the dry. If a rockfill platform is utilized, it will be constructed by temporarily covering/filling the area with rock obtained from adjacent areas of excavation. This will permit drilling and blasting through the rock platform, shattering the solid rock beneath. To control sediment release during this work, turbidity curtains will be used around the perimeter of the rockfill platform to isolate the work area. If a cofferdam is utilized, the area subject to drilling and blasting will be dewatered behind the cofferdam. It is expected that due to the low flow velocities in the area, sediment will be managed to fully contain all disturbed or suspended particles.

Primary Spillway Commissioning

During **commissioning** of the primary spillway, sediment within the approach and discharge channels, will be mobilized and transported downstream. The estimated river flow during the commissioning process is equivalent of the 95% flow condition in the Winnipeg River, with the flow being split between the full powerhouse capacity and one gate open on the primary spillway. The sediment in the approach and discharge channels will consist of some clay and silt present in the existing environment which has accumulated on the bedrock, as well as material left behind during the blasted bedrock excavation. The maximum increase in TSS is predicted to occur during the opening of the first gate for a short duration (approximately 1 hour). The short term instantaneous (hourly) increase in TSS is predicted to be up to 95 mg/L in Reach 3 and 40 to 50 mg/L in Reach 4 (fully mixed zone). The daily average TSS is predicted to increase by 2 to 4 mg/L in Reach 3 and 1 to 2 mg/L in Reach 4. Opening the second gate would result in a predicted daily TSS increase up to 1 mg/L with each successive gate resulting in a lower TSS increase in Reach 4.

In a small area immediately downstream of the primary spillway discharge channel, flow patterns and velocities will be changed locally during spillway gate commissioning. The flow velocities for the 95% flow will increase by 0.25 to 2 m/s. Considering the size of substrate materials in this area (cobbles and boulders) bed material transport is not expected due to the increase in flow velocity; however, it is likely that smaller cobbles will be displaced locally by the flow within the area of higher velocities.

Permanent Dams and Secondary Spillway Construction

The primary spillway will be able to pass the entire river flow so that all existing spillways and sluiceway bays can be closed and will act as the upstream cofferdam for

the construction of the permanent dams and secondary spillway. The work area downstream from the existing structures will then be accessible in dry conditions isolated from river flow. Therefore, introduction of sediment to the river during construction of the permanent dams and secondary spillway is not expected.

Secondary Spillway Commissioning

The river bed upstream and downstream of the secondary spillway is characterized as "clean" bedrock so there is only a minor potential to flush fines downstream during the initial operation of the secondary spillway. Therefore, introduction of sediment to the river during commissioning of the secondary spillway is not expected.

Existing Spillway and Sluiceway Decommissioning

The existing spillways and sluiceways will be decommissioned following completion of the new earthfill dams and the secondary spillway. The decommissioning process will involve the removal of gates, hoists, railings, and decks and the underwater cutting of selected spillway piers. These piers will be cut underwater using either a concrete wire saw or conventional mechanical demolition and/or blasting. Due to the low volume of material to be demolished and the relatively small area influenced by the demolition, the introduction of sediments to the river during decommissioning of the existing spillway and sluiceway is considered to be minimal.

Effluent Discharge from Settling Ponds/Tanks

As described in Chapter 3.0, settling ponds or tanks will be required on both the west and east sides. All discharge from the settling ponds/tanks will be such that the Manitoba Surface Water Quality Objectives and Guidelines in the river are not exceeded.

Sedimentation and Erosion Analysis

An empirical analysis has been conducted to qualitatively assess where sedimentation will occur. The analysis indicated the following:

- Deposition patterns during construction and operation of the new spillways will generally remain the same as what is observed in the existing environment;
- Fine material, such as clay, silt and very fine sand, will follow the same depositional pattern between Eight Foot Falls and Slave Falls GS as that currently observed in the existing environment. Fine material will not deposit in the area between Pointe du Bois GS and Eight Foot Falls, except in the shallow bays and the back-bays;
- The amount of sand that will be deposited between Pointe du Bois GS and Eight Foot Falls is minimal, if any. It will only deposit along the shoreline where lower velocities are observed. This is also observed in the current substrate where there is very little sand deposited between the Pointe du Bois GS and Eight Foot Falls;

- It is likely that all of the cobbles (64-256 mm) will deposit immediately downstream of the Pointe du Bois GS. A similar depositional pattern is observed in the current substrate where cobbles are found immediately downstream of the Pointe du Bois GS; and
- It is expected that some of the gravel (2-64 mm) will deposit between the Pointe du Bois GS and Eight Foot Falls. However, this gravel will likely be deposited immediately downstream of Eight Foot Falls as the channel becomes deeper with lower velocities. This is observed in the current substrate where some gravel is found downstream of the Pointe du Bois GS.

The potential volume of total deposited material introduced by all construction activities within the Winnipeg River between Pointe du Bois GS and Slave Falls GS is estimated to be 1-5 m^3 of clay, 25-60 m^3 of silt and 205-215 m^3 of sand 4-45 m^3 of gravel and 2-11 m^3 of cobbles.

8.4.7.2 Operation

Operation of the existing generating station will not change as a result of the Project, as there are no changes to the powerhouse capacity, nor the frequency of spill operations. As a result, water levels will not increase and no additional flooding of the forebay will occur under normal conditions. The Project will have a greater capacity to pass flood flows and the forebay levels during floods will be better maintained with the new spillway structures. Therefore, there will be no change to the shoreline or riverine erosion processes as a result of this Project. The current erosion rates that are considered to be representative of future erosion rates without the Project are also considered to be representative of erosion rates with the Project.

During commissioning of the primary spillway, sediment in the approach channel from the existing environment and sediment from the construction activities associated with blasting and excavation of the approach channel will likely be displaced. This will leave the immediate area upstream of the primary spillway as bedrock which is not susceptible to erosion. Therefore, operation of the primary spillway in a manner similar to that during commissioning (flows up to approximately the 95% flow condition) will not result in any additional erosion of sediment from the upstream approach channel.

The proposed repositioning of the spillways associated with the Project will only result in nominal changes to localized flow patterns and velocities both immediately upstream and downstream of the spillways. This area consists mainly of granite bedrock, therefore, erosion is not expected.

There is a small area of the river bottom immediately upstream of the approach channel where clay and silt sediments has accumulated on the bedrock which may be exposed to increased flow velocities and potentially erode under high flow conditions during flood handling operation of the primary spillway. Operational scenarios for flood handling refer to river flow conditions in excess of the 95% flow. In these flood cases, additional

sediment in the approach channel from the existing environment and sediment from the construction activities associated with blasting and excavation of the approach channel would likely be displaced.

Under the operation of the spillways for flood handling (i.e., floods greater than the 95% flow), the daily average increases in TSS in the Winnipeg River under fully mixed conditions would be less than those experienced during spillway commissioning. During spillway operations for flood handling, the spillway gates will be raised in response to the increasing flows on the river. The rate at which the spillway gates are opened for flood passage will be more drawn out than the rate at which the spillway gates are raised as part of commissioning.

During the most extreme flood event (i.e., the Inflow Design Flood event with all spillway bays open), the volume of sediment expected to be mobilized into the Winnipeg River is comprise of 900 m^3 of clay, and 1000 m^3 of silt which will be eroded and carried downstream of Eight Foot Falls. Approximately 2750 m^3 of sand will mobilize with settlement above and below Eight Foot Falls. Approximately 120 m^3 of gravel will erode and likely settle in the lake sturgeon habitat below the primary spillway.

In a small area downstream of the spillway discharge channel, high flow velocity during this extreme flood event might displace some of the existing cobbles/boulders, as well as any gravel which could have been deposited due to the commissioning of the primary spillway.

8.4.7.3 Mitigation Measures

Mitigation measures include the following:

- An erosion and sediment control plan will be developed and implemented for the Project;
- The introduction of suspended sediments to surface waters will be avoided/minimized by controlling the mobilization of sediments at source and providing erosion control measures as required. Sediment control measures, such as turbidity curtains, will be employed to control release of suspended sediments to downstream environments;
- The exterior sides of the cofferdam that are exposed to fast flowing water will be covered with riprap armouring to prevent erosion during operation;
- During removal of the downstream cofferdam, the inner groin and clay will be removed as much as possible using the outer groin for protection from the bulk of the flow from the existing sluiceways and spillway;
- A sediment management plan will be developed for the Project which will measure sediment inputs into the Winnipeg River during in-stream construction

and spillway gate commissioning. It will also prescribe actions to be taken so TSS remains below target levels;

- During dewatering, sediment-laden water within the cofferdam will be pumped to a settling pond to remove suspended solids before being discharged to the river. If required, water will be treated to minimize the introduction of TSS to the Winnipeg River during dewatering of the settling ponds; and
- The discharge channel will be blasted and excavated in the dry. The majority of sediment that accumulates in the discharge channel during construction will be removed following excavation which will minimize the volume of sediments available for mobilization during commissioning of the primary spillway.

8.4.7.4 Residual Effects after Mitigation

The residual effect on erosion and sedimentation as a result the Project is expected to be small in magnitude, local in geographic extent, short-term in duration, low in frequency, reversible, moderate in uncertainty and is considered to be not significant.

Refer to Section 8.5.1 for the effects assessment of TSS and the potential to affect aquatic life.

8.4.8 Woody Debris

8.4.8.1 Construction

Woody debris is produced when forested lands are flooded or cleared. Additional lands will not be flooded as a result of the Project. However, as a result of clearing, woody debris may enter the waterway if felled inappropriately.

8.4.8.2 Operation

Woody debris production from the operation of the Project is not expected.

8.4.8.3 Mitigation Measures

Mitigation measures include the following:

- During clearing of work areas, trees will not be felled towards water; and
- Timber and slash from clearing of work areas will be stored in such a manner that it will not enter water.

8.4.8.4 Residual Effects after Mitigation

Residual effects of the Project respecting woody debris production are not anticipated.

8.4.9 Groundwater

8.4.9.1 Construction

During material extraction operations, there is potential for some temporary lowering of the local groundwater table as part of the work. Recovery of the normal water table level is anticipated after completion of the work.

8.4.9.2 Operation

There will not be any effect to groundwater as a result of the operation of the Project.

8.4.9.3 Mitigation Measures

There are no mitigation measures proposed.

8.4.9.4 Residual Effects after Mitigation

Residual effects to groundwater as a result of the Project are not anticipated.

8.5 Aquatic Environment

The aquatic environment components include: water quality, sediment quality, aquatic habitat, lower trophic levels, fish community, and fish quality. Potential effects to the aquatic environment during construction are linked to the following:

- Footprint of the instream structures;
- Clearing of riparian areas;
- Changes in water flow during construction including temporary dewatering;
- Construction and removal of instream structures (e.g., cofferdams);
- Inputs of materials (e.g., through controlled discharges, in-stream construction, surface runoff etc.);
- Effluent streams;
- Blasting;
- Water withdrawal;
- Changes in the ice regime;
- Accidental releases (spills) of oil, fuel, or hazardous substances; and
- Presence of a workforce with potential to increase recreational fishing in the area.

Potential effects to the aquatic environment during Project operation are linked to the following:

- Changes to water flow patterns and velocities (i.e., reduced number of spillway bays and changed location);

- Mobilization of sediments from work areas during initial operation with subsequent deposition downstream;
- Change in sediment deposition patterns;
- Change in ice regime;
- Presence of the new spillway structure; and
- Accidental releases (spills) of oil, fuel, or hazardous substances.

8.5.1 Water Quality

Effects of the Project on water quality are assessed in terms of the suitability of surface water for aquatic life and wildlife, as defined by standards, objectives, and guidelines specified in the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs; Williamson 2002). Water quality parameters are assessed as a group in this section.

8.5.1.1 Construction

Total Suspended Solids

Potential effects of Project construction on TSS are described in detail in Section 8.4.7. The following provides a summary of this information and an assessment of effects on water quality and the potential to affect aquatic life.

The EGD rockfill stabilization, cofferdam construction and operation, and commissioning of the primary spillway were identified as potential concerns with respect to TSS. Potential increases in TSS were estimated for a 95th percentile flow and 50 year construction design flood.

Predicted daily average increases in TSS in the Winnipeg River under fully mixed conditions during these construction activities range from 1 mg/L (east gravity dam stabilization and cofferdam construction and operation) to 2.0 mg/L (commissioning of the primary spillway). Higher increases are predicted to occur downstream of the spillway rapids, prior to full mixing in the river during these activities. TSS will be fully mixed in the river by Eight-Foot Falls. The spatial extent of the increases in TSS are not known but will extend downstream of the Slave Falls GS.

If the curved or high spillways along the EGD are operated, it may result in increased TSS in the Winnipeg River. The increase would be temporary, approximately 2 hours. On a hourly basis, the TSS increase is predicted to be between 4 to 6 mg/L downstream of the spillway rapids and up to 1 mg/L in the fully mixed zone.

Cofferdam construction and operation are predicted to cause negligible increases in the daily average TSS concentrations in the fully mixed zone of the Winnipeg River (i.e., ≤0.1 mg/L). Short-term increases in TSS (daily average) in the mixing zone (i.e., below the spillway rapids) are predicted to range from 1 mg/L to 5 mg/L for a daily average

and up to 10 mg/L above background on an hourly basis. Effects would occur over periods ranging from 1 day to 25 days.

During commissioning of the primary spillway, sediment within the approach and discharge channels, as well as sediment upstream of the approach channel, will be mobilized and transported downstream. The maximum increase in TSS is predicted to occur during the opening of the first gate and would occur for a short duration (approximately 1 hour). Smaller increases are predicted during the opening of the remaining four gates. TSS is predicted to increase by up to 95 mg/L immediately downstream of the spillway rapids and by 40 to 50 mg/L in the fully mixed zone during opening of the first gate. The daily average TSS is predicted to increase by 2 to 4 mg/L and 1 to 2 mg/L downstream of the spillway rapids and in the fully mixed zone, respectively.

The predicted daily average increases in TSS during construction are within the MWQSOGs for the protection of aquatic life for both the 1-day averaging duration (i.e., 25 mg/L increase) and the 30-day averaging duration (i.e., 5 mg/L increase). Increases in TSS within the order of tens to hundreds of mg/L are generally associated with sub-lethal effects to fish such as behavioural alterations, reduced growth or condition, and physiological stress (e.g., DFO 2000). However, as the predicted increases in TSS during commissioning of the primary spillway are short-term (approximately 1 hour), the exposure would be acute and not chronic. Acute toxicities to freshwater fish species are generally reported for TSS concentrations ranging from the hundreds to hundreds of thousands of mg/L (DFO 2000; Robertson et al. 2006). Increases on the order of 49–95 mg/L are therefore not expected to be lethal and effects are predicted to be restricted to potential short-term, sub-lethal stress.

All other activities and potential sources of TSS, including overland drainage, construction of barge landings, blasting, effluents from settling ponds, and directional drilling are expected to have negligible effects on water quality.

Dissolved Oxygen

Ammonium nitrate-fuel oils (ANFOs) will not be used for blasting in the wet. There is potential for ANFO residues to be introduced to the Winnipeg River in areas where ANFOs are used and subsequently exposed to surface waters. However, the effects associated with introduction of ammonia from blasting residues are not predicted to cause a measurable change in DO in the Winnipeg River due to the large flows and the relatively high concentrations of DO.

Minor effects of Project construction on the ice regime are anticipated during construction. Currently, open-water or thin ice conditions occur for several hundred metres downstream of the existing spillway/rockfill dam when there is flow through the spillway. This area would generally be unchanged but there is potential for a minor increase in the spatial extent of this open-water area due to a potential minor increase in water velocity during construction. This change in ice-cover may have a minor effect

(i.e., increase) on DO concentrations due to the increased potential for atmospheric re-aeration of the water column.

As previously noted, sewage will either be trucked off site or directed to the existing wastewater treatment plant (WWTP) and will not affect DO levels.

Nutrients

Nutrients may be introduced to the aquatic environment through activities that introduce TSS. ANFOs will not be used for blasting in the wet but as noted in the description of effects to dissolved oxygen, nitrogenous residues may potentially be introduced to surface waters in areas exposed to drainage and/or surface waters. Effects of blasting residues on nitrate and ammonia are predicted to be small and are not predicted to result in exceedances of water quality objectives or guidelines for the protection of aquatic life due to high river discharge and low background concentrations of these substances in the river. Sewage will be trucked off site or directed to the existing WWTP.

Total Kjeldahl nitrogen (TKN) and **total phosphorus** (TP) are positively correlated with TSS in the Winnipeg River and construction activities that are predicted to increase TSS would also likely increase TKN and TP. Therefore, short-term, small increases in TKN and TP are expected during stabilization of the EGD, cofferdam construction and operation, and commissioning of the primary spillway. Increases would be greatest during commissioning of the primary spillway.

pH and Alkalinity

Use of rock materials (such as those that may be used in the construction of the main dams and cofferdams) may have the potential to generate **acid leachate** (which could subsequently enter the local surface water environment, acidify local waters and adversely affect aquatic biota). An assessment was conducted to determine the potential for the rock material to be used for the Project to generate acid leachate. The rock material was found to be not potentially acid generating and no effects on water quality are predicted.

Wastewaters from concrete processing (i.e., wash water for the concrete aggregate and batch plant) may be alkaline and therefore may increase pH in receiving waters. This potential effect will be mitigated, if required, through implementation of appropriate effluent treatment methods prior to release to the Winnipeg River. Discharge of this effluent is not predicted to result in changes to pH in the Winnipeg River outside of the MWQSOGs for protection of aquatic life (PAL).

Microbiological Parameters

Sewage from construction support buildings will either be trucked off-site by a septic service provider or will be directed to the existing Pointe du Bois sewage collection system and treated at the existing WWTP. The WWTP will operate and discharge in

accordance with its licence conditions, including those for **total** and fecal coliform bacteria.

Metals

Project construction activities, notably stabilization of the EGD, cofferdam construction and operation, and commissioning of the primary spillway are expected to cause short-term increases in TSS in the Winnipeg River. These increases in TSS would also increase the concentration of metals associated with the sediments and/or sediment pore water. The effects would be greatest during commissioning of the primary spillway. These activities may cause or contribute to exceedances of MWQSOGs for PAL but are not expected to result in exceedances of MWQSOGs for drinking water, with the possible exception of the aesthetic drinking water quality guideline for iron. Manganese, iron, and aluminum are positively correlated to TSS and are likely to experience the largest increases due to increases in TSS. Other metals, notably copper, lead, selenium, and silver would also be more likely to exceed the MWQSOGs for PAL.

Fill materials that have been newly exposed to the atmosphere during construction have the potential to generate acid leachate which may affect pH and mobilize metals when materials are placed in the aquatic environment or when drainage is introduced to the aquatic environment. Construction materials that will be placed in the aquatic environment in relation to the Project were tested for their potential to generate acid leachate. Results of this testing indicate a negligible potential for generation of acid leachate from material sources and effects on metals are therefore considered to be negligible.

Hydrocarbons and Hazardous Substances

Release of hydrocarbons and other hazardous substances to the aquatic environment have the potential to cause both direct and indirect adverse effects on flora and fauna. Hydrocarbons and other contaminants may be introduced through site drainage, cofferdam seepage, and/or accidental spills and releases.

During construction, water with elevated levels of contaminants may accumulate within the cofferdams due to runoff and seepage. This water may be affected by contaminants from the operation of heavy equipment and will be tested and treated, if required, prior to discharge to the Winnipeg River.

The release of significant quantities of hazardous substances to the aquatic environment as a result of accidental spills and releases (including potential frac-outs) is considered unlikely.

8.5.1.2 Operation

Total Suspended Solids

Potential effects of Project operation on TSS are described in detail in Section 8.4.7. The following provides a summary of this information and an assessment of effects on water quality and potential to affect aquatic life.

During Project operation, water levels in the Pointe du Bois forebay will remain within the historic range and there will be no overall change in the flow regime of the forebay; therefore Project operation would not alter TSS due to shoreline erosion. Small quantities of sediments may also be mobilized from work areas in the initial post-construction period. The sewage generated during operation of the Project will be similar to existing conditions. It will be treated at the existing Pointe du Bois WWTP and discharged through the existing outfall, no changes to the existing licensed operations are anticipated.

As described in Section 8.4.7.2, there is a small area of the river bottom immediately upstream of the approach channel where clay and silt sediment has accumulated on the bedrock which may be exposed to increased flow velocities and potentially erode under high flow conditions during flood handling operation of the primary spillway. Operational scenarios for flood handling refer to river flow conditions in excess of the percentile 95% flow. In these flood cases, additional sediment in the approach channel from the existing environment and sediment from the construction activities associated with blasting and excavation of the approach channel would likely be displaced causing an increase in TSS.

As described in Section 8.4.7.2, the daily average increase in TSS in the Winnipeg River under fully mixed conditions is predicted to be lower than those predicted during spillway commissioning (i.e., daily average increase of 2 and 4 mg/L in the fully mixed condition and in the mixing zone respectively). Therefore, it is predicted that TSS will remain within the MWQSOG PAL objective for the 1-day averaging duration.

Dissolved Oxygen

Currently, an open-water area occurs upstream of the spillway during years when the spillway is operated in winter. During Project operation, an open-water area would continue to occur when the primary spillway is used but the area would shift closer to the eastern shore upstream of the primary spillway. Similarly, the locations of open-water areas downstream of the Pointe du Bois GS will also shift slightly. Overall, these minor changes in the ice regime (i.e., locations of open-water areas) are expected to have a negligible effect on DO in the Winnipeg River as the spatial extent of open-water areas and the timing of ice formation and breakup will not be altered by the Project.

During Project operation, flow through the large ponds on the spillway shelf (Reach 2, spillway Ponds #2 and #3) will be discontinued. The elimination of flow to these ponds may cause oxygen depletion during the open-water season and, particularly, the ice-

cover season, and these effects may increase over time with evolution of the limnological characteristics of the ponds in relation to changes in hydrology. The ponds may also thermally stratify with the elimination of inflow and outflow which may lead to development of lower DO at depth under ice-cover and/or during hot, calm periods in the open-water season. Thermal stratification and DO depletion at depth is observed in Blind Bay, upstream of the Pointe du Bois GS, in the ice-cover and open-water seasons. DO depletion would likely be greatest under ice cover and may be temporarily alleviated during periods of inflow (i.e., as a result of testing of the secondary spill gates and very high spill events). DO depletion may be of the magnitude where MWQSOGs for PAL are not met, most notably at depth and in late winter.

As previously noted, sewage generated during operation of the Project will be similar to existing conditions. It will be treated at the existing Pointe du Bois WWTP and discharged through the existing outfall, no changes to the existing licensed operations are anticipated.

Nutrients

As described in Section 8.4.7.2, sediments upstream of the approach channel may be mobilized during extreme high flow events. Mobilization of these sediments may in turn increase nutrients in surface waters under these flood conditions. The precise magnitude of the increases is not known but it is assumed that increases may be high enough to result in detectable increases in nutrients.

pH and Alkalinity

Project operation is not expected to affect pH and alkalinity.

Microbiological Parameters

Sewage generated during operation of the Project will be similar to existing conditions. It will be treated at the existing Pointe du Bois WWTP and discharged through the existing outfall, no changes to the existing licensed operations are anticipated.

Metals

As described in Section 8.4.7.2, scouring of the river bottom following the commissioning of the primary spillway may occur during high flow events and would result in suspension of bottom sediments and release of sediment to the surface water environment. Similar to effects during construction and commissioning, this sediment re-suspension would increase the concentrations of metals in surface waters and may cause or contribute to exceedances of MWQSOGs for PAL under flood conditions.

Hydrocarbons and Hazardous Substances

Activities associated with Project operation are not expected to result in the introduction of hydrocarbons or other hazardous substances to the aquatic environment.

8.5.1.3 Mitigation Measures

Mitigation measures include the following:

- Section 8.4.7.3 outlines sediment and erosion control measures that also mitigate effects on total suspended solids, turbidity, colour, nutrients and metals;
- ANFO blasting materials will not be used in or near water in accordance with DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998);
- Rock materials planned for construction use in and near water will be tested for acid generation potential. If testing reveals that acid generation potential exits, these materials will not be used;
- Handling of all hazardous materials on site will be in accordance with the Environmental Protection Plan and all federal and provincial standards and protocols;
- Directional drilling operations will be conducted in accordance with conditions stipulated in the DFO High Pressure Directional Drilling – Manitoba Operational Statement;
- Refuelling and equipment maintenance activities will occur at least 100 m away from a water body, or conducted in a manner to prevent the release of deleterious substances to a water body; and
- Emergency response plans, procedures and equipment to address accidental oil, fuel, or hazardous waste spills into the aquatic environment in the vicinity of the Project will be in place to minimize effects should an accidental spill occur.

All measures implemented to mitigate effects to water quality will also mitigate effects on sediment quality.

8.5.1.4 Residual Effects after Mitigation

The largest effects to TSS during construction are associated with the East Gravity Dam stabilization, cofferdam construction and operation, and commissioning of the primary spillway. Residual effects during operation are related to the potential for re-suspension of sediments upstream of the approach channel during high flow events. As the estimated increases in TSS during construction and operation are within the MWQSOGs for PAL, the magnitude of these increases is ranked as small. The residual effect of TSS in the Winnipeg River as a result of Project activities after the implementation of mitigation is expected to be small in magnitude, regional in geographic extent, short-term in duration, low in frequency, reversible and moderate in uncertainty.

The Project is predicted to have a minor effect on dissolved oxygen concentrations in the main flow of the Winnipeg River during construction and operation. DO depletion is expected within spillway ponds #2 and #3 on the spillway shelf, notably under ice cover,

due to elimination of inflows and outflows during operation, with the exception of periodic events where flow is introduced (i.e., testing of the secondary spill gates every two years and very high spill events). DO may decrease to concentrations below the MWQSOGs for PAL in these ponds, notably at depth near the end of the ice-cover season. Residual effects to dissolved oxygen in spillway Ponds #2 and #3 may are expected to be moderate in magnitude (i.e., MWQSOGs may not be met), site in geographic extent, long-term in duration, high in frequency, not reversible, and moderate in uncertainty.

Nutrients may increase during Project construction and operation in relation to Project-related increases in TSS. Residual effects are expected to be small in magnitude, regional in geographic extent, short-term in duration, low in frequency, reversible, and low in uncertainty.

Increases in TSS during Project construction and operation may also increase the concentrations of metals (notably aluminum, iron, and manganese) and may cause or contribute to exceedances of MWQSOGs for PAL during short-term construction activities and high flow events during operation. Residual effects are expected to be small in magnitude, regional in geophraphic extent, short-term in duration, low in frequency, reversible and low in uncertainty.

Residual effects related to pH and alkalinity, and hydrocarbons and other hazardous substances are not expected.

With the exception of potential effects on DO in the spillway ponds, residual effects to water quality are predicted to be small to moderate in magnitude, regional in geographic extent, short-term in duration, low in frequency, reversible, and low to moderate in uncertainty.

Overall, residual effects of Project construction, decommissioning and operation on water quality are considered to be not significant.

8.5.2 Sediment Quality

8.5.2.1 Construction

Sediment quality may be affected by activities that introduce contaminants and/or nutrients to the surface water environment and/or by activities that result in sediment re-suspension or deposition.

Activities such as construction of new dams and spillways and decommissioning of the existing facilities such as the rockfill dam (known to contain a high proportion of embedded fine materials) have the potential to introduce both nutrients and sediments to receiving waters which may subsequently settle in downstream locations.

8.5.2.2 Operation

Activities associated with Project operation are not expected to affect sediment quality in the study area.

8.5.2.3 Mitigation Measures

Measures implemented to mitigate effects to water quality will also mitigate effects on sediment quality.

8.5.2.4 Residual Effects after Mitigation

Residual effects of Project construction, decommissioning and operation on sediment quality are not anticipated.

8.5.3 Aquatic Habitat

8.5.3.1 Construction

Effects of the Project on aquatic habitat may be temporary or long term. The post-Project environment at 50th and 95th percentile flow conditions is shown in Figure 8.4. In general, changes in the type and area of wetted habitat may arise from:

- Creation of new permanently wetted habitat in the forebay;
- Permanent loss of intermittent flows to the bedrock spillway as flows route through the discharge channel;
- Complete or partial loss of ponds in Reach 2 above and below the 95th percentile shoreline due to new flow routing or principal structures;
- Loss of shallow connecting channels that convey **leakage flows** (under no spill conditions) among the larger ponds to Reach 3; and
- Intermittently wetted habitat that will be maintained infrequently near the bottom of the discharge channel. Infrequently, the latter may connect spillway pond #2 to Reach 3.

A schematic diagram of the changes expected in the short term due to construction and long term changes expected due to operation of the new spillway is shown in Figures 8.5 and 8.6.

Placement of a cofferdam or blast platform upstream of the proposed primary spillway will temporarily infill 42,652 m^2 of deep, low velocity Reach 1 habitat for approximately four years. Barge landings on the west and east side of the river will temporarily infill 2,700 m^2 of shallow nearshore habitat, characterized by rocky shorelines transitioning to organic/mineral substrates offshore for approximately 4 years. A cofferdam for construction of the powerhouse transition structure will temporarily infill 575 m^2 of shallow, low velocity, bedrock substrate habitat for 3 months. In addition, 15,264 m^2 of an intermittently connected pond habitat (spillway pond #3) in Reach 2 will be infilled

by the cofferdam separating the primary and secondary spillways and by the new west main dam.

Two small intermittently connected ponds (spillway ponds #7 and #8) on the east side of the existing spillway shelf (see Figure 8.5) will be excavated for construction of the primary spillway discharge channel, permanently altering this habitat. This will result in the area being dewatered during non-spill events but will result in greater connectivity of this area to other aquatic habitats during low spill events.

Construction of the new spillway structure downstream of the existing dam and decommissioning of the existing structures is shown in Figure 8.5, and will result in inundation of an area and a habitat gain of approximately 23,799 m^2. Excavation of the new approach channel upstream of the primary spillway will result in depths of approximately 11.6 m in this area with boulder/cobble or bedrock substrates. The newly wetted area adjacent to the west main dam will be approximately 5m deep, characterized by boulder/cobble substrates and will have negligible water velocities. Depth averaged water velocities in the spillway approach channel will be negligible during no spill events and will range from about 1 m/s, 40 m upstream of the spillway to about 1.5–2 m/s closer to the spillway gates, under 95th percentile inflows.

During construction, spill flows will be managed either by use of existing facilities during Stage 1 construction or by the use of the new primary spillway during Stage 2 construction. Spillway flows will be managed to protect the existing station and construction area. Some minor training of flows as a result of cofferdam placement on the spillway shelf (Reach 2) is expected to have negligible effect on flow patterns in Reach 3.

Substratum will be altered in up to 30,982 m^2 of deep, low velocity habitat in Reach 1 upstream of the primary spillway by cofferdam/blast platform remnants. An additional 7,035 m^2 of substrate in the approach channel will be changed from a depositional environment to a scoured bedrock environment. Nearshore substratum in 2,700 m^2 of habitat in Reach 1 will be altered by remnants of the barge landings. Scouring subsequent to commissioning of the new primary spillway is expected to alter substrates upstream of the new primary spillway approach channel. All of the habitats altered within the Pointe du Bois forebay are considered resilient and are expected to rapidly regain their productive capacity post-Project.

In Reach 3, approximately 575 m^2 of habitat will be altered by the powerhouse transition structure cofferdam remnants. Downstream to Eight Foot Falls, the substratum may be altered temporarily by the transport and/or deposition of sediments mobilized from upstream and from work areas during construction or decommissioning. This temporary movement of materials on the river bed is expected to result in coarse material deposition (cobble and gravel sized material) downstream of the spillway discharge channel outflow area. Small quantities of sand and gravel will continue to be transported along the bottom to the lower half of Reach 3 and these are expected to be

deposited primarily in Reach 4, where the bed is mainly sand, gravel and fine materials. Incremental deposition of fines (e.g., silt/clay with some sand) is not expected in Reach 3, except in **depositional habitat** that exists today in lentic bays where aquatic macrophytes are found. Deposition of small quantities of fines in Reach 4 is anticipated.

Rooted vascular macrophyte beds are not expected to be affected by construction activities occurring as part of the Project. Macrophyte beds do not occur in Reach 2 and areas where they occur in Reaches 1, 3 and 4 (primarily in small bays and sheltered areas) will not be subject to changes in flow pattern or water levels as a result of the Project.

8.5.3.2 Operation

Inundation of areas between the existing and new structures will continue during Project operation and for the life of the new facilities. New aquatic habitats can be expected to stabilize during the early years of Project operation with the overall result that a gain of productive habitat is achieved upstream of the Project.

Project operation will not change the frequency that spills will occur, nor will it change water levels in Reaches 1, 3 or 4 (see Section 8.4.4). The secondary spillway will convey flows very rarely. It will be in association with larger floods, times required to maintain control of the reservoir or during gate tests. The Project will not affect powerhouse operations.

In Reach 1 water velocities will decrease across the face of the existing spillway and increase in the area of the new spillway approach channel.

In Reach 2, the direct changes resulting from new spillway operation are expected to be large, relative to the size of the reach. Flow will be concentrated in the spillway discharge channel rather than across the existing spillway rapids, resulting in a loss of wetted habitat across the spillway rock shelf. Based on an open-water 50th percentile flow, the redirection of spillway flows will dewater 56,961 m^2 of intermittently wetted channels and 12,450 m^2 of permanently wetted channels on the spillway rock shelf. Flow will no longer be provided through the two large ponds (spillway ponds #2 and #3) located on the spillway rapids (Figure 8.6), except during extremely high inflow events when the secondary spillway is in operation. Continuous flow into these ponds as a result of spillway leakage will be substantially reduced or will cease to occur. Changes in the amount of wetted area within Reach 2 will be greater during higher spill events compared to lower events.

As flow enters Reach 3, there will be a concentration of flow discharge to the east side of the river and a subsequent redirection of flows immediately below the spillway shelf (See Section 8.4.4). The flow pattern changes in Reach 3 will be more moderate than in Reach 2 and will be greatest downstream of the spillway shelf where flow direction will be shifted to the west during all spill events (Figure 8.7A and 8.7B). Downstream of the

convergence of generating station and spillway flows, little change in flow pattern will be noticeable.

During the initial period of primary spillway operation (characterized by a wide range of possible spillway discharges), there is potential for transport of coarse bed materials for a short distance below the primary discharge channel and deposition in an area where coarse materials already exist.

Rooted vascular macrophyte beds in the study area are not expected to be affected by operation activities occurring as part of the Project. Macrophyte beds do not occur in Reach 2 and areas where they occur in Reaches 1, 3 and 4 (primarily in small bays and sheltered areas) will not be subject to changes in flow pattern or water levels as a result of the Project.

8.5.3.3 Mitigation Measures

During the design of the principal structures and the associated construction infrastructure, potentially significant environmental effects were identified. In such cases, aspects of the Project were re-designed to minimize or avoid adverse environmental effects. These design features include the following:

- Measures to disperse flows over the lower extent of the bedrock shelf of Reach 2 before entering Reach 3, where aggregate materials are more common;
- With the exception of a small short-term cofferdam for the powerhouse transition structure, avoidance of direct effects to aquatic habitats downstream of the spillway rapids. The size of cofferdams and barge landings upstream of the spillway and in Reach 2 will be minimized to the extent practicable in order to minimize temporary and permanent losses of aquatic habitat. Decommissioning of the east gravity dam and the main dam will allow fish access into additional forebay areas created upstream of the new dams;
- Construction of the new spillway structure downstream of the existing dam and decommissioning of the existing structures (Figure 8.6) such that a habitat gain of approximately 23,799 m^2 will occur. The majority of aquatic habitats created are expected to be approximately 5 m deep and have boulder/cobble or bedrock substrates; and
- Design of the new spillways and discharge channel so as to minimize changes to flow patterns downstream of Reach 2. The lower end of the spillway discharge channel is designed to allow flow to exit over the existing unaltered spillway rapids in order to disperse flows released from the discharge channel into Reach 3. The primary spillway flow also discharges into a relatively shallow bay which causes the flow to diverge at higher discharges. The spillway design maintains flows over existing lake sturgeon spawning habitats below the spillway rapids in Reach 3.

No specific mitigation measures are proposed with respect to substratum in the study area. Any sediment mobilized during construction and subsequently deposited in the study area is expected to be of a similar composition to the host substratum materials and small in quantity. Cofferdam, blast platform and barge landing remnants in Reach 1 are expected to have positive effects on aquatic biota in that area by increasing substratum diversity. Similarly in Reach 3, any coarse material deposition is expected to augment spawning substrates located there. Sand and gravel deposition in Reach 4 is expected to have a negligible effect on existing sand and silt habitats in this reach.

Similarly, no mitigation measures are proposed with respect to rooted vascular macrophyte beds.

8.5.3.4 Residual Effects after Mitigation

Upon conclusion of the Project there will be a net gain of 23,799 m^2 of habitat in the Pointe du Bois forebay. All of this gain will be in the immediate forebay upstream of the new dam and spillway approach channel. The Project will result in the loss of approximately 15,601 m^2 of intermittently connected pond habitat (in spillway pond #3) on the spillway rock shelf, 12,450 m^2 of permanently wetted channels on the spillway rock shelf, and an average of 56,961 m^2 of intermittently wetted channel habitat on the spillway rock shelf. The remaining aquatic habitat in spillway ponds #2 and #3 will change from a primarily lotic to lentic environment. There will be no change to the amount of habitat located downstream of the spillway rapids and powerhouse. Changes to aquatic habitats in relation to fish habitat and Section 35 of the Federal *Fisheries Act* are addressed in the Pointe du Bois Spillway Replacement Project Fish Habitat Compensation Plan. The residual effect to the aquatic habitat is small in magnitude, local in geographic extent, long-term in duration, low in frequency, moderately reversible and moderate in uncertainty.

The spillway structures and discharge channel have been designed to minimize the flow changes at the base of the spillway rapids and to optimize lake sturgeon spawning habitat in Reach 3. However, flows will be directed down the spillway discharge channel rather than across the spillway rapids. In Reach 2, spillway flows will no longer occur into the ponds on the existing spillway rapids except during extreme flow events or during annual secondary spillway gate tests that are expected to have limited benefit to habitat. No effect is anticipated downstream of Eight Foot Falls. The overall residual effect to the change in flow pattern is moderate in magnitude, local in geographic extent, long-term in duration, high in frequency, moderately reversible and low in uncertainty.

Except in the footprint of permanent facilities, construction and operation effects on substratum are expected to be negligible. Any movement of coarse bed materials near the outlet of the discharge channel is localized and is considered a small change. Subtle changes in bottom type in a small area are not expected to result in a detectable change in lake sturgeon spawning success (Section 8.5.4.4). However, monitoring of bed material type in the area of the spillway discharge channel before and after the

beginning of the Project operation phase is planned. The residual effect to substratum alteration is considered small in magnitude, local in geographic extent, short-term in duration, low in frequency, reversible and low in uncertainty.

Activities associated with the Project are not expected to affect rooted macrophyte beds in the study area and residual effects will not occur.

Small residual effects to fish habitat will be offset by compensation as described in the Project Fish Habitat Compensation Plan. The overall residual effect to fish habitat will be a small net gain in productive capacity of fish habitat upon completion of the Project and the associated compensation.

8.5.4 Lower Trophic Levels

Lower trophic level communities are assessed as a group in this section.

8.5.4.1 Construction

Phytoplankton and Periphyton

During construction, the primary potential effects on phytoplankton and periphyton are related to inputs affecting water quality, such as increases in TSS concentrations and related variables (i.e., turbidity) due to in-stream activities (e.g., EGD stabilization, downstream cofferdam construction and operation, commissioning of the primary spillway), and nutrient inputs (e.g., with particulate materials [i.e., TSS]), and changes in the type and area of wetted habitat. As the estimated increases in TSS are within MWQSOGs for PAL and the duration of these effects are expected to be moderate, there is the potential for negligible to small decreases in phytoplankton and periphyton biomass during the construction period, most likely due to a reduction in light penetration from increases in TSS concentrations.

As the expected increase in nutrient inputs to the Winnipeg River during the construction period is small and for a short duration, nutrient inputs will likely not have a measurable effect on phytoplankton and periphyton biomass (i.e., negligible to small increases).

Metals (notably aluminum, iron, and manganese) will be introduced into the aquatic environment in association with construction activities that release sediments. As exceedances of MWQSOGs for PAL, if they were to occur, would be short-term and regional, increases in metal concentrations will likely not have a measurable effect on phytoplankton and periphyton biomass (i.e., negligible to small decreases).

The presence and levels of hydrocarbons in the aquatic environment could potentially be affected by accidental spills or release of substances containing hydrocarbons (e.g., diesel fuel, gasoline, lubricating oil, etc.). Other hazardous substances will also be used during the construction period. The release of significant quantities of hazardous substances to the aquatic environment as a result of accidental spills and releases is

considered unlikely due to the development and implementation of environmental protection and **spill response plans**.

Temporary and permanent dewatering of work areas upstream of the spillway (i.e., placement of cofferdam or blast platform, and barge landings) will have small, negative effects on phytoplankton and periphyton biomass within a portion of Reach 1. Decommissioning of existing spillway and dam structures in Reach 2 will likely negatively affect periphyton biomass in the short-term. Activities such as the replacement of the east gravity and west main dams, the spillways downstream of existing structures, and the excavation of the spillway approach channel, will ultimately result in the expansion of deep, low velocity aquatic habitat and will likely have a small, positive effect on algal biomass.

Drifting Aquatic Macrophytes

An assessment of potential Project effects on the aquatic macrophyte community (periphyton and rooted vascular macrophytes) is based on the assessment of construction-related effects to surface water quality and physical attributes of aquatic habitat. Periphyton biomass may be reduced during construction by changes in water quality, and the type and area of wetted habitat and this may result in site-specific, small decreases in the production of drifting algae during construction activities.

Zooplankton

The primary potential effects on zooplankton are related to inputs affecting water quality, such as increases in TSS concentrations and related variables (i.e., turbidity) due to in-stream activities, inputs or construction activities that affect dissolved oxygen concentrations, and changes in the type and area of wetted habitat. Additionally, the zooplankton community may respond to changes in phytoplankton biomass. As the estimated increases in TSS are within MWQSOGs for PAL and the duration of these effects is expected to be moderate, there is the potential for negligible to small decreases in zooplankton density during the construction period.

Negligible changes in dissolved oxygen concentrations are expected due to construction activities; therefore, no effect on zooplankton density is likely.

Metals (notably aluminum, iron, and manganese) will be introduced into the aquatic environment in association with construction activities that release sediments. As exceedances of MWQSOGs for PAL, if they were to occur, would be short-term and regional, increases in metal concentrations will likely not have a measurable effect on zooplankton density (i.e., negligible to small decreases).

Temporary and permanent dewatering of work areas upstream of the spillway (i.e., placement of cofferdam or blast platform, and barge landings) will have a small, negative effect on zooplankton density within a portion of Reach 1. Activities such as the replacement of the east gravity and west main dams, the spillways downstream of existing structures, and the excavation of the spillway approach channel, will ultimately

result in the expansion of deep, low velocity aquatic habitat and will likely have a small, positive effect on zooplankton density. Negligible to small changes in phytoplankton biomass are expected due to construction activities; therefore, no effect on zooplankton density is likely to be detected.

Aquatic Macro-Invertebrates

The primary potential effect(s) on aquatic macro-invertebrates is related to inputs affecting water quality, such as increases in TSS concentrations and related variables (i.e., turbidity) due to in-stream activities and inputs or construction activities that affect dissolved oxygen concentrations in the Winnipeg River, and changes in the type (e.g., water velocity, substratum) and area of wetted habitat. Additionally, the macro-invertebrate community may respond to changes in periphyton biomass. As the estimated increases in TSS are within MWQSOGs for PAL and the duration of these effects is expected to be moderate, there is the potential for negligible to small decreases in macro-invertebrate abundance during the construction period in Reaches 2 and 3. The current variability of river flow results in variations in the concentrations of suspended sediments and their deposition in the study area. As a result, the current aquatic macro-invertebrate community should be able to withstand very short-term increases (i.e., days to a few weeks) in suspended and benthic sediments with negligible, long-term negative effects. Prolonged (i.e., months), low to moderate increases in suspended fine sediments beyond the current range of concentrations may affect aquatic macro-invertebrates in the following ways: abrasion of/deposition on respiratory surfaces (i.e., gills) (e.g., a reduction in certain types of mayflies); interference of food intake for filter-feeders (e.g., a reduction in certain types of caddisflies and fingernail clams); and increased rates of invertebrate drift due to changes in feeding efficiency and behaviour (e.g., a temporary reduction in aquatic insect abundance in areas exposed to increases in TSS).

Negligible changes in dissolved oxygen concentrations are expected due to construction activities; therefore, no effect on either macro-invertebrate abundance or community composition is likely.

Metals (notably aluminum, iron, and manganese) will be introduced into the aquatic environment in association with construction activities that release sediments. As any exceedances of MWQSOGs for PAL, if they were to occur, would be short-term and regional, increases in metal concentrations will likely not have a measurable effect on either macro-invertebrate abundance (i.e., negligible to small decreases) or community composition.

Temporary and permanent dewatering of work areas upstream of the spillway (i.e., placement of cofferdam or blast platform, and barge landings) will have a small, negative effect on macro-invertebrate abundance within a portion of Reach 1. Decommissioning of existing spillway and dam structures in Reach 2 will likely negatively affect macro-invertebrate abundance in the short-term. Activities such as the replacement of the east gravity and west main dams, the spillways downstream of

existing structures, and the excavation of the spillway approach channel, will ultimately result in the expansion of deep, low velocity aquatic habitat and will likely have a small, positive effect on macro-invertebrate abundance. Incremental deposition of fines (e.g., silt/clay with some sand) is not expected in Reach 3, except in depositional habitat that exists today in lentic bays where rooted vascular macrophytes are found. Deposition of small quantities of fines in Reach 4 is anticipated. This additional sedimentation could negatively influence the aquatic macro-invertebrate community in the affected area depending on the size of sediment particles, the type of substrate (e.g., greater negative potential if coarser substrate affected), the spatial extent (e.g., greater negative potential as percent surface cover increases), and depth of deposited sediments (e.g., greater negative potential if depth of sediments exceeds 5 cm), the rate of deposition, and if deposited sediments are stable or transient (e.g., washed away with the next higher flow event).

There is a potential for construction (e.g., dam and cofferdam construction) and decommissioning (e.g., removal of existing dams and spillway structures) activities to disturb or destroy individual corpulent rams-horn snail residing in the footprint of these structures or activities.

8.5.4.2 Operation

Phytoplankton and Periphyton

Operation-related pathways that were assessed for potential effects to the phytoplankton and periphyton communities included: net gain in aquatic habitat area, with the majority in the immediate forebay upstream of the new dam and spillway approach channel (Reach 1); and changes in water flow patterns (primarily in Reach 2).

The small gain in aquatic habitat in Reach 1 will likely have a small, positive effect on phytoplankton biomass. The changed pattern of water flow in Reach 2 will increase the residence time of water within the spillway ponds. The increase in lentic habitat may allow algal biomass to increase depending on other factors such as nutrient availability and TSS concentrations. There is also the potential for small, negative effects on periphyton distribution and biomass in Reach 2 due to the permanent dewatering of areas within the spillway shelf. The altered pattern of water flows anticipated in Reach 3 is expected to be small and should have no measurable effect on the biomass and distribution of phytoplankton in that reach.

Drifting Aquatic Macrophytes

An assessment of potential Project effects on the aquatic macrophyte community (periphyton and rooted vascular macrophytes) is based on the assessment of operation-related effects to physical attributes of aquatic habitat. Periphyton biomass may be reduced during operation by changes in the type and area of wetted habitat (Section 8.5.3.2); this may result in site-specific, small decreases in the production of drifting algae during operation of the Project. Additionally, the distribution of drifting aquatic

macrophyte biomass may be altered during operation as the proportion of flow directed down the east side of the Winnipeg River in Reaches 1 and 2, relative to present, will increase with increasing flows. Rooted vascular macrophyte beds are not expected to be affected by Project operation (Section 8.5.3.2).

Zooplankton

Operation-related pathways that were assessed for potential effects to the zooplankton community included: DO depletion in the spillway ponds, notably under ice cover; net gain in aquatic habitat area, with the majority in the immediate forebay upstream of the new dam and spillway approach channel (Reach 1); and changes in water flow patterns (primarily in Reach 2). Additionally, the zooplankton community may respond to changes in phytoplankton biomass.

DO depletion is expected within spillway ponds #2 and #3 on the spillway shelf, notably under ice cover, due to elimination of inflows and outflows during the majority of operation. DO may decrease to concentrations below the MWQSOGs for PAL in these ponds, notably at depth near the end of the ice-cover season. Depending on DO concentrations, and duration and spatial extent of DO depletion, zooplankton may either be negatively affected by the low DO concentrations, or these conditions may create refugia for zooplankton from **planktivorous** fish predation.

The small gain in aquatic habitat in Reach 1 will likely have a small, positive effect on zooplankton density. The changed pattern of water flow in Reach 2 will increase the residence time of water within the spillway ponds. The increase in lentic habitat may allow zooplankton density to increase depending on other factors such as TSS and dissolved oxygen concentrations, and phytoplankton biomass (i.e., food availability and quality). The altered pattern of water flows anticipated in Reach 3 is expected to be small and should have no measurable effect on the density and distribution of zooplankton in that reach.

Aquatic Macro-Invertebrates

Operation-related pathways that were assessed for potential effects to the macro-invertebrates included: DO depletion in the spillway ponds, notably under ice cover; net gain in aquatic habitat area, with the majority in the immediate forebay upstream of the new dam and spillway approach channel (Reach 1); and changes in water flow patterns (primarily in Reach 2). Additionally, the macro-invertebrate community may respond to changes in periphyton biomass. It is expected that effects will be managed through appropriate mitigation measures (Section 8.5.1.3; Section 8.5.3.3), thereby reducing the duration and magnitude of any operation-related effects on the macro-invertebrate community.

DO depletion is expected within spillway ponds #2 and #3 on the spillway shelf, notably under ice cover, due to elimination of inflows and outflows during the majority of operation. DO may decrease to concentrations below the MWQSOGs for PAL in these

ponds, notably at depth near the end of the ice-cover season. Depending on DO concentrations, and duration and spatial extent of DO depletion, macro-invertebrate colonization may be limited to a few resilient groups (e.g., chironomids). Most invertebrate taxa tolerate all but very low DO levels (less than or equal to 10% saturation); however, effects of low DO concentrations are typically observed at concentrations of less than or equal to 5-6.5 mg/L. Of the insects, mayflies demonstrate the highest sensitivity to low DO conditions (lethal effects observed at less than or equal to 20% saturation or less than 1 mg/L), while chironomids are more tolerant. During periods of ice-cover, water temperatures typically approach 0°C; such low temperatures may reduce invertebrate metabolism (and thus, oxygen demand) sufficiently to somewhat lessen the negative impacts of low DO concentrations during the late-winter.

The small gain in aquatic habitat in Reach 1 will likely have a small, positive effect on macro-invertebrate abundance. The changed pattern of water flow in Reach 2 will increase the residence time of water within the spillway ponds. The increase in lentic habitat may lead to changes in the macro-invertebrate community composition found in these ponds (e.g., increase in abundance of macro-invertebrate taxa more typical of standing water environments). There is also the potential for small, negative effects on macro-invertebrate distribution and abundance in Reach 2 due to the permanent dewatering of areas within the spillway shelf; the direct changes to Reach 2 resulting from new spillway operation are expected to be large, relative to the size of the reach. The altered pattern of water flows anticipated in Reach 3 is expected to be small and should have no measurable effect on the abundance and distribution of macro-invertebrates in that reach.

8.5.4.3 Mitigation Measures

Mitigation measures include the following:

- Mitigation measures designed and employed to avoid/minimize Project effects on water quality (Section 8.5.1.3) and aquatic habitat (Section 8.5.2.3.) will also avoid/minimize effects on lower trophic level communities; and
- Prior to construction and decommissioning activities, a SCUBA-based survey in areas that could potentially be habitat for the corpulent rams-horn snail will be conducted. Snails found in this area will be manually removed from the substrate and relocated to a suitable location that is not subject to Project-related effects.

8.5.4.4 Residual Effects after Mitigation

The relatively small net gain in aquatic habitat, primarily in Reach 1, and the increased water residence time within the spillway ponds may have a small, positive effect on phytoplankton biomass. The permanent dewatering of areas within the spillway shelf may result in a site-specific, small reduction in the distribution and biomass of periphyton.

The reduction in the distribution and biomass of periphyton within the spillway shelf may contribute to site-specific, small decreases in the production of drifting algae. Additionally, the distribution of drifting aquatic macrophyte biomass may be altered during operation as the proportion of flow directed down the east side of the Winnipeg River in Reaches 1 and 2, relative to present, will increase with increasing flows.

Depending on DO concentrations, and duration and spatial extent of DO depletion within ponds on the spillway shelf, zooplankton may either be negatively affected by the low DO concentrations, or these conditions may create refugia for zooplankton from planktivorous fish predation. The relatively small net gain in aquatic habitat, primarily in Reach 1, and the increased water residence time within the spillway ponds may have a small, positive effect on zooplankton density.

Depending on DO concentrations, and duration and spatial extent of DO depletion, within ponds on the spillway shelf, macro-invertebrate colonization may be limited to a few resilient groups, such as chironomids. The relatively small net gain in aquatic habitat, primarily in Reach 1, may have a small, positive effect on macro-invertebrate abundance. However, this small increase in abundance may be off-set by the potential for small decreases in macro-invertebrate distribution and abundance in Reach 2 due to the permanent dewatering of areas within the spillway shelf. The increase in water residence time within Reach 2 spillway ponds may lead to changes in the macro-invertebrate community composition found in these ponds (e.g., increase in abundance of macro-invertebrate taxa more typical of standing water environments).

Residual effects on corpulent rams-horn snail are expected to be non-detectable.

The residual effects on **lower trophic levels** are small in magnitude, local in geographic extent, short-term in duration, low in frequency, reversible, low in uncertainty and are considered to be not significant.

8.5.5 Fish Community

This section considers the entire fish community in the study area but focuses on VEC species (lake sturgeon, walleye and northern pike). Lake sturgeon has been designated as "endangered" in the Winnipeg River by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is a candidate for possible listing under the *Species at Risk Act* (SARA). It is also considered a "Heritage Species" by Manitoba Water Stewardship due to its "unique life history characteristics, limited distribution and social and historical significance." It is a key recreational fish species in the Pointe due Bois area, subject to a catch and release fishery. Northern pike and walleye are considered VECs due to their importance in the recreational fishery and their place at the top of the aquatic food chain.

8.5.5.1 Construction

Potential adverse effects on the fish community resulting from construction activities include direct effects such as avoidance behaviour, trauma or mortality as well as indirect effects such as changes in water quality, aquatic habitat and food sources.

Direct Effects

Blasting associated with construction activities can have a number of direct adverse effects on fish. Explosives detonated in or near water produce post-detonation compressive shock waves consisting of a rapid rise to a high peak pressure followed by a rapid decay to below ambient **hydrostatic pressure**, causing a pressure deficit that is responsible for effects on fish such as rupturing and haemorrhaging of vital organs. Fish eggs and larvae are also prone to damage and potentially may be killed by pressure changes caused by blasting. Noise from explosions has also been found to cause non-lethal effects such as changes in behaviour of fish and these effects may become greater in the presence of ice and in areas of hard substrate. The degree of damage is directly related to the type of explosive, the size and pattern of the charge(s), method of detonation, distance from the point of detonation, water depth, species, and size and life stage of fish.

During construction activities associated with the Project, water will be required for several uses including mixing of concrete. If not properly designed, river water intakes have the potential to cause **entrainment** and **impingement** of fish, particularly larvae, juveniles and adults of species with poor swimming performance.

The workforce associated with construction and decommissioning activities of the Project has the potential to increase recreational fishing pressure in the local area, with a resulting direct effect on abundance of recreationally important fish species such as walleye and northern pike. There is no potential for an effect on the abundance of lake sturgeon because of the catch-and-release nature of this fishery.

Indirect Effects

Indirect effects to the fish community associated with Project construction and decommissioning may occur as a result of potential changes in water quality, aquatic habitat and lower trophic levels. Potential construction and decommissioning effects on these ecosystem components are described in Sections 8.5.1 (Water Quality), 8.5.2 (Sediment Quality), 8.5.3 (Aquatic Habitat) and 8.5.4 (Lower Trophic Levels). If left unmitigated, effects to water quality, aquatic habitat and lower trophic levels as a result of Project construction and decommissioning activities have the potential to affect fish abundance, species composition and distribution in Reaches 1 (inner forebay only), 2, 3 and 4.

Mobilization and subsequent deposition of sediments in and near the Project footprint as a result of episodic spill events during construction and decommissioning activities have the potential to cause sedimentation in the immediate vicinity as well as contribute to

the transport of TSS downstream. This has the potential to affect fish distribution and community composition initially, as fish preferring clear waters will avoid areas of high turbidity. While fish within the immediate construction area may be exposed to elevated levels of TSS for short durations, it is expected that the fish will be adaptable and able to avoid non-desirable concentrations. Elevated TSS concentrations are expected to be diluted quickly by flows from the powerhouse and are not expected to be detectable downstream of Reach 4.

During construction, several activities may cause habitat losses for some species of fish; however, the majority of losses are predicted to be temporary and/or small, and will have little effect on overall habitat availability. Cofferdam placement for the primary spillway and the powerhouse transition structure, as well as construction of barge landings will, in total, temporarily displace fish from approximately 45,927 m^2 of habitat during the construction period and possibly for a short time after construction as lower trophic levels adapt. The majority of these habitats are primarily used for foraging and overwintering and have little value for spawning or rearing. It is expected that the productive capacity of these areas, in terms of contributing to the local fish community, will not only recover quickly post project, but also will be enhanced by cofferdam and barge landing remnants.

The partial infill of spillway pond #3 by the cofferdam separating the primary and secondary spillways will result in a permanent loss of 15,264 m^2 of semi-isolated aquatic habitat (Figure 8.6). This habitat is primarily transitory for most large bodied species, which use it temporarily as they move downstream from Reach 1. Longnose sucker are believed to move upstream into the spillway ponds to spawn during low spill events or spillway leakage in spring and will be adversely affected by reduced access to the ponds.

Replacement of the east gravity dam, west main dam and spillways downstream of the existing structures and excavation of the spillway approach channel will result in a gain of 23,799 m^2 of deep, low velocity fish habitat. Production of phytoplankton, zooplankton and macro-invertebrates in this area (see Section 8.5.3) will contribute to its suitability as fish habitat. This additional habitat will benefit all species currently found in the area immediately upstream of the spillway including walleye, northern pike, sauger, white sucker, yellow perch, and rock bass.

8.5.5.2 Operation

Direct Effects

Upstream movement past the Pointe du Bois GS currently is not possible and historically, the natural rapids would have been a deterrent or barrier to upstream movement for most resident species and sizes of fish under most, if not all, flow conditions. Operation of the new spillway facilities at Pointe du Bois will result in no change to upstream fish movement at this location. Successful downstream movement of walleye, northern pike and lake sturgeon has been documented at the Pointe du Bois

GS and the rate of such movement and any associated mortality and/or injury is expected to remain unchanged with the new facilities.

Loss of most spillway flows to the spillway ponds in Reach 2 may result in the temporary stranding of some fish post project.

Indirect Effects

Loss of most spillway flows through the pools in Reach 2 will adversely affect those species that purposely use those habitats to fulfill some life history requirement. It is expected that loss of access to the pools during low spill events will negatively affect longnose sucker spawning habitat availability.

Changes to water velocities and flow patterns in the immediate vicinity of the spillway and downstream to Eight Foot Falls during operation of the new spillway facilities have the potential to alter localized habitat suitability for fish spawning in Reach 3, particularly for lake sturgeon (Figure 8.8A and 8.8B). Although some suitable walleye spawning habitat is found in this area, most walleye and northern pike spawn further downstream in Reaches 3 and 4. Walleye spawning habitat suitability under 50th and 95th percentile flows are illustrated in Figure 8.9A and 8.9B.

8.5.5.3 Mitigation Measures

Mitigation measures include the following:

- Blasting associated with Project construction and decommissioning will be conducted in accordance with DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998);
- Blasting for removal of existing structures or instream blasting of spillway approach and discharge channels will not take place between April 1 and June 30 of any year;
- In cases of in-water blasting, mitigation measures such as bubble curtains will be placed around the area to be blasted to exclude fish in order to minimize fish overpressures;
- Water intake pipes will be screened according to Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995) to minimize the entrainment and impingement of fish;
- No in-water work will take place between April 1 and June 30 of any year;
- A sediment management plan will be developed to minimize inputs of sediment to the aquatic environment and the plans implementation and effectiveness will be monitored;
- Fish residing in areas subject to either permanent or temporary dewatering will be live salvaged and relocated to adjacent areas not subject to Project effects; and

- A lake sturgeon spawning monitoring and adaptive management program will be implemented during Project construction and operation. In Reach 3 lake sturgeon spawning success and flow velocities (to the extent possible) will be monitored to determine whether any effects of the Project on lake sturgeon spawning success are occurring. Any reduction in lake sturgeon spawning success during spill events as a result of changed flow pattern below the spillway rapids will be mitigated through an adaptive habitat enhancement approach.

8.5.5.4 Residual Effects after Mitigation

Residual effects of blasting, water withdrawal and increased recreational fishing as a result of the Project on fish abundance and distribution including lake sturgeon, walleye and northern pike are not anticipated.

Residual effects to water and sediment quality as a result of the Project are expected to be minor and short term in nature and consequently there will be negligible effects on fish habitat and fish including lake sturgeon, walleye and northern pike.

Residual effects to lower trophic levels as a result of the Project are expected to be negligible and short term and consequently there will be a negligible effect on the use of habitat for foraging by fish including lake sturgeon, walleye and northern pike.

Residual effects to fish habitat are expected to be site specific and confined to Reaches 1, 2 and 3. Relatively small gains in direct fish habitat (23,799 m^2) will occur immediately upstream of the spillway structure following decommissioning of the existing structure and completion of the spillway approach channel. These gains will be beneficial for walleye and northern pike as well as several other species inhabiting the Pointe du Bois forebay. Fish habitat will be lost through partial infilling of spillway pond #3 (15,264 m^2). A reduction in the frequency and magnitude of flows through the spillway ponds will result in a shift from lotic to lentic fish species within these habitats. A loss of 12,450 m^2 of permanently wetted channels and an average of 56,961 m^2 of intermittently wetted channels on the spillway shelf will result in the loss of indirect fish habitat that primarily contributes lower trophic productivity to downstream environments. These losses and habitat changes will have a negative effect on longnose suckers, which use the spillway pond habitat for foraging and spawning. A minor loss of individual fish (e.g., longnose sucker, northern pike) may occur during infilling for cofferdams and blast platforms.

Design features for the new spillways (as described for aquatic habitat in Section 8.5.3) provide mitigation of potential effects to lake sturgeon habitat (particularly spawning habitat) downstream of the Pointe du Bois facilities. These features include measures to disperse flows entering Reach 3 from both the primary and secondary spillways, avoidance of direct impacts to aquatic habitats downstream of the spillway rapids and minimizing changes to existing flow patterns in Reach 3. In addition the Project incorporates spillway design features similar to the existing Slave Falls GS facilities; the latter providing an additional example of successful lake sturgeon spawning below a generating station on the Winnipeg River.

Observed patterns of lake sturgeon egg deposition below the Pointe du Bois GS appear to relate closely to the location and pattern of water movements during the spawning period. Spawning occurred in the tailrace each year, as turbine flows always offered hydraulic habitat of suitable water velocity. Spawning below the spillway occurred only when spill flow reached a minimum level and the area where eggs were deposited increased notably when spillway flows complemented those of the powerhouse. As spillway flows occurred, eggs were found over a wide range of hard substrates, i.e., from smooth bedrock to boulder, and all available depths suggesting that sturgeon at Pointe du Bois appear to opportunistically exploit the available lotic habitat for spawning. After four years of study, 95% of all egg deposition was within 85 m of the powerhouse or spillway outlet (lower end of rock shelf), which are from physical or energetic standpoints, a barrier to movement. Eggs were found mainly in areas of suitable velocity that moved down river; eggs were not observed within areas of suitable velocity that moved up river within a back eddy.

Agreement between the five variable Habitat Suitability Index (HSI) model (North/South Consultants Inc. 2011) and the pattern of egg abundance observed for each of the spawning periods is good, recognizing that not all suitable habitat is used in any single spawning period. Model results for the existing environment show that suitable areas are lowest for the 5th percentile flow as water releases occur only through the powerhouse, and fewer turbines operate at this low flow. The total suitable area below the powerhouse and tailrace increases notably at the 50th percentile flow or higher because spill occurs and new suitable areas become available below the spillway. As spills increase from the 50th percentile, suitable areas increase until velocities in the main path of flow exceed suitable velocity for spawning. The suitable area below the powerhouse remains similar among 50–95th percentile inflows because all turbines are assumed to operate at maximum capacity. Most HSI values for the moderate (>0.5 to <0.75) and high categories (>0.75) are within 85 m of the powerhouse and spillway outlet. The existing environment results also show variation in suitable area below the powerhouse can be expected due to flow and/or turbine operation.

The post-Project HSI results also show that the areas below the powerhouse are similar to those of the existing environment, and confirm that the egg deposition habitat below the powerhouse is not affected by the Project. Below the spillway, the suitable areas for the 50th percentile inflow increase for the moderate (>0.5 to <0.75) and high categories (>0.75) by approximately 1,200 m^2 or 16.5% compared to the existing environment. Suitable areas for the 75th percentile for the moderate and high categories are estimated to be the same. Losses are estimated for the 85th and 95th percentiles. The loss in suitable habitat for the 85th percentile below the spillway is 3,550 m^2, and is about 900 m^2 for the 95th percentile. These losses represent approximately 8–26% of the suitable habitat available at these flows in the existing environment. The loss estimated at high flows occurs infrequently and is expected to be offset by the gain at the 50th percentile, despite being a smaller area, because this suitable habitat will be available more frequently.

Overall no negative residual effects to lake sturgeon, walleye and northern pike or their habitat are anticipated as a result of the Project.

The residual effects to the fish community in general are considered to be small in magnitude, local in geographic extent, long-term in duration, moderate in frequency, reversible, moderate in uncertainty and are considered to be not significant.

8.5.6 Fish Quality

8.5.6.1 Construction

The flooding of terrestrial vegetation and soils often associated with hydroelectric development has been found to increase the production and concentrations of **methylmercury** in the aquatic environment. Construction activities associated with the Project will not cause flooding of terrestrial vegetation and soils.

8.5.6.2 Operation

The Project will be operated such that the outer forebay levels in Reach 1 will be controlled within the historical operating range at or near the target FSL elevation of 299.1 m and no new flooding will occur. As a result there is no potential for increased production and concentrations of methylmercury in the aquatic environment as result of the Project.

8.5.6.3 Residual Effects after Mitigation

Residual effects on fish quality are not anticipated as a result of Project construction and operation.

8.6 Terrestrial Environment

The terrestrial environment components include: wetland vegetation, terrestrial vegetation and rare plants, invertebrates, amphibians and reptiles, birds, and mammals.

8.6.1 Wetlands and Terrestrial Vegetation

8.6.1.1 Construction

Wetland Vegetation

Wetland habitat includes land areas where ground water, surface water and ice conditions and processes are the dominant influences on vegetation and soils. The water regime and ice processes in off-channel areas of the Winnipeg River where wetland habitats form will not change as a result of the water regime associated with the Project and therefore effects on shoreline wetland vegetation as a result of the Project will not occur. Localized wetland habitats located at inland and shoreline sites on both the east and west side of the Winnipeg River near Pointe du Bois have the potential to be adversely affected by construction and operation of ancillary facilities associated with

the Project including concrete batch plant(s), equipment staging, access roads, borrow sites, barge landings and management of aggregate and impervious materials. Construction will result in the loss of approximately 0.2 ha of inland wetlands (loss of three small ponds #4, #5 and #6 to the east of the existing spillway).

Terrestrial Vegetation and Rare Plants

This section considers effects to the terrestrial vegetation and rare plants in the study area as well as the VECs identified for the Project. Merritt Fernald's sedge and white wood aster have been identified as VECs as they have been ranked as being "very rare" in Manitoba by the Manitoba Conservation Data Centre and they are found in the Project construction area.

Terrestrial vegetation and rare plants located at inland and shoreline sites have the potential to be adversely affected by clearing for ancillary facilities including those associated with concrete batch plant(s), equipment staging, access roads and borrow sites.

Terrestrial vegetation could be directly or indirectly affected in areas used for construction, areas used for the Project's principal structures, and the disturbed areas around these sites which could extend up to 100 m beyond the Project construction area.

Up to 79 ha of aspen forest, 27 ha of sparsely treed on dry sites, 20 ha of jack pine mixedwood forest, and 11 ha of jack pine forest could be affected by the Project activities. Approximately 1 ha each of ash forest, balsam fir forest and black spruce forest may also be affected.

Other Project-related activities may affect up to 14 ha of aspen forest, 8 ha of jack pine forest, and 6 ha of sparsely treed on dry sites. Other vegetation types that could have small areas affected include jack pine forest, black spruce forest, tall shrub, and low shrub, graminoid and/or emergent (all <5 ha). It is very unlikely that all of the potential disturbance areas will be affected by Project activities, however this conservative approach ensures that any potential disturbance in these areas is addressed.

Eleven terrestrial plant species of conservation concern were found in areas of Project activities, including two species ranked S1 (i.e., Merritt Fernald's sedge, white wood aster) which were identified as VECs and four species ranked S2 (dwarf bilberry, Hooker's orchid, hop-hornbeam, sessile-fruited arrowhead) by the Manitoba Conservation Data Centre. Project activities could potentially result in the loss of some of these plants.

Terrestrial clearing and construction activities associated with the Project have the potential to adversely affect terrestrial vegetation including:

- Loss of plants of conservation concern;
- Loss of native forest vegetation;
- Temporary reduction and change in vegetation diversity;

- Modification of existing landscape;
- Increased abundance of non-native (including invasive and noxious) plant species;
- Alteration of native vegetation; and
- Fragmentation of vegetation.

8.6.1.2 Operation

- Project operation is anticipated to have no effect on wetland and terrestrial vegetation including rare plants.

8.6.1.3 Mitigation Measures

Mitigation measures include the following:

- Where practicable, wetlands will be avoided during clearing and construction activities;
- Where not possible to avoid wetlands during clearing and construction, a re-vegetation and rehabilitation plan will be implemented to ensure no net loss of wetland habitat. Native plant species will be utilized for re-vegetation of wetland sites;
- Measures to manage storm water runoff (e.g., vegetation buffer or silt fences) will be implemented to minimize sedimentation in wetlands;
- Locations of S1 and S2 rare plants will be marked prior to clearing and construction activities;
- Clearing of vegetation near S1 andS2 rare plants will be avoided to the extent practicable;
- Material source clearing activities will be limited to the minimum area required for material extraction;
- A 30 m riparian vegetation buffer will be maintained adjacent to the Winnipeg River to the extent practicable;
- Trees will be felled so as not to damage remaining vegetation and tree removal will be confined within the limits of the project activity areas;
- All equipment will be washed prior to working in the Project area to reduce the spread of non-native species;
- Any topsoil removed will be stockpiled during construction activities for use during site rehabilitation;
- A re-vegetation and rehabilitation plan will be implemented for terrestrial sites that are disturbed or lost. Native plant species will be used for re-vegetation and

rehabilitation of disturbed areas with increased erosion potential or where vegetation has been completely removed; and

- Existing access roads and trails will be utilized to the extent feasible to reduce further vegetation removal from newly created roads.

8.6.1.4 Residual Effects after Mitigation

Residual effects include the potential loss of plant species of concern, loss of wetlands, loss of native forest vegetation and temporary reduction and change in vegetation diversity, and fragmentation of vegetation for sites that have been cleared for Project activities. A modification of wetland habitats and terrestrial vegetation will occur for Project activities where substrate material and/or vegetation will be removed to develop material sources and ancillary facilities. Adjacent to Project activities, native vegetation will be altered along newly created forest edges.

The residual effects for wetlands and terrestrial vegetation (including rare plants) are small in magnitude, local in geographic extent, short to medium-term in duration, high in frequency, moderately reversible, low in uncertainty and are considered to be not significant.

8.6.2 Terrestrial Invertebrates

In general, terrestrial invertebrates tend to have high reproductive capabilities and overall abundance. However, the monarch butterfly has a limited overwintering distribution, restricted to the forests of Central Mexico and coastal regions of California. As such, it has been listed as a species of "special concern" under the federal SARA. Because the summering range of this species overlaps with the Project study area, it was selected as a VEC.

8.6.2.1 Construction

Inland construction activities may cause changes in forest gap dynamics (i.e., forest openings formed by the removal of trees), degree and number of open spaces, and the abundance of grasses and disturbance-tolerant plants. Consequently, changes in the distribution, abundance, movements, and reproduction of terrestrial invertebrate species such as the monarch butterfly have the potential to occur. Specifically, changes in the availability of larval source food such as dogbane and milkweed (i.e., common, swamp and green milkweed), direct mortality, sensory disturbance, or injury may occur as a result of construction-related activities.

Construction-related activities that are expected to affect terrestrial invertebrates include the development of borrow areas and access roads, and the clearing of habitat for the construction of ancillary facilities. Potential pathways of effects include habitat loss, exhaust emissions, dust, noise and vibrations, machinery and blasting, and the presence of security and work lights. With respect to stream construction and

decommissioning activities, the majority of pathways for effects on terrestrial invertebrates occur at the aquatic life stage and are discussed in Section 8.5.4.1.

8.6.2.2 Operation

Use and maintenance of the new roadways and permanent access roads have the potential to produce small changes in local distribution and movement patterns. It is expected that the effects of the operation of the Project on the monarch butterfly will be similar to those that are occurring with the existing spillway in place.

8.6.2.3 Mitigation Measures

Mitigation measures include the following:

- Material source areas, work areas and surrounding disturbed areas will be rehabilitated to reduce and mitigate the loss of terrestrial invertebrate habitat incurred by development activities associated with the Project.

8.6.2.4 Residual Effects after Mitigation

Since most invertebrate habitat types are common in the study area, there is a small potential for residual effects to the terrestrial invertebrate community, including the monarch butterfly, as a result of habitat loss or change resulting from Project construction and operation. This is largely due to the high reproductive capabilities and overall abundance of terrestrial invertebrates in general, as well as the availability of monarch butterfly host plant species outside of the study area, and in areas throughout southern Manitoba.

The residual effects are small in magnitude, site related in geographic extent, short-term in duration, low in frequency, reversible and low in uncertainty and are considered to be not significant.

8.6.3 Amphibians and Reptiles

In general, amphibian and reptile species of conservation concern that are listed as at risk and that have the potential for interactions with the Project have been designated as VECs. The northern leopard frog has had a considerable historical contraction of range and loss of populations. Although it has shown some signs of recovery, this species is adversely affected by habitat conversion, and habitat fragmentation, among other factors. As such, the northern leopard frog has been designated as of “special concern” by COSEWIC and under SARA. Because this species distribution range overlaps with the Project study area, it has been selected as a VEC.

Although the common snapping turtle is widespread and still somewhat abundant, its late maturity, great longevity, low recruitment, and dependence on long warm summers for successful incubation make it unusually susceptible to anthropogenic threats. As such, the common snapping turtle has been designated as of “special concern” by

COSEWIC. Because this species distribution range overlaps with the Project study area, it has been selected as a VEC.

8.6.3.1 Construction

Northern Leopard Frog

Overall, northern leopard frog habitat is not restricted to the Project footprint, which is relatively small in comparison to the study area. Observations of northern leopard frogs were made throughout the Project study area in all study years.

The majority of construction activities will occur in areas where infrastructure is already in place (i.e., human-impacted areas, urban, or developed areas where existing disturbance is high). These areas represent low quality wildlife habitat and as such, many construction-related activities are expected to have negligible effects on the northern leopard frog. However, construction-related activities may result in loss or fragmentation of breeding habitat and changes in microhabitat quality. Such effects have the potential to occur during inland activities associated with the construction phase of the Project. Construction activities associated with these effects include the development of borrow areas, infilling of ponds and the construction of ancillary facilities.

Proposed borrow locations associated with upland areas on the east side of the Pointe du Bois GS are adjacent to ponds used by breeding frogs. While adults were found in the general vicinity, northern leopard frogs were not heard during breeding call surveys in or near the proposed borrow locations.

Overall, vehicular traffic related to the construction phase of the Project has the potential to have minor adverse effects on the northern leopard frog through sensory disturbance, possible injury or direct mortality. Pathways include exhaust emissions, dust, noise and vibrations, potential spills, machinery and blasting, and the presence of security and work lights.

Potential effects of in-stream construction activities on aquatic life stages of the northern leopard frog (i.e., eggs and tadpoles) are minor and include dewatering of aquatic habitats and possible addition of sediments to the aquatic environment.

Common Snapping Turtle

Overall, common snapping turtle habitat is not abundant within the Project footprint although several observations of snapping turtles were made outside of the footprint area.

The majority of construction activities will occur in areas where infrastructure is already in place (i.e., human affected areas, urban, or developed areas where existing disturbance is high). These areas represent low quality common snapping turtle habitat and as such, many construction-related activities are expected to have negligible effects on this VEC species. Inland habitat clearing associated with the construction phase of the Project may result in the loss of breeding and summering habitat for the snapping

turtle. Construction activities associated with these effects include the development of borrow areas, infilling of ponds and the construction of ancillary facilities.

There were no incidental observations of common snapping turtles in the vicinity of existing or proposed Pointe du Bois facilities. However, as this species nests on banks along waterways, construction activities affecting bank quality have the potential to affect this species.

Overall, vehicular traffic related to the construction phase of the Project has the potential to have minor adverse effects on the common snapping turtle through sensory disturbance and possible injury or direct mortality. Pathways include exhaust emissions, dust, noise and vibrations, potential spills, machinery and blasting, and the presence of security and work lights.

In-stream construction activities have the potential to have minor effects on the common snapping turtle, primarily through dewatering of aquatic habitats and possible addition of sediments to the aquatic environment.

8.6.3.2 Operation

Northern Leopard Frog

Use and maintenance of the new roadways and permanent access roads have the potential to increase road mortality or adult individuals, and produce small changes in local distribution and movement patterns. It is expected that the effects of the operation of the Project on the northern leopard frog will be similar to those that are occurring with the existing spillway in place.

Common Snapping Turtle

Use and maintenance of the new roadways and permanent access roads have the potential to increase common snapping turtle road mortality as this species is occasionally seen crossing roads, especially during breeding season. It is expected that the effects of the operation of the Project on the common snapping turtle will be similar to those that are occurring with the existing spillway in place.

8.6.3.3 Mitigation Measures

Mitigation measures include the following:

- Disturbance of wetlands will be avoided to the extent practicable;
- To the extent practicable, construction activities within, and in the immediate vicinity of, wetlands will be conducted during winter months so as to avoid effects on northern leopard frog breeding activity;
- To the extent practicable, a 30 m shoreline buffer will be retained along the Winnipeg River; and

- Mitigation measures designed to minimize effects on water quality (see Section 8.5.1.3) also will serve to minimize any effects to northern leopard frogs and common snapping turtle.

8.6.3.4 Residual Effects after Mitigation

There is a small potential for residual effects to amphibians and reptiles, including the northern leopard frog and the common snapping turtle, as a result of Project construction and operation activities.

The residual effects are small in magnitude, site related in geographic extent, short-term, low in frequency, reversible, low in uncertainty and are considered to be not significant.

8.6.4 Birds

Bird species that are listed on Schedule 1 of SARA (Canada warbler) or those (bald eagle, osprey) that have special management prescriptions applied through provincial guidelines or policy (i.e., requirement for minimum disturbance distance from known nests) and that have the potential for interactions with the Project have been designated as VECs.

8.6.4.1 Construction

Unless properly mitigated, habitat loss and sensory disturbance due to Project construction has the potential to negatively affect birds, including Canada warbler, bald eagle and osprey, through loss of nesting habitat and actual nests. Some interior forest bird species that have large home ranges may be susceptible to habitat fragmentation. Noise associated with Project construction activities may cause temporary sensory disturbance, resulting in avoidance or abandonment of suitable habitat by breeding and resident birds.

Increased bird mortality for bird species occupying habitats within the Project area may result from nest damage if clearing is done during the nesting and rearing season and/or as result of collisions with vehicles and construction equipment during the construction period. Increased mortality to larger birds such as **raptors** and particularly night flyers (owls) could result from wire strikes along the new distribution line east of the spillway. Larger bird species, including waterbirds and birds of prey, are more susceptible to collision-related mortality. Smaller species may be subject to increased predation due to the removal of tree cover in the construction area creating habitat conditions favourable to bird predators (small hawks and crows).

8.6.4.2 Operation

It is expected that the effects of the operation of the Project on birds will be similar to those that are occurring with the existing spillway in place.

8.6.4.3 Mitigation Measures

Mitigation measures include the following:

- A preconstruction barred owl, Cooper's hawk, and bald eagle nest survey will be conducted to determine presence or absence of these species in the Project construction area;
- If raptor nests are present, in consultation with Manitoba Conservation, determine the appropriate buffer zone to leave around the nest or relocate the nests to an artificial structure or nearby suitable mature tree;
- Clearing activities will avoid critical nesting periods (generally May 1-July 31);
- Where practicable, wetlands will be avoided during clearing and construction activities;
- Locations of any stick nests will be marked prior to clearing and construction activities;
- Material source clearing activities will be limited to the minimum area required for material extraction;
- To the extent practicable, a 30 m riparian vegetation buffer will be maintained adjacent to the Winnipeg River; and
- Existing access roads and trails will be utilized to the extent feasible to reduce further vegetation removal from newly created roads.

8.6.4.4 Residual Effects after Mitigation

The quantity and quality of habitat for the SARA listed species and the species of conservation concern is not limiting in the Project footprint area. The Project construction area is small compared to the home range and seasonal requirements of bird species with only a small potential for residual effects.

The residual effects are small in magnitude, local in geographic extent, short-term, low in frequency, reversible, low in uncertainty and are considered to be not significant.

8.6.5 Mammals

Mammal VECs have not been selected due to the low level of potential Projects effects on mammal species.

8.6.5.1 Construction

Construction activities on the east side and in material source areas have the potential to displace mammals including white-tailed deer, black bear, beaver, river otter, American mink, American marten, fisher, red fox and other mammals. Loss of habitat and sensory disturbance due to clearing and ongoing access to construction sites by construction

crews may result in short-term avoidance to this area by mammals. Aquatic furbearers such as river otter and American mink may be more affected by activities near the shoreline. Larger mammals such as white-tailed deer and black bear will be displaced into adjacent habitat which are not limiting in the area. The degree of avoidance will depend on the species and the frequency of vehicular traffic and construction activity on the site. There is also the potential of increased mammal mortality due to human-wildlife encounters with problem wildlife. These effects are expected to be limited to the construction period of the Project.

8.6.5.2 Operation

Effects of the Project operation on mammals are expected to be similar to the existing conditions.

8.6.5.3 Mitigation Measures

Mitigation measures include the following:

- An environmental protection plan will be developed for the Project outlining practices that should be adopted during Project activities to reduce the potential of wildlife interactions;
- To the degree practicable, clearing of terrestrial vegetation will be conducted during winter months to minimize effects on furbearer and mammal species that maintain dens or use tree cavities to rear their young; and
- General mitigation measures specified in Section 8.6.1.3 (Wetlands and Terrestrial Vegetation) and Section 8.6.4.3 (Birds) also serve to mitigate effects to mammals.

8.6.5.4 Residual Effects after Mitigation

There is a small potential for residual effects on mammals from Project construction activities.

The residual effects are small in magnitude, local in geographic extent, short-term in duration, low in frequency, reversible, and low in uncertainty and are considered to be not significant.

8.7 Socio-Economic Environment

The socio-economic environment includes: economy, property ownership and land use, infrastructure and services, personal, family and community life, municipal and local government district controls, commercial resource use, recreational use and tourism, and heritage resources.

Employment, business opportunities, and enjoyment of local area were identified as VECs.

8.7.1 Economy

8.7.1.1 Construction

The Project will provide opportunities for the local and regional population and businesses with respect to employment, training and provision of construction materials and support for the construction workforce .

8.7.1.2 Operation

Project operation will result in essentially the same workforce as present with a loss of two positions as a result of the automation of the spillway. Support services for the Pointe du Bois GS will continue to be required.

8.7.1.3 Mitigation Measures

Mitigation measures include the following:

- A Project Preference Zone (PPZ) has been established for determining eligibility for opportunities (Figure 8.10). This zone was selected to include Aboriginal groups and stakeholders that may be potentially affected by the Project. To be consistent with Manitoba Hydro's goal of having a diverse workforce and the goal of strengthening working relationships with Aboriginal groups, Manitoba Hydro has incorporated preferences for Aboriginal individuals;
- Manitoba Hydro has created a hiring preference for "new hires" that provides employment priority:
    - To Aboriginal individuals who are full-time residents of the PPZ,;
    - To all other full-time residents of the PPZ; and
    - To all others;
- Where numbers warrant, Manitoba Hydro require designated contractors, through the project tender specifications, to provide on-the-job training to workers in specified trades with a preference for:
    - Aboriginal individuals who are full time residents of the PPZ; and
    - All other full time residents of the PPZ;
- Manitoba Hydro will scope certain work packages to provide preferred **tendering** opportunities for businesses in the PPZ.

8.7.1.4 Residual Effects after Mitigation

The residual effects on employment during construction of the Project are moderate in magnitude, regional in geographic extent, short-term in duration, high in frequency, reversible, and low in uncertainty and are considered to be not significant.

During operation, the residual effects on employment are small in magnitude, local in geographic extent, long-term in duration, not reversible, low in uncertainty and are considered to be not significant.

The residual effects on training and business opportunities during construction of the Project are moderate in magnitude, regional in geographic extent, short-term in duration, high in frequency, reversible, and low in uncertainty and are considered to be not significant. Although part of the PPZ, there is the potential for some reduction in business for lodges and outfitters as a result of Project construction. The residual effects are moderate in magnitude, local in geographic extent, short-term in duration, high in frequency, reversible, low in uncertainty and are considered to be not significant.

There are no residual effects anticipated during operation of the Project.

8.7.2 Property Ownership and Land Use

8.7.2.1 Construction and Operation

There will be no changes in property ownership in the local and regional study areas as a result of the Project. In addition, there will be no changes in land use to the regional study area, nor to the communities of Lac du Bonnet and Pinawa in the local study area as a result of the Project.

At Pointe du Bois, land use changes will occur on the east and west sides of the river and the center island as a result of construction activities. On the west side of the river, which is adjacent to the Pointe du Bois townsite, there is a work area for Manitoba Hydro and contractors. Within the work area, a contractor access road will be created along with a new public access road. A security gate will be located to prohibit the public from entering the work area. A new public/townsite two lane gravel road will be constructed from PR 313 to Glassco Avenue to separate the public/townsite traffic from the contractor work area traffic and provide continued access to cottages. In addition, in the townsite, there will be a new substation, adjacent to the existing switchyard, required for construction and permanent power for the Project.

8.7.2.2 Mitigation Measures

Mitigation measures relating to land use changes include the following:

- Vegetation buffers will be retained on the east side of the river, to the extent possible, to limit visual effects; and
- Disturbed areas will be rehabilitated following completion of construction and decommissioning activities.

8.7.2.3 Residual Effects after Mitigation

There will be no residual effects on property ownership as a result of construction and operation of the Project in the local or regional study areas.

Residual effects on land use will occur as a result of the construction activities at Pointe du Bois. During operations, the new public/townsite gravel road will remain in place.

The residual effects on land use at Pointe du Bois during construction are moderate in magnitude, local in geographic extent, short-term in duration, low in frequency, reversible, and low in uncertainty, and are considered to be not significant.

The residual effects during operation are moderate in magnitude, local in geographic extent, long-term in duration and frequency, reversible, and low in uncertainty and are considered to be not significant.

8.7.3 Infrastructure and Services

8.7.3.1 Construction

Construction activities in the local study area will result in additional traffic on PR 313, the Slave Falls road and other highways and roads in the area. The existing condition of PR 313 and increased truck traffic on PR 313 and the Slave Falls road was an issue raised during the consultation process (Chapter 5.0). Increased truck traffic will be related to hauling materials from rock and clay sources along PR 313, and granular materials from the Seddons Corner and Milner Ridge areas. Increase in personal vehicle traffic will be related to worker transportation to the site.

During the peak construction period (Year 2), construction traffic along PR 313 is estimated to increase average daily traffic from 380 to 650 vehicles per day. The additional 270 vehicles per day consist of 50 personal vehicles, 5 buses and 215 heavy trucks. During non-peak construction periods, traffic increases are expected to be about 15 to 20% (57 to 76 vehicles) of existing traffic volumes and are predominantly light vehicle traffic.

8.7.3.2 Operation

Traffic levels will return to historical levels after completion of the Project. The new public/townsite road will remain in place.

8.7.3.3 Mitigation Measures

Mitigation measures include the following:

- Use of local material sources for rock and clay materials will be maximized;
- Shuttle buses will be provided to transport workers to and from the construction site;
- A traffic safety plan for the period of construction and decommissioning will be prepared and implemented;

- A new public/townsite road will be constructed from PR 313 to Glassco Avenue to separate the public/townsite traffic from the contractor work area traffic and provide continued access to cottages;
- Traffic safety measures for truck hauls will be implemented through the town site as required during construction and decommissioning; and
- Traffic on PR 313, the Slave Falls road and the public/townsite access road will be monitored as part of the socio-economic monitoring plan for the Project.

8.7.3.4 Residual Effects after Mitigation

Residual adverse effects related to increased traffic (truck and personal vehicles) on PR 313, the Slave Falls road and local roadways will result from construction activities.

The residual effects are moderate in magnitude, regional in geographic extent, short-term in duration, moderate in frequency, reversible, and low in uncertainty and are considered to be not significant.

8.7.4 Personal, Family and Community Life

8.7.4.1 Construction

Effects on personal, family and community life as a result of construction of the Project are not anticipated in the regional study area.

Construction of the Project may have some effect (both positive and negative) on Lac du Bonnet, Pinawa and Pointe du Bois, which are located in the local study area. The estimated workforce consists of 3300 person months with a peak workforce (Year 2) estimated to be about 225 (contractors and Manitoba Hydro). Potential positive economic effects are outlined in Section 8.7.1, Economy. Having a workforce residing in the local study area could potentially have positive and negative effects on these communities. Potential negative effects are expected to be minimal during most construction years as the workforce required for the Project is small. In addition, given the establishment of the PPZ, it is anticipated that some of the workforce will already reside in the local study area, as well as in the regional study area. This will further decrease amount of additional persons in the workforce staying in these communities.

The Project will result in changes to the appearance of the Pointe du Bois area. The potential aesthetic effect is unique to individual perspectives and will likely change over time, particularly once the Project is completed.

During construction, vegetation will be removed from the east side of the river to provide construction work areas, a barge landing, and access to rock and clay sources. Vegetation will also be removed from the center island to provide construction work areas. Construction and decommissioning activities will also have an effect on the appearance of the area.

Construction activities for the Project will affect the enjoyment of the local area although the construction site will be separated from the general community. Construction activities for the Project will include establishment of work areas, building new structures, a new townsite access road, blasting, and hauling of materials. The use of barges for access to the east side will result in restricted boat travel within the barge route. During consultation for the Project several issues were identified including safety, security, noise, inconvenience and general disruption to the enjoyment of the area.

8.7.4.2 Operation

The view from the Pointe du Bois town site and cottage areas will change following completion of the Project. Artistic renderings have been completed show the new views of the spillways, Figure 8.11A and 8.11B.

Safety, security, noise and enjoyment of the local area will return to normal following completion of construction.

8.7.4.3 Mitigation Measures

Mitigation measures include the following:

- Vegetation buffers will be retained on the east side of the river, to the extent possible, to limit visual effects;
- Disturbed areas will be rehabilitated following completion of construction and decommissioning activities;
- Separate access will be provided for the public traffic to the town site and cottages areas through the development of a public/town site access road;
- Security gates will be installed north of the new public/town site access road and at the entrance to the contractor access road to prohibit public access to the contractor work area;
- Navigation safety measures will be implemented related to the barge and other upstream access routes;
- A safety protocol will be prepared to be used during blasting;
- Mitigation measures for noise will be implemented as outlined in Section 8.2.2;
- Workforce accommodations, if required, will be constructed outside Whiteshell Provincial Park;
- Emergency response plans with input from local authorities will be prepared and implemented prior to construction; and
- Regular communications with local stakeholders during construction will be implemented so that if issues arise they can be addressed.

8.7.4.4 Residual Effects after Mitigation

Residual effects related to aesthetics will occur as a result of the construction activities. Residual effects will also occur from the operation of the Project as a result of the change in the new spillways location and structures.

The residual effects are moderate in magnitude, local in geographic extent, medium-term in duration, high in frequency, moderately reversible, and low in uncertainty and are considered to be not significant.

Residual effects related to enjoyment of the area will occur during the construction of the Project.

The residual effects are moderate in magnitude, local in geographic extent, short-term in duration, high in frequency, reversible, and low in uncertainty and are considered to be not significant.

8.7.5 Municipal and Local Government District Controls

8.7.5.1 Construction and Operation

There are portions of six rural municipalities, one local government district and three incorporated towns in the local and regional study area. There will be no effect on municipal and local government controls in any of the municipalities as a result of the Project. If designated contractors choose to operate temporary accommodations to house the construction workforce in the local study area, Manitoba Hydro will require that these facilities be located outside of Whiteshell Provincial Park. Local planning and development controls will be adhered to.

8.7.5.2 Mitigation Measures

No mitigation measures are proposed.

8.7.5.3 Residual Effects after Mitigation

Residual effects on municipal and local government district controls as a result of the Project are not anticipated.

8.7.6 Commercial Resource Use

8.7.6.1 Construction and Operation

There are no commercial forestry, mining or commercial fishing activities in the local project area around Pointe du Bois. No logging is allowed in Whiteshell Provincial Park. There will be no effects on commercial resource use as a result of the Project. There are small portions of three individual traplines within the local study area around Pointe du Bois. One of the traplines runs through the east side area to be cleared for the Project; the area is a small portion of the trapline.

8.7.6.2 Mitigation Measures

No mitigation measures are identified.

8.7.6.3 Residual Effects after Mitigation

Residual effects on commercial resource use are not anticipated.

8.7.7 Recreational Use and Tourism

8.7.7.1 Construction

Construction activity has the potential to discourage recreational and tourism use of the Pointe du Bois area. Surveys of users of the area during the assessment process generally indicated that despite the disruption from construction activities, use of the area during construction would not change. There will be no road access to the boathouses or to the Manitoba Hydro boat launch along the northern peninsula during construction. This could potentially result in decreased boating activities and/or increased use of the boat launch at Sawmill Bay. Rental of cabins and accommodation in the local study area by workers could result in lower availability of the local accommodations for use by recreational users.

8.7.7.2 Operation

Access to the boathouses and the Manitoba Hydro boat launch will be restored following completion of construction.

8.7.7.3 Mitigation Measures

Mitigation measures include the following:

- Manitoba Hydro will work with Manitoba Conservation to determine a feasible option to reduce the effect to the Sawmill Bay boat launch as a result of increased usage; and
- Regular communications will be implemented with local stakeholders during construction to address issues if they arise.

8.7.7.4 Residual Effects after Mitigation

Residual effects to recreation and tourism related to no access to boathouses and the Manitoba Hydro boat launch during construction are anticipated. The effects are moderate in magnitude, local in geographic extent, short-term in duration, high in frequency, reversible, and low in uncertainty and are considered to be not significant. Residual effects related to overall recreation and tourism during operation of the Project are not anticipated.

8.7.8 Heritage Resources

Heritage resource investigations were undertaken in 2007 and 2008 in the study area from Lamprey Falls to Slave Falls. The investigations further investigated existing known heritage sites and identified and designated new sites.

8.7.8.1 Construction

Construction of the Project has the potential to affect sites located in areas to be cleared for work area construction purposes and in material source areas.

8.7.8.2 Operation

Effects to heritage resources effects are not anticipated during operation.

8.7.8.3 Mitigation Measures

Mitigation measures include the following:

- Pre-construction heritage surveys of the east side area to be cleared and the material source areas to be used for the Project will be conducted to further identify and flag the sites for protection; and
- The Project Environmental Protection Program will contain measures for the protection and management of heritage resources.

8.7.8.4 Residual Effects after Mitigation

Residual effects on heritage resources as a result of the Project are not anticipated.

8.8 Summary of Mitigation Measures and Significance

Table 8.2 contains a summary of Project mitigation measures.

Table 8.3 contains a summary of Residual Effects after Mitigation and Significance on the Valued Environmental Components.

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Air Quality							
Increased atmospheric emissions from construction activities	♦ An environmental protection plan will be developed for the Project; ♦ Limiting unnecessary idling of equipment /machinery; and ♦ Regular vehicle / equipment maintenance.	Small	Local	Short-term	Moderate	Reversible	Moderate
Increased dust levels from construction activities	♦ An environmental protection plan will be developed for the Project; and ♦ As necessary, application of acceptable dust-control measures on the roadway during the construction period to limit the amount of airborne dust.	Small	Local	Short-term	Moderate	Reversible	Moderate
Increased particulate matter and emissions from burning scrub and brush	♦ An environmental protection plan will be developed for the Project	Small	Local	Short-term	Moderate	Reversible	Moderate
Noise							
Increased noise from construction activities	♦ An environmental protection plan will be developed for the Project; ♦ The usage of the east side material sources will be maximized to reduce the amount of heavy truck traffic on PR 313 and through the townsite; ♦ Rock drilling and blasting operations will not take place between 10 pm and 7 am; and ♦ To the extent reasonably possible, activities that generate excessive levels of noise will be scheduled to take place between 7 am and 10 pm.	Moderate	Local	Short-term	Moderate	Reversible	Low
Climate							
Green house gas emissions from construction activities	♦ No mitigation proposed	N/A	N/A	N/A	N/A	N/A	N/A
Surface Water Regime							
Change in water levels upstream and downstream of the generating station.	♦ No mitigation proposed	N/A	N/A	N/A	N/A	N/A	N/A
Change in water velocities, flow patterns and depths	♦ No mitigation proposed	Small	Local	Long-term	High	Not reversible	Low
Ice Regime							
Change in ice conditions	♦ No mitigation proposed	Small	Local	Long-term	High	Not reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Physiography and Landscape							
Clearing of land for temporary construction activities (i.e. work areas, access roads, material source areas)	♦ An environmental protection plan will be developed for the Project; ♦ Clearing of work area sites will be limited to only those areas required for the construction infrastructure; ♦ If feasible, vegetated buffers (minimum of 30 m) will be maintained between work areas and the river; and ♦ Sites cleared for work areas, material source and disposal areas and access roads not required for long-term operation of the station will be rehabilitated following construction	Moderate	Site	Long-term	High	Not reversible	Low
Construction and footprint of new spillways, approach and discharge channels and earth dams	♦ No additional mitigation required.	Moderate	Site	Long-term	High	Not reversible	Low
Removal and changes to soils including compaction, loss due to erosion, mixing of soil and potential soil contamination as a result of accidental spills	♦ An environmental protection plan and erosion and sediment control plan will be developed for the Project; ♦ Organic material and overburden will be removed to expose the desired materials and stockpiled for use in site rehabilitation at the end of the Project; ♦ An emergency response plan will be developed for the Project and will include spill response procedures to minimize effects to soil; and ♦ Sites cleared for work areas, material source and disposal areas and access roads not required for long-term operation of the station will be rehabilitated following construction.	Moderate	Site	Short-term	High	Moderately reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Erosion and Sedimentation							
Erosion and sedimentation processes as a result of Project activities.	♦ An erosion and sediment control plan (ESCP) will be developed and implemented for the Project; ♦ The introduction of suspended sediments to surface waters will be avoided/minimized by controlling the mobilization of sediments at source and providing erosion control measures as required. Sediment control measures, such as turbidity curtains, will be employed to control release of suspended sediments to downstream environments; ♦ The exterior sides of the cofferdam that are exposed to fast flowing water will be covered with riprap armouring to prevent erosion during operation; ♦ During removal of the downstream cofferdam, the inner groin and clay will be removed as much as possible using the outer groin for protection from the bulk of the flow from the existing sluiceways and spillway; ♦ A sediment management plan will be developed for the Project which will measure sediment inputs into the Winnipeg River during in-stream construction and spillway gate commissioning. It will also prescribe actions to be taken so TSS remains below target levels; ♦ During dewatering, sediment-laden water within the cofferdam will be pumped to a settling pond to remove suspended solids before being discharged to the river. If required, water will be treated to minimize the introduction of TSS to the Winnipeg River during dewatering of the settling ponds; and ♦ The discharge channel will be blasted and excavated in the dry. The majority of sediment that accumulates in the discharge channel during construction will be removed following excavation which will minimize the volume of sediments available for mobilization during commissioning of the primary spillway.	Small	Local	Short-term	Low	Reversible	Moderate
Woody Debris							
Woody material entering waterways	♦ During clearing of work areas, trees will not be felled towards water; and ♦ Timber and slash from clearing of work areas will be stored in such a manner that it will not enter water.	N/A	N/A	N/A	N/A	N/A	N/A

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Groundwater							
Water table lowering	♦ No mitigation proposed	N/A	N/A	N/A	N/A	N/A	N/A
Water Quality							
Reduction of water quality as a result of Project works / activities.	♦ Mitigation measures noted above for erosion and sedimentation also mitigate effects on total suspended solids and related variables (e.g., nutrients and metals); ♦ ANFO blasting materials will not be used in or near water in accordance with DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998); ♦ Rock materials planned for construction use in and near water will be tested for acid generation potential. If testing reveals that acid generation potential exits, these materials will not be used; ♦ Handling of all hazardous materials on site will be in accordance with the environmental protection plan (EnvPP) and all federal and provincial standards and protocols; ♦ Directional drilling operations will be conducted in accordance with conditions stipulated in the DFO High Pressure Directional Drilling – Manitoba Operational Statement; ♦ Refuelling and equipment maintenance activities will occur at least 100 m away from a water body, or conducted in a manner to prevent the release of deleterious substances to a water body; and ♦ Emergency response plans, procedures and equipment to address accidental oil, fuel, or hazardous waste spills into the aquatic environment in the vicinity of the Project will be in place to minimize effects should an accidental spill occur.	Small to Moderate	Regional	Short-term	Low	Reversible	Low to Moderate
Total Suspended Solids	♦ Refer to mitigation measures for overall water quality	Small to moderate	Regional	Short-term	Low	Reversible	Moderate
Dissolved Oxygen	♦ No mitigation proposed	Moderate	Site	Long-term	High	Not reversible	Moderate
Nutrients	♦ Refer to mitigation measures for overall water quality.	Small	Regional	Short-term	Low	Reversible	Low
Change in pH	♦ No mitigation proposed	N/A	N/A	N/A	N/A	N/A	N/A
Total and fecal coliform	♦ No mitigation proposed	N/A	N/A	N/A	N/A	N/A	N/A
Metals	♦ Refer to mitigation measures for overall water quality.	Small	Regional	Short-term	Low	Reversible	Low
Hydrocarbons and hazardous substances	♦ Refer to mitigation measures for overall water quality.	N/A	N/A	N/A	N/A	N/A	N/A

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Sediment Quality							
Introduce contaminants as a result of Project works / activities	♦ Measures implemented to mitigate effects to water quality will also mitigate effects on sediment quality.	N/A	N/A	N/A	N/A	N/A	N/A
Aquatic Habitat							
Habitat gain and loss	♦ No mitigation proposed.	Small	Local	Long-term	Low	Moderately Reversible	Moderate
Change to flow pattern	♦ No mitigation proposed.	Moderate	Local	Long-term	High	Moderately reversible	Low
Substratum alteration	♦ Potential sources of sediment will be controlled at the source.	Small	Local	Short-term	Low	Reversible	Low
Rooted macrophyte bed change	♦ No mitigation proposed.	N/A	N/A	N/A	N/A	N/A	N/A
Lower Trophic							
Change to macro invertebrate abundance and composition	♦ Mitigation measures designed and employed to avoid/minimize Project effects on water quality and aquatic habitat will also avoid/minimize effects on lower trophic level communities; and ♦ Prior to construction and decommissioning activities, a SCUBA-based survey in areas that could potentially be habitat for the corpulent rams-horn snail will be conducted. Snails found in this area will be manually removed from the substrate and relocated to a suitable location that is not subject to Project-related effects.	Small	Local	Short-term	Low	Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Fish Community							
Potential effects general fish community and specifically on lake sturgeon, northern pike, walleye	♦ Blasting associated with Project construction and decommissioning will be conducted in accordance with DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998); ♦ Blasting for removal of existing structures or in stream blasting of spillway approach and discharge channels will not take place between April 1 and June 30 of any year; ♦ In cases of in-water blasting, mitigation measures such as bubble curtains will be placed around the area to be blasted to exclude fish in order to minimize fish overpressures; ♦ Water intake pipes will be screened according to Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995) to minimize the entrainment and impingement of fish; ♦ No in-water work will take place between April 1 and June 30 of any year; ♦ A sediment management plan will be developed to minimize inputs of sediment to the aquatic environment and the plan's implementation and effectiveness will be monitored; ♦ Fish residing in areas subject to either permanent or temporary dewatering will be live salvaged and relocated to adjacent areas not subject to Project effects; and ♦ A lake sturgeon spawning monitoring and adaptive management program will be implemented during Project construction and operation. In Reach 3, lake sturgeon spawning success and flow velocities (to the extent possible) will be monitored to determine whether any effects of the Project on lake sturgeon spawning success are occurring. Any reduction in lake sturgeon spawning success during spill events as a result of changed flow pattern below the spillway rapids will be mitigated through an adaptive habitat enhancement approach.	Small	Local	Long term	Moderate	Reversible	Moderate
Fish Quality							
Increase in methymercury level in fish	♦ No mitigation measures are proposed with respect to fish quality.	N/A	N/A	N/A	N/A	N/A	N/A

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Wetland Habitat and Terrestrial Vegetation							
Potential effects on wetland habitat and rare plants	♦ Where practicable, wetlands will be avoided during clearing and construction activities; ♦ Where not possible to avoid wetlands during clearing and construction, a re-vegetation and rehabilitation plan will be implemented, to ensure no net loss of wetland habitat. Native plant species will be utilized for re-vegetation of wetland sites; ♦ Measures to manage storm water runoff (e.g., vegetation buffer or silt fences) will be implemented to minimize sedimentation in wetlands; ♦ Locations of S1 and S2 rare plants will be marked prior to clearing and construction activities; ♦ Clearing of vegetation near S1 andS2 rare plants will be avoided to the extent practicable; ♦ Material source clearing activities will be limited to the minimum area required for material extraction; ♦ A 30 m riparian vegetation buffer will be maintained adjacent to the Winnipeg River to the extent practicable; ♦ Trees will be felled so as not to damage remaining vegetation and tree removal will be confined within the limits of the project activity areas; ♦ All equipment will be washed prior to working in the Project area to reduce the spread of non-native species; ♦ Any topsoil removed will be stockpiled during construction activities for use during site rehabilitation; ♦ A re-vegetation and rehabilitation plan will be implemented for terrestrial sites that are disturbed or lost. Native plant species will be used for re-vegetation and rehabilitation of disturbed areas with increased erosion potential or where vegetation has been completely removed; and ♦ Existing access roads and trails will be utilized to the extent feasible to reduce further vegetation removal from newly created roads.	Small	Local	Short-term to Medium-term	High	Moderately Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Terrestrial Invertebrates							
Change in distribution, abundance, navigation and reproduction of terrestrial invertebrate species	♦ Material source areas, work areas and surrounding disturbed areas will be rehabilitated to reduce and mitigate the loss of terrestrial invertebrate habitat incurred by development activities associated with the Project.	Small	Site	Short-term	Low	Reversible	Low
Amphibians and Reptiles							
Change in distribution, abundance and movement of amphibians and reptiles	♦ Disturbance of wetlands will be avoided to the extent practicable; ♦ To the extent practicable, construction activities within, and in the immediate vicinity of, wetlands will be conducted during winter months so as to avoid effects on northern leopard frog breeding activity; ♦ To the extent practicable, a 30 m shoreline buffer will be retained along the Winnipeg River; and ♦ Mitigation measures designed to minimize effects on water quality also will serve to minimize any effects to northern leopard frogs and common snapping turtle..	Small	Site	Short-term	Low	Reversible	Low
Birds							
Potential effects on birds	♦ A preconstruction barred owl, Cooper's hawk, and bald eagle nest survey will be conducted to determine presence or absence of these species in the Project construction area; ♦ If raptor nests are present, in consultation with Manitoba Conservation, determine the appropriate buffer zone to leave around the nest or relocate the nests to an artificial structure or nearby suitable mature tree; ♦ Clearing activities will avoid critical nesting periods (generally May 1 – July 31). ♦ Where practicable, wetlands will be avoided during clearing and construction activities; ♦ Locations of any stick nests will be marked prior to clearing and construction activities; ♦ Material source clearing activities will be limited to the minimum area required for material extraction; ♦ To the extent practicable, a 30 m riparian vegetation buffer will be maintained adjacent to the Winnipeg River; and ♦ Existing access roads and trails will be utilized to the extent feasible to reduce further vegetation removal from newly created roads.	Small	Local	Short-term	Low	Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Mammals							
Potential effects on mammals	♦ An environmental protection plan will be developed for the Project outlining practices that should be adopted during Project activities to reduce the potential of wildlife interactions; ♦ To the degree practicable, clearing of terrestrial vegetation will be conducted during winter months to minimize effects on furbearer and mammal species that maintain dens or use tree cavities to rear their young; and ♦ General mitigation measures specified for Wetlands and Terrestrial Vegetation and Birds also serve to mitigate effects to mammals.	Small	Local	Short-term	Low	Reversible	Low
Economy							
Employment and business opportunities	♦ A Project Preference Zone (PPZ) has been established for determining eligibility for opportunities. This zone was selected to include Aboriginal groups and stakeholders that may be potentially affected by the Project. To be consistent with Manitoba Hydro's goal of having a diverse workforce and the goal of strengthening working relationships with Aboriginal groups, Manitoba Hydro has incorporated preferences for Aboriginal individuals; ♦ Manitoba Hydro has created a hiring preference for "new hires" that provides employment priority: o To Aboriginal individuals who are full-time residents of the PPZ,; o To all other full-time residents of the PPZ; and o To all others; ♦ Where numbers warrant, Manitoba Hydro require designated contractors, through the project tender specifications, to provide on-the-job training to workers in specified trades with a preference for: o Aboriginal individuals who are full time residents of the PPZ, o All other full time residents of the PPZ, ♦ Manitoba Hydro will scope certain work packages to provide preferred tendering opportunities for businesses in the PPZ.	Moderate	Regional	Short-Term	High	Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Property, Ownership and Land Use							
Residual effects on property in the local or regional areas	♦ No mitigation proposed.	N/A	N/A	N/A	N/A	N/A	N/A
Residual effects on land use at Pointe du Bois	♦ Vegetation buffers will be retained on the east side of the river, to the extent possible, to limit visual effects; and ♦ Disturbed areas will be rehabilitated following completion of construction and decommissioning activities.	Moderate	Local	Short-Term	Low	Reversible	Low
Infrastructure and Services							
Additional traffic on local roadways	♦ Use of local material sources for rock and clay materials will be maximized; ♦ Shuttle buses will be provided to transport workers to and from the construction site; ♦ A traffic safety plan for the period of construction and decommissioning will be prepared and implemented; ♦ A new public/townsite road will be constructed from PR 313 to Glassco Avenue to separate the public/townsite traffic from the contractor work area traffic and provide continued access to cottages; ♦ Traffic safety measures for truck hauls will be implemented through the town site as required during construction and decommissioning; and ♦ Traffic on PR 313, the Slave Falls road and the public/townsite access road will be monitored as part of the socio-economic monitoring plan for the Project.	Moderate	Regional	Short-term	Moderate	Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Personal, Family and Community Life							
Aesthetics	♦ Vegetation buffers will be retained on the east side of the river, to the extent possible, to limit visual effects; and ♦ Disturbed areas will be rehabilitated following completion of construction and decommissioning activities.	Moderate	Local	Medium-term	High	Moderately reversible	Low
Safety, Noise, General Disruption	♦ Separate access will be provided for the public traffic to the town site and cottages areas through the development of a public/town site access road; ♦ Security gates will be installed north of the new public/town site access road and at the entrance to the contractor access road to prohibit public access to the contractor work area; ♦ Navigation safety measures will be implemented related to the barge and other upstream access routes; ♦ A safety protocol will be prepared to be used during blasting; ♦ Mitigation measures for noise as outlined under noise will be implemented; ♦ Workforce accommodations, if required, will be constructed outside the Whiteshell Provincial Park; ♦ Emergency response plans with input from local authorities will be prepared and implemented prior to construction; and ♦ Regular communications with local stakeholders during construction will be implemented so that if issues arise they can be addressed.	Moderate	Local	Short-term	High	Reversible	Low
Municipal and Local Government District Controls							
Potential effects on municipal and local government controls	♦ No mitigation proposed.	N/A	N/A	N/A	N/A	N/A	N/A
Commercial Resource Use							
Potential effects on commercial resource use	♦ No mitigation proposed.	N/A	N/A	N/A	N/A	N/A	N/A
Recreational Use and Tourism							
Potential effects on recreational use and tourism	♦ Manitoba Hydro will work with Manitoba Conservation to determine a feasible option to reduce the effect to the Sawmill Bay boat launch as a result of increase usage; and ♦ Regular communications will be implemented with local stakeholders during construction to address issues if they arise.	Moderate	Local	Short-term	High	Reversible	Low

Table 8.2: Mitigation and Residual Effect Summary							
Potential Environmental Effect	Mitigation	Potential Environmental Effect					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty
Heritage Resources							
Potential effects on heritage resources	♦ Pre-construction heritage surveys of the east side area to be cleared and the material source areas to be used for the Project will be conducted to further identify and flag the sites for protection; and ♦ The Project Environmental Protection Program will contain measures for the protection and management of heritage resources.	N/A	N/A	N/A	N/A	N/A	N/A

Table: 8.3: Summary of Residual Environmental Effects after Mitigation on Valued Environmental Components									
Valued Environmental Component	Residual Environmental Effect after Mitigation	Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty	Significance
Lake sturgeon	♦ Residual effects to lake sturgeon and lake sturgeon habitat (including spawning habitat) are not expected as the Project has been planned specifically to avoid effects on lake sturgeon and lake sturgeon habitat. Lake sturgeon populations will be monitored and if residual effects do occur, the effects can be mitigated through adaptive management. ♦ Residual effects of blasting, water withdrawal and increased recreational fishing as a result of the Project on lake sturgeon abundance and distribution are not expected.	Neutral	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Moderate	Not significant
Northern pike	♦ Relatively small gains in fish habitat (23,799 m^2) immediately upstream of the new spillway structures will be beneficial for northern pike. Residual effects to water and sediment quality and lower trophic levels are expected to be minor and short term in nature and consequently there will be a minor effect on the use of habitat for foraging by northern pike. ♦ A minor loss of individual northern pike may occur during infilling for cofferdams and blast platforms. ♦ Residual effects of blasting, water withdrawal and increased recreational fishing as a result of the Project on northern pike are not expected.	Positive	Small	Local	Long-term	Moderate	Reversible	Moderate	Not Significant
Walleye	♦ Relatively small gains in fish habitat (23,799 m^2) immediately upstream of the new spillway structures will be beneficial for walleye. Residual effects to water and sediment quality and lower trophic levels are expected to be minor and short term in nature and consequently there will be a minor effect on the use of habitat for foraging by walleye. ♦ Residual effects of blasting, water withdrawal and increased recreational fishing as a result of the Project on walleye are not expected.	Positive	Small	Local	Long-term	Moderate	Reversible	Moderate	Not Significant
Merritt Fernald's sedge	♦ A modification of terrestrial vegetation will occur where substrate material and/or vegetation will be removed to develop material sources and ancillary facilities. Adjacent to Project activities, native vegetation will be altered along newly created forest edges. ♦ A minor loss of individual Merritt Fernald's sedge may occur during clearing and construction activities.	Negative	Small	Local	Long-term	High	Moderately Reversible	Low	Not Significant

Table: 8.3: Summary of Residual Environmental Effects after Mitigation on Valued Environmental Components									
Valued Environmental Component	Residual Environmental Effect after Mitigation	Residual Effect After Mitigation							
		Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty	Significance
White wood aster	♦ A modification of terrestrial vegetation will occur where substrate material and/or vegetation will be removed to develop material sources and ancillary facilities. Adjacent to Project activities, native vegetation will be altered along newly created forest edges. ♦ A minor loss of individual white wood aster may occur during clearing and construction activities.	Negative	Small	Local	Long-term	High	Moderately Reversible	Low	Not Significant
Bald eagle	♦ The quantity and quality of habitat for bald eagle is not limiting in the study area. With the application of mitigation measures, potential effects to nesting activities will be minor. ♦ Sensory disturbance will be temporary and residual effects to individual bald eagle are expected to be short-term and minor.	Negative	Small	Site	Short-term	High	Reversible	Moderate	Not Significant
Osprey	♦ The quantity and quality of habitat for osprey is not limiting in the study area. With the application of mitigation measures, potential effects to nesting activities will be minor. ♦ Sensory disturbance will be temporary and residual effects to individual osprey are expected to be short-term and minor.	Negative	Small	Site	Short-term	High	Reversible	Moderate	Not Significant
Canada warbler	♦ The quantity and quality of habitat for Canada warbler is not limiting in the study area. With the application of mitigation measures, potential effects to nesting activities will be minor. ♦ Sensory disturbance will be temporary and residual effects to individual Canada warbler are expected to be short-term and minor.	Negative	Small	Site	Short-term	High	Reversible	Moderate	Not Significant
Monarch butterfly	♦ There is negligible potential for residual effects to the monarch butterfly, as a result of habitat loss or change resulting from the Project. This is largely due to the availability of monarch butterfly host plant species outside of the study area, and in areas throughout southern Manitoba.	Negative	Small	Site	Short-term	Low	Reversible	Low	Not Significant
Northern leopard frog	♦ After mitigation, there is negligible potential for residual effects to amphibians and reptiles, including the northern leopard frog as a result of the Project.	Negative	Small	Site	Short-term	Low	Reversible	Low	Not Significant
Common snapping turtle	♦ There is negligible potential for residual effects to amphibians and reptiles, including the common snapping turtle, as a result of the Project.	Negative	Small	Site	Short-term	Low	Reversible	Low	Not Significant

Table: 8.3: Summary of Residual Environmental Effects after Mitigation on Valued Environmental Components

Valued Environmental Component	Residual Environmental Effect after Mitigation	Residual Effect After Mitigation							
		Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Uncertainty	Significance
Employment	♦ During construction of the Project, there will be an increase in employment opportunities, approximately 4600 person months.	Positive	Moderate	Regional	Short-term	High	Reversible	Low	Not significant
	♦ During operation of the Project, it is expected that there will be a loss of approximately 2 FTEs as a result of the automation of the spillway.	Neutral	Small	Local	Long-term	High	Not reversible	Low	
Business opportunities	♦ During construction of the Project, there will be an increase in business opportunities.	Positive	Moderate	Regional	Short-term	High	Reversible	Low	Not significant
	♦ During construction of the Project, there is a potential reduction in business to the outfitters as recreational users may chose to avoid the area.	Negative	Moderate	Local	Short-term	High	Reversible	Low	
Enjoyment of local area	♦ The Project will provide an improved level of dam safety which will be beneficial to local property owners.	Positive	Large	Local	Long-term	High	Not Reversible	Low	Not significant
	♦ Noise levels will increase as a result of construction activities.	Negative	Moderate	Local	Short-term	High	Reversible	Low	
	♦ Traffic levels will increase as a result of construction related traffic.	Negative	Moderate	Regional	Short-term	High	Reversible	Low	
	♦ Change in appearance to the east side work area.	Negative	Moderate	Site	Medium-term	High	Moderately Reversible	Low	
	♦ Public concern with space available and wait times at existing boat launch in Sawmill Bay. The closure of the MB Hydro boat launch during construction will increase this pressure.	Negative	Moderate	Local	Short-term	High	Reversible	Low	