3. Description of the Project

The proposed Project consists of four small waterpower facilities, each with a nominal installed capacity of 6.5 MW and designed to be very similar to one another. Numerous common elements have been introduced into the development concept and have been included into the layout arrangements. The general or common permanent components of the Project are discussed in Section 3.1, while the specific aspects of each of the four facilities are discussed in Section 3.2. Section 3.3 discusses the proposed construction of the facility including all temporary works necessary to construct the Project and the methodology that will be employed. Operational aspects of the Project are discussed in Section 3.4, long-term maintenance activities are discussed in Section 3.5 and decommissioning is discussed in Section 3.6.

3.1 General Facility Components

Each facility will have the following permanent components:

- powerhouse with two net 3.25-MW Bulb style turbines
- intake channel to convey water into the powerhouse
- tailrace channel to convey water back to the river
- 50-m long concrete overflow spillway and earth dam embankments
- plunge pool downstream from spillway to provide energy dissipation
- head pond, to provide generating head for the major equipment
- temporary diversion works
- small switchyard to connect power from each facility to the main 44-kV or 115-kV transmission line running between the facilities (note the preferred transmission line voltage has not yet been determined)
- local access road from the main site access road and local parking area.

The following common permanent components will also service all of the four proposed facilities:

- main site access road on the west side of Kabinakagami River
- 44-kV or 115-kV transmission line on the west side of the Kabinakagami River to the interconnection point with the existing Atlantic Power transmission line adjacent to the Calstock power plant
- 44-kV to 115-kV step-up transformer station near the Calstock power plant (if 44-kV determined to be the preferred line voltage from the facilities) or a switch yard (if 115-kV option determined to preferred line voltage), as well as a short (< 100 m long) access road to the transformer/switchyard from the existing road adjacent to Calstock power plant

- Maintenance and Control Facility to service all plants, located near the Site 3 - Neeskah facility.

These general and/or common permanent components are discussed in the following sections.

3.1.1 Powerhouses

The four concrete powerhouses will be virtually identical. A typical cross-section and a plan view of the powerhouse are shown in Figure 3.1.

Each powerhouse is an integral part of the dam structure and is located on the west bank of the river, with all four being located in currently terrestrial areas.

The upstream face of each powerhouse consists of an intake structure to draw water from the intake channel. Each powerhouse is fitted with steel trashracks on the upstream face in order to protect the turbine components from damage due to debris. A central concrete pier will be present. The trashracks will consist of vertical metal bars with a clear spacing of 75 mm between bars.

Gate slots will be provided at both the intake and the draft tube (upstream and downstream ends of the powerhouse, respectively) to allow for dewatering of the turbine for maintenance. Roller-type gates will be included for the draft tube to allow emergency closure of the units and 2 sets of sectional, intake bulkhead gates will be shared between the four sites.

The powerhouses will each contain two 3.25-MW, Bulb style turbine units, each with a runner diameter of 2.4 m and equipped with four blades. Each turbine will have a rated maximum flow capacity of 41 m^3/s, for a total overall facility flow capacity of 82 m^3/s. It may possible to operate an individual turbine temporarily above the rated flow capacity by approximately 10%, but this would only be undertaken by Northland if one of the turbines in a powerhouse is not operating and the natural flow rate in the river is greater than 41 m^3/s. The minimum rated flow of each turbine will be approximately 8 m^3/s. Flow passing through the turbines is discharged to the tailrace via a draft tube.

Each turbine is directly connected to a synchronous, permanent magnet generator and enclosed within a steel fabricated bulb assembly immediately upstream of the runner. Access to the bulb will be provided by a steel manhole installed downstream of the intake gate slots.

All auxiliary electrical and mechanical equipment will be arranged in a power house building positioned behind the intake gates. The building will include electrical equipment, including one water cooled power converter for each unit. The cooling water system will be closed loop.

An oil-water separator will be provided to ensure oil is not accidentally discharged to the environment in the event of accidental spillage. Potential effects and mitigation associated with accidental spills are assessed in Section 6.

Other interior components of each powerhouse will include:

- Protection and control panels
- Station service transformer

- Station service disconnect switch
- Station service distribution panel
- Generator breakers
- Neutral grounding cabinets
- Hydraulic power units, with oil containment
- Air compressors
- Gate HPU with oil containment
- Motor control center
- Plant control and SCADA cubicles
- Lead-acid battery bank (typical bank is comprised of approximately 60 cells)
- Battery charger
- Powerhouse building electrical services comprising of lighting, heating and convenience outlets
- One set of cables – 5-kV power cables, LV power, control, protection and instrumentation cables
- Fire protection system
- Cooling water system
- Heating, ventilation and air conditioning (HVAC) equipment
- Back-up diesel generator – in weatherproof enclosure on powerhouse deck or within a room off the main powerhouse enclosure.

A small permanent parking area will be located immediately adjacent to each powerhouse.

3.1.2 Intake Channel

An intake channel will be excavated into the existing bank and river bed (where applicable) to create a channel to convey water from the river into the powerhouse. The intake channel will typically be excavated into bedrock with a longitudinal slope to transition from the existing river bed invert to the invert of the powerhouse at the intake structure. The side walls of the intake channel will also be excavated into bedrock and will likely be near-vertical. A rock trap may be incorporated into the base of the intake channel immediately upstream from the trashrack face to ensure rocks do not pile up against the trashrack face. The intake will draw water from the full height of the water column.

3.1.3 Tailrace Channel

A tailrace channel will excavated downstream from each facility to direct water from the powerhouse back to the Kabinakagami River. The tailrace will typically be excavated into bedrock at a 7:1 longitudinal slope to transition from the powerhouse invert up to the existing river bed elevation. Although typically excavated to bedrock, aquatic habitat enhancement measures will be incorporated into each tailrace, as discussed further in Section 5.

3.1.4 *Overflow Spillway and Earth Fill Embankment Dam*

An overflow spillway and earth-fill embankment dam will be constructed at each site to create the necessary head for the proposed facilities. The overflow spillway at each facility will be 50 m long and will be of concrete construction. The spillway crest will be set 5 cm above the TOL for the facility and is designed to pass river flows exceeding the flow capacity of the powerhouse (more information on water management during operations is provided in Section 3.4). The spillway crest will be a standard Ogee profile (see Appendix B). The toe of the overflow spillway will be shaped as a trajectory bucket, designed to project the flow into the air beyond the structure so that it lands in a pre-excavated plunge pool.

The powerhouse will tie in directly to the west side of each spillway. The east side of each spillway and the west side of each powerhouse will be flanked by earth-fill embankment dam sections, which will extend into the existing valley banks to contain water within each head pond.

The earth-fill dams will be constructed primarily of impervious fill material with a chimney drain of filter material. The impervious material will consist of a well-graded glacial till material with a mix of compacted fines, sands and gravels. The chimney drain and an upstream filter layer will be made up fine to coarse material. The shell of the earth-fill dam section will consist of rip rap on the upstream slope (to protect from erosion due to the head pond water level) and aggregate on the downstream slope.

An 18.7-m wide by 6-m deep plunge pool will be excavated approximately 6 m downstream and along the length of the overflow spillway at each proposed facility. As the water passes over the spillway, it will be projected into the air and land in this plunge pool. The energy in the flow is dissipated by the water in the pool, thereby protecting the surrounding bedrock from erosion.

3.1.5 *Temporary Diversion Works*

During Phase 2 of construction, the river flow will be diverted through the diversion channel so that the main dam and the remainder of the overflow spillway can be constructed in the dry. There are three structures associated with the diversion channel:

- The upstream culvert structure.
- The diversion openings in the overflow spillway along with the partially completed powerhouse.
- The downstream culvert structure.

Flow enters the diversion channel and flows first through the upstream culvert structure. The culvert structure forms part of the temporary construction access road to the east bank, along with the upstream cofferdam. From there, it flows through either the diversion openings in the overflow structure or through the partially completed powerhouse. Finally, the flow passes through the downstream culvert structure and re-enters the river. The downstream culvert structure provides a second temporary access point across the river during construction.

The upstream and downstream diversion structures will be constructed into the upstream and downstream cofferdams, respectively.

Three temporary diversion outlets will be incorporated into each overflow spillway. The openings will consist of flow passages through the overflow spillway with provision for a closure gate at the upstream end. When the diversion is complete, the openings will be closed and the flow passage filled with concrete.

The powerhouse structure will also be used to pass flow. The powerhouse concrete will be constructed in Phase 1 and then water can be diverted through the powerhouse in Phase 2 of construction, as well as through the openings in the overflow structure. Once construction is complete and diversion is no longer required, the powerhouse gates will be closed and the generating equipment will be installed.

A three level diversion concept will be used:

- For flows up to 100 m^3/s, all flow passes through the culverts in the cofferdams. This allows un-restricted access to the east bank across the cofferdams when flows are less than 100 m^3/s.
- For flow rates between 100 m^3/s and 177 m^3/s (the 1:25-yr non-spring flood), the culvert structure will be overtopped. Flow will continue to pass through the culverts, but will also flow over the structure. The cofferdam section with the culverts will be constructed with a crest that is lower than the remaining structure and reinforced for this purpose. The remainder of the cofferdam will be sufficiently high to protect the main construction works from flooding. However, with the culvert structures overtopped, construction access to the east bank of the river over the cofferdams will not be possible.
- For flows up to 352 m^3/s (April to June flood), the cofferdams will also be overtopped. It is assumed that by April, the main dam and spillway sections will be constructed sufficiently high that they will not be overtopped and therefore do not require a separate cofferdam.

3.1.6 Switchyards

Electricity generated at 3.3 kV by the turbine generators in each powerhouse will be directed to a switchyard near each powerhouse, where it will be transformed to 44-kV or 115-kV line voltage and connected with the main transmission line from the facilities. The switchyards will each contain:

- conductors and ground wires
- switching equipment
- transformer with lightning arrestors
- disconnect equipment
- lightning protection system, and
- metering devices.

Secondary containment will be present around the transformer in each switchyard to contain oil in the event of an accidental spill. Each switchyard will be surrounded with chain link fence topped with barbed wire to prevent unauthorized entry.

3.1.7 Permanent Site Access

Permanent site access roads, including the existing portions of Roger's Road and Pelican Road, are shown in Figure 3.2. Access to the west side of the river will be via Highway 663, Roger's Road (via the Constance Lake Bypass) and an upgraded Pelican Road to Site 3 - Neeskah. Two short (approximately 300 m) sections of new access road will be developed to tie the existing Pelican Road into the facility locations at Site 3 - Neeskah and Site 4 - Peeshoo. A new, 8-km long access road will be constructed along the west bank of the Kabinakagami River with approach road sections to join the two most downstream sites.

There will be no permanent road access to the east bank of each facility. Access to the east bank for maintenance and inspection purposes, will occur by boat from the west bank.

3.1.8 Transmission Components

From each facility's switchyard, power will be directed into a single, common 44-kV or 115-kV transmission line from Site 6 - Wapoose, running south along the permanent access road to Site 3 - Neeskah, and then through a new corridor running south to a new 44-kV to 115-kV transformer substation (if the line voltage from the facilities is at 44-kV). The transformer substation will then interconnect with the existing 115-kV line that runs from the Calstock power plant to Hearst. The transmission line routing is shown in Figure 3.2.

The 44-kV transmission line option would consist of overhead wooden poles, spaced at approximately 75 to 125 m, depending on elevation and turn requirements. The line will be approximately 6 m off the ground, at its lowest point between poles, assuming flat topography. The 44-kV transmission corridor Right of Way (ROW) would be cleared to a width of 15 m to protect the line from adjacent trees. An additional 15 m on either side of the ROW will be termed the vegetation management zone and vegetation may be selectively cut within the zone, if it is deemed to represent a hazard to the line, were it to fall over. This clearing width is considered to be sufficient to minimize fire hazard as well.

The 115-kV transmission line option would consist of overhead wooden poles, spaced at approximately 200 m, depending on elevation and turn requirements. The line will be approximately 6.7 m off the ground, at its lowest point between poles, assuming flat topography. The 115-kV transmission corridor ROW would be cleared to a width of 20 m to protect the line from adjacent trees. An additional 25 m on either side of the ROW will be termed the vegetation management zone and vegetation may be selectively cut within the zone, if it is deemed to represent a hazard to the line, were it to fall over. The clearing width is considered to be sufficient to minimize fire hazard as well.

There will be no permanent access road along the length of either of the 44-kV or 115-kV line options.

3.1.9 Substation at Calstock Power Plant

If the transmission line voltage from the facilities is at 44-kV, a new substation will be required near the Calstock power plant to step up the voltage from 44 kV to 115 kV. This is the voltage of the existing transmission line delivering power from the Calstock power plant to the Hydro One 115-kV Transmission System at Hearst.

The substation will contain:

- conductors and ground wires
- 44/115-kV transformer with lightning arrestors
- 44-kV and 115-kV circuit breakers and disconnect switches
- lightning protection system, and
- protection, control and metering devices.

Secondary containment will be present around the transformer to contain oil in the event of an accidental spill. The substation will be surrounded with chain link fence topped with barbed wire to prevent unauthorized entry.

If the 115-kV transmission option is selected, no transformer will be necessary at this site and only a switching station will be required near the interconnection point next to the Calstock power plant. The switching station would include switchgear, 115 kV breaker and instrument transformers as required to control and protect the interconnection of the two transmission lines. In addition to the outdoor equipment typical of a conventional, air-insulated switching station, there will also be a control building constructed to contain control, protection and ac and dc auxiliary systems components as well as communications and SCADA equipment.

A new access road to the switching station or transformer will be required to access the site from the existing access road adjacent to the Calstock power plant.

3.1.10 Maintenance and Control Facility

A permanent maintenance and control facility will be located near the Site 3 - Neeskah facility. The building will be a covered facility with a floor space of approximately 16 x 8 m. The facility will consist of the following components:

- warehouse open space for storage of spare parts and maintenance equipment
- one office space
- water supply
- a washroom facility, including sink for hygienic purposes
- a shop sink for maintenance washing purposes
- communication equipment
- power supply
- welding receptacle

- heating, ventilation and air conditioning (HVAC) equipment
- septic system for waste water discharge
- outside parking area consisting of coarse granular surfacing.

3.1.11 Oil Containment Building

A 4 by 1.5 m hazardous material storage facility will be erected near the Maintenance and Control Facility to store potentially hazardous materials, such as lubricating oils. The facility will be constructed to contain any liquids that may leak from their container within the interior of the building.

3.2 Site Specific Descriptions

3.2.1 Site 3 – Neeskah Site Description

3.2.1.1 Description of Proposed Project

The Site 3 - Neeskah location is characterized by a localized S-shaped section of the river, the upstream part of which contains a series of rapids, about 6 m high and about 120 m long. The proposed facility is situated at the base of the rapids. The proposed development would raise the water level above the rapids by 3.5 m and improve the tailrace to capture an overall gross head of about 10 m. The proposed general arrangement for Site 3 - Neeskah is shown in Figure 3.3.

3.2.1.2 Site Specific Hydraulic Characteristics

Table 3.1 provides the site specific hydraulic characteristics for Site 3 – Neeskah.

Table 3.1 Site 3 – Neeskah Hydraulic Characteristics

Maximum headwater level (1:100-yr flood)	el 202.3 m
Head pond TOL	el 199.95 m
Spillway crest elevation	el 200.0 m
Normal tailwater level downstream, at powerhouse	el 190.1 m
Normal operating gross head	9.9 m
Estimated net head	9.6 m
Long-term average flow	50.7 m^3/s
Total rated turbine flow (Two turbines running)	82 m^3/s

The head pond TOL is 199.95 m during normal operation, with a maximum head pond elevation of 202.30 m, which occurs during maximum design floods, assuming, conservatively, that the facility would not be operating so all flow would be passing over the overflow weir. This provides the maximum water level that could occur at the 1:100-yr flood level, although it is possible that the facility could be operating, resulting in lower water levels. The normal tailrace water level will be el 190.1 m.

3.2.1.3 Site Specific Design

An earth-fill dam will be constructed at the base of the existing rapids and extended onto each bank. The powerhouse will be constructed on the west bank, adjacent to the 50-m long concrete overflow spillway. The bedrock in the area is thought to be sufficiently competent to withstand unacceptable scour development.

3.2.1.4 Tailrace

Minor tailrace excavation will be required to transition the draft tube to the natural river bed. This will be in the order of 1 m deep and extend approximately 60 m downstream of the powerhouse. Aquatic habitat enhancement measures will be built adjacent to the tailrace, as discussed in Section 5.

3.2.1.5 Area of Inundation

The Kabinakagami River is characterized by relatively steep river banks incised 10 to 15 m into otherwise flat terrain. Because of these steep banks, relatively little lateral inundation is expected (Figure 3.4). The total area of the proposed Site 3 - Neeskah head pond is approximately 20.8 ha, of which only 8.0 ha would result from new inundation.

3.2.2 Site 4 - Peeshoo Site Description

3.2.2.1 Description of Proposed Project

Similar to Site 3 - Neeskah, the Site 4 - Peeshoo location is also characterized by a localized S-shaped section of the river. The upstream part contains a series of rapids, about 3.5 m high and 50 m long. The project will be constructed approximately 180 m downstream of the rapids, capturing an additional 1.5 m of head. The proposed development would raise the water level above the rapids by about 3.0 m and improve the tailrace to capture an overall gross head of about 10 m.

The proposed general arrangement for Site 4 - Peeshoo is shown in Figure 3.5.

3.2.2.2 Site Specific Hydraulic Characteristics

Table 3.2 provides the site specific hydraulic characteristics for Site 4 – Peeshoo.

Table 3.2 Site 4 – Peeshoo Hydraulic Characteristics

Maximum head pond level (1:100-yr flood)	el 192.3 m
Head pond TOL	el 189.95 m
Spillway crest elevation	el 190.0 m
Normal tailwater level downstream, at powerhouse	el 180.1 m
Normal operating gross head	9.8 m
Estimated net head	9.5 m
Long-term average flow	50.8 m^3/s
Total rated turbine flow (Two turbines running)	82 m^3/s

The head pond TOL is 189.95 m during normal operation, with a maximum head pond elevation of 192.3 m occurring during the 1:100-yr flood. The normal tailrace water level will be el 180.1 m.

3.2.2.3 *Site Specific Design*

An earth-fill dam will extend from the east bank across most of the river width. The powerhouse will be constructed on the west bank and is adjacent to the 50-m long concrete overflow spillway. A total of approximately 150 m of low earthen wing dikes extend from the main dam and powerhouse into the banks. These are used to provide freeboard for the earth-fill dam in the case of severe floods and will not be part of the head pond during normal operation. The bedrock in the area is thought to be sufficiently competent to withstand unacceptable scour development.

3.2.2.4 *Tailrace*

Tailrace excavation will be required to transition from the draft tube to the natural riverbed. This will be in the order of 1 to 2 m deep and extend approximately 120 m downstream of the powerhouse, as shown in Figure 3.5.

3.2.2.5 *Area of Inundation*

The Kabinakagami River is characterized by relatively steep river banks incised 10 to 15 m into otherwise flat terrain. Because of these steep banks, relatively little lateral inundation is expected (Figure 3.6). The total area of the proposed Site 4 - Peeshoo head pond is approximately 31 ha of which only 11 ha would result from new inundation at the TOL.

3.2.3 *Site 5 – Wahpeestan Site Description*

3.2.3.1 *Description of Facility*

The proposed Site 5 - Wahpeestan facility is located in a natural bend in the river, without any significant natural gradient change in the riverbed at this location.

The proposed general arrangement for Site 5 - Wahpeestan is shown in Figure 3.7.

3.2.3.2 *Site Specific Hydraulic Characteristics*

Table 3.3 provides the site specific hydraulic characteristics for Site 5 – Wahpeestan.

Table 3.3 Site 5 – Wahpeestan Hydraulic Characteristics

Maximum head pond level (1:100-yr flood)	el 181.8 m
Head pond TOL	el 179.45 m
Spillway crest elevation	el 179.5 m
Normal tailwater level downstream, at powerhouse	el 168.7 m
Normal operating gross head	10.7 m
Estimated net head	10.4 m
Long-term average flow	51.2 m^3/s
Total rated turbine flow (Two turbines running)	82 m^3/s

The head pond TOL is 179.45 m during normal operation, with a maximum head pond elevation of 181.8 m, which occurs during maximum design floods. The normal tailrace water level will be el 168.7 m.

3.2.3.3 *Site Specific Design*

The Site 5 - Wahpeestan site is located in a natural bend in the river with a wide (50 m) bench on the inside of the bend (west bank). This natural bench allows for the powerhouse and part of the spillway to be constructed in the dry. The remainder of the 50-m concrete overflow spillway and the main earth-fill dam will be constructed across the river.

As with Site 4 - Peeshoo, low earthen wing dikes extend from the main dam and powerhouse into the banks. A total of approximately 300 m (150 m per side) are required to provide freeboard for the earth-fill sections in the case of severe floods and will not be part of the head pond during normal operation.

The bedrock at the Site 5 - Wahpeestan location appears to be dominated by interbedded shales, siltstone and limestone. This foundation material could be prone to erosion, therefore adequate energy dissipation measures, which may include an apron slab with or without energy dissipating baffle blocks will be constructed downstream of the overflow spillway to prevent excessive scour development. Grouting of the foundation will be required.

3.2.3.4 *Tailrace*

Tailrace excavations are required to convey the water from the powerhouse across an existing bench back to the main river course. No significant in-water tailrace excavation is anticipated.

3.2.3.5 *Area of Inundation*

The Kabinakagami River is characterized by relatively steep river banks incised 10 to 15 m into otherwise flat terrain (Figure 3.8). The total area of the proposed Site 5 - Wahpeestan head pond, at the TOL is approximately 99 ha, of which 50 ha would result from new inundation.

3.2.4 *Site 6 - Wapoose Site Description*

3.2.4.1 *Description of Proposed Project*

Similar to Site 5 - Wahpeestan, the proposed Site 6 - Wapoose location is in a natural bend in the river with a bench on the left bank and without any significant change in river bed elevation.

The proposed general arrangement for Site 6 - Wapoose is shown in Figure 3.9.

3.2.4.2 *Site Specific Hydraulic Characteristics*

Table 3.4 provides the site specific hydraulic characteristics for Site 6 – Wapoose.

Table 3.4 Site 6 – Wapoose Hydraulic Characteristics

Maximum head pond level (1:100-yr flood)	el 170.8 m
Head pond TOL	el 168.45 m
Spillway Crest Elevation	el 168.5 m
Normal tailwater level downstream at powerhouse	el 158.4 m
Normal operating gross head	10.0 m
Estimated net head	9.7 m
Long-term average flow	51.3 m^3/s
Total rated turbine flow (Two turbines running)	82 m^3/s

The head pond TOL is 168.45 m during normal operation, with a maximum head pond elevation of 170.8 m, which occurs during maximum design floods. The normal tailrace water level will be el 158.4 m.

3.2.4.3 *Site Specific Design*

The Site 6 - Wapoose is very similar in layout and design to Site 5 - Wahpeestan. It is located in a natural bend in the river with a wide (50 m) bench on the inside of the bend (west bank). This natural bench allows for the powerhouse and part of the spillway to be constructed in the dry. The remainder of the 50-m concrete overflow spillway and the main earth-fill dam will be constructed across the river.

Low earthen wing dikes extend from the main dam and powerhouse into the banks. A total of approximately 400 m (200 m per side) are required to provide freeboard in the case of severe floods and will not be part of the head pond during normal operation.

The bedrock at the Site 6 - Wapoose, like Site 5 - Wahpeestan, appears to be dominated by interbedded shales, siltstone and limestone. This foundation material could be prone to erosion, therefore adequate energy dissipation measures which could include an apron slab with or without energy dissipating baffle blocks will be constructed downstream of the overflow spillway to prevent river excessive scour development. Grouting of the foundation will be required.

3.2.4.4 *Tailrace*

Similar to Site 5 - Wahpeestan, tailrace excavations are only required to convey the water from the powerhouse, across the existing bench, back to the main river channel. No significant in-water excavation is anticipated.

3.2.4.5 *Area of Inundation*

The Kabinakagami River is characterized by relatively steep river banks incised 10 to 15 m into otherwise flat terrain. The total area of the proposed Site 6 - Wapoose head pond at the TOL is approximately 39 ha of which 22 ha would result from new inundation (Figure 3.10).

3.3 Construction

Construction of the Project is anticipated to occur over approximately 30 months, commencing upon completion of the Class EA process, completion of detailed engineering design and receipt of all necessary permits and approvals.

Given that the timeline for completion of the ER, detailed engineering detail and permits and approvals is subject to change, a construction schedule has not been determined at this point in the process. However, Northland will follow constraints such as in-water works timelines and clearing restrictions and agencies will be kept informed of changes in scheduling.

The following are the major components/activities involved in the implementation of the Project:

- upgrading existing access roads and constructing new access roads
- construction camp installation
- site preparation, including, site clearing/grading, lay down and works yards
- develop material borrow areas for rock, aggregate and impervious fill

- powerhouse, intake channel and tailrace channel construction
- overflow spillway and earth-fill dam construction and plunge pool excavation
- switchyard and transmission line installation
- head pond filling
- testing and commissioning
- demobilization and site rehabilitation.

These activities are described in more detail below.

Vegetation clearing operations conducted under approval of the *Crown Forest Sustainability Act* will be done in accordance with the requirements of MNR's Modifying Industrial Operations Protocol (MNR, 2008) to prevent wildfires from occurring. Section 6 provides additional detail on this protocol.

3.3.1 Site Access

Access to the Project Area will be via Highway 11, Highway 663, the Constance Lake Bypass, Roger's Road and Pelican Road, followed by new local roads to the facility locations (Figure 3.2). No upgrading will be required on Highway 11, Highway 663, Constance Lake Bypass and Roger's Road. Highways 11 and 663 are all-weather, asphalt roads maintained by the Ontario Ministry of Transportation (MOT). The Constance Lake Bypass is an existing, gravel road, originally constructed to allow logging trucks to bypass CLFN without having to go directly through the community. The Bypass is well constructed and maintained, and sufficient for heavy equipment use. Roger's Road, a gravel based road, was originally constructed as a logging access road and to provide access to Roger's Road Landing and the Kabinakagami River. It is maintained by Hearst Forest and is sufficient for construction traffic without any upgrades.

Pelican Road was constructed by Hearst Forest, which started construction of Pelican Road in 1998 to facilitate forestry activities with the extensions closer to Site 3 – Neeskah and Site 4 – Peeshoo constructed around 2002. Pelican Road is predominantly gravel-based and generally sufficient for construction traffic, although local upgrading of the road surface may be necessary, including addition of coarse granular fill, compacting and grading. The existing portions of the Pelican Road in proximity to Site 3 – Neeskah and Site 4 – Peeshoo are construction of lifted clay. The sections of Pelican Road that will become the long-term access road for the facilities will be upgraded, as necessary, to a 9-m wide road surface with appropriate ditching and hydraulic connectivity across the road.

There are several larger existing water crossing structures (bridges) on Pelican Road and these will likely have to be upgraded to accept heavy construction equipment traffic and to meet safety regulations. The structures will be open-bottom arch culverts, properly designed to ensure adequate flow passage and fish movement. There is one small water crossing at the eastern end of the main branch of the existing Pelican Road that has washed out, although remains passable by four-wheel drive vehicles. This water crossing will be replaced with a properly designed corrugated steel plate (CSP) culvert. Other small water crossings may also require upgraded CSP culverts. The detailed design for the road upgrades and water crossing structures will be submitted to the MNR as part of an application for a Work Permit under the *Public Lands Act* to authorize upgrading of the road. Water crossings with spans greater than 3 m will require approval under the LRIA, with sign off from DFO and possibly Transport Canada (pursuant to the NWPA) being required before MNR will issue any permit/approval.

As shown on Figure 3.2, a new, approximately 8-km long section of access road will be required to join the existing Pelican Road section terminating around Site 4 - Peeshoo to the Site 5 – Wahpeestan and Site 6 - Wapoose. Short new sections of access road will be constructed to access each site from the main road. This new section of road will be the permanent access road to the facilities and will be constructed with a 9-m road surface, within an 18-m wide corridor. Water crossings will generally consist of properly designed CSP culverts. For streams which are used for fish migrating or spawning areas, arch culverts, which retain the natural stream bottom and slope will be used. The detailed design for new road construction and water crossing structures will be submitted to the MNR as part of an application for a Work Permit under the *Public Lands Act* and approval under the LRIA will be required for water crossings with spans greater than 3 m. DFO and possibly Transport Canada sign-off will be required before MNR will issue permits/approvals for water crossings.

Road construction along this permanent corridor will include:

- surveying and staking of road centreline and corridor width limits
- vegetation clearing and grubbing within the corridor
- blasting, if necessary to remove bedrock
- grading, as necessary to prepare road bed
- installation of water crossing structures including open-bottom arch culverts on fish-bearing streams and CSP culverts on non-fish bearing streams
- additional of coarse granular road fill and topping with Granular A material
- ditching, including ditch treatments such as rock-fill check dams and off-shoot ditches
- re-vegetation of corridor with fast growing, native meadow seed mix.

Temporary access to the east side of the Kabinakagami River in the local vicinity of each development site will be required to facilitate construction activities, primarily the earth-fill dam construction and removal of vegetation within the proposed head pond areas on the east side of the river. This access will be provided by temporary travel lanes which will traverse the flow diversion culverts and the Phase 2 upstream and downstream cofferdams at each site.

The design of all upgrades to existing roads as well as all new road construction will be performed in accordance with the following references for the design of roads on Crown land:

- MNR: *Environmental Guidelines for Access Roads and Water Crossings* (MNR, 1990)
- MTO: *Geometric Design Standards for Ontario Highways*

- Canadian Standards Association (CSA): *CAN/CSA-S6-06: Canadian Highway Bridge Design Code*
- Transportation Association of Canada (TAC): *Geometric Design Guide for Canadian Roads.*

A new, approximately 100-m long access road will be required to the switchyard (and transformer station if the 44-kV transmission option is selected) located at the interconnection point near the Calstock power plant. This access road will be constructed off the existing road from Highway 11 adjacent to the Power Plant. The road will be constructed in a similar manner to the permanent access roads discussed above.

3.3.2 Construction Camp

A temporary construction camp will be established at the end of Pelican Road near the Site 3 - Neeskah site (Figure 3.11). The camp will be sized to house 100 construction workers for the duration of the 30-month construction period and will occupy a footprint size of approximately 300 x 300 m. The camp will include pre-fabricated buildings for sleeping quarters, common areas, eating area, washroom facilities and a kitchen. The camp will draw water from the Kabinakagami River at a temporary intake installed near the Site 3 - Neeskah, with water being pumped through trenched pipe to the camp location (Figure 3.11). The water will be treated as necessary to ensure potability to Ontario drinking water standards. Water is anticipated to be required at a rate of approximately 0.2 m^3/day/person, reaching a maximum of approximately 20 m^3/day.

Liquid sewage from the camp will be discharged to a septic system for treatment. The septic system will require approval from the MOE and the local Health Department. Electricity will be provided by portable diesel generators, located within the camp footprint. Heating will be electric. A small parking area, topped with Granular B material, will be located adjacent to the camp.

Solid waste from the camp will be transported by an approved waste hauler to an approved disposal facility.

Construction of the camp will occur in the following sequence:

- vegetation clearing and grubbing of regenerating trees and ground cover
- grading
- installation of water and septic underground utilities
- addition of coarse granular fill as base material
- installation of pre-fabricated trailers.

Following completion of construction activities, the construction camp will be decommissioned. This will include removal of all buildings and equipment, removal of the water supply lines and septic bed equipment, removal of the base granular material, fill with topsoil as necessary and revegetation with suitable forest tree species to the satisfaction of the Sustainable Forest License (SFL) holder.

3.3.3 Site Preparation

Site preparation activities will occur following construction of access roads to the proposed sites. Site preparation activities will include clearing of trees, grubbing (i.e., removal of stumps and other embedded woody debris, where necessary) removal of topsoil and site grading at each of the proposed facility locations. A relatively flat area, approximately 150 x 50 m, adjacent to each of the proposed dam sites will be utilized for staging and laydown during construction. Figures 3.12 to 3.15 show the proposed staging locations for each site and the overall area to be cleared for each development. Staging and laydown activities/components will include temporary trailers for office and lunchroom, areas for equipment storage (e.g., rebar, formwork), Sea Can shipping container storage for tools and small equipment, and portable, contained washroom facilities.

Overburden soil is expected to be removed during excavation and site preparation throughout the proposed facility locations. All stripped and excavated overburden materials will be separated into topsoil and subsoil, and then stockpiled on site until they are ready for use during site restoration activities or for off-site disposal. Excavated earth and organic materials will be reused on site in areas to be rehabilitated and revegetated following construction to the greatest extent possible.

A temporary settling pond will be constructed at each site to treat water pumped from excavations prior to discharge back to the Kabinakagami River. Treatment will primarily be for Total Suspended Solids (TSS), although contingencies will be in place to treat for pH as well. The nature, size, location and treatment requirements will be determined during the detailed design process. An Environmental Compliance Approval will be required from the MOE to authorize the construction, operation and discharge from the temporary settling pond. Permits from the MNR under the *Public Lands Act* and Forest Resource Licenses will also be required for settling ponds.

3.3.4 Construction Materials

Construction materials, including bedrock (for large fill and rip rap, and possibly crushing for aggregate), aggregate (sand and gravel) and impervious fill (well-graded till material) will be sourced from the local area.

The amount of each type of construction material (i.e., rock, sand and gravel and impervious fill) required by Project site is approximated as follows:

	Estimated Quantities, m^3		
	Rock	**Till**	**Aggregate[1]**
Site 3	24 000	30 000	27 000
Site 4	37 000	38 000	32 000
Site 5	26 000	33 000	31 000
Site 6	29 000	36 000	29 000

[1] Includes sand and gravel fill, road fill and all concrete aggregate.

Potential sources are shown on Figure 3.16. Each of these is described in the following sections.

3.3.4.1 *Proposed Rock Source*

There is one proposed new rock quarry located adjacent to Pelican Road (Figure 3.16). Characteristics of the proposed rock quarry are identified in Table 3.5.

Table 3.5 Characteristics of Proposed Rock Quarry

Name/Owner	New/ Existing	Existing Condition/Vegetation	Dimensions (m) and Potential Volume (m^3)	Distance to T-junction at Site 3 (km)	Groundwater	Comments
Pelican Road Quarry/Morin Construction and CLFN (Joint Venture – JV) hold mining claim for area	New	Tableland, clear-cut with new young growth, bedrock is 2 – 3-m high knoll	330 x 100 x3 99 000	2.8	Below 3 m, water may percolate in from varved clay	Deep saturated varved clay to north side, till cap up to 0.5 - 1.5 m to remove in areas, maintain rock barrier to varved clay

Use of this proposed rock source would require removal of the till overburden to expose the underlying bedrock, drilling of holes for blast charges, blasting to break up the rock and excavation of the rock. Excavation at this quarry will be below the groundwater table. Depending on the rock requirements, rock may be crushed (see Section 3.3.5 for a description of rock crushing activities). A permit under the *Aggregate Resources Act* will be required from MNR to operate this proposed quarry. The crusher will be included in the Site Plan submitted as part of the permit application.

3.3.4.2 *Proposed Aggregate Sources*

Aggregate material (sand and gravel) is used for a variety of purposes, including fill and surfacing of access roads, construction and staging area bases, use in concrete preparation and use as filter material in the earth-fill dam.

As shown in Figure 3.16, there are two existing aggregate pits along Roger's Road including Osprey Lake Pit; and Taylors Pit (which includes an existing pit face, as well as an undeveloped potential source area north of the existing pit) that will be used to provide aggregate for the proposed project.

Taylors Pit is an existing pit with an active permit under the *Aggregate Resources Act* (Taylors No 1 – Permit number 8389). The existing permit authorizes a pit size of 1.77 ha. Additional aggregate may be required, and if it is proposed to come from this pit, an amendment to the Permit would be necessary.

Osprey Lake, which is an existing pit, but which does not have an active Permit under the *Aggregate Resources Act*, will be used to supply aggregate for filter material on the earth fill dams at each site.

In addition, there are two aggregate sources in the vicinity of Site 6 – Wapoose, that may also be utilized to provide aggregate material to the Site 6 – Wapoose Project.

The characteristics of these existing pits are identified in Table 3.6.

Table 3.6 Potential Sand and Gravel Sources

Name	New/ Existing	Existing Condition/ Vegetation	Dimensions (m) and Potential Volume (m^3)	Groundwater Level relative to Pit Floor	Test pitted or/and Tested	Comments
Taylors Pit	Existing	Face 20 - 25 m high, high ridge, heavy forested slopes, access road 400 m from Roger's Road, ponds 100 m either side	250 x 50 x 20 250 000	> 1.5 m	Yes	Sand and gravel potential, sand is coarse
	New	Undeveloped high ridge about 300 m east of Roger's Road and north of existing Taylors Pit face	250 x 100 x 20 500 000	> 1.5 m	Yes	Sand and gravel potential, sand is coarse
Osprey Lake Pit	Existing	Face 20 – 25 m high, high ridge, heavy forested back slopes, access road 400 m from Roger's Road, 100 – 150 m to lake	300 x 200 x 20 1 200 000	> 1.5 m	Yes	Sand and gravel potential, sand is coarse
SG6-2	New	Site 6, terrace west side of river, immediately u/s, would be flooded, heavily forested	(250 m x 100)/ 2 x 2 25 000	< 1.5 m (pit excavated to just above groundwater table)	Yes	Dirty sand and gravel, cobbles and boulders
SG6-3	New	Site 6, terrace east side of river, immediately u/s, would be flooded, heavily forested	150 x 300 x 2 90 000	< 1.5 m (pit excavated to just above groundwater table)	Yes	Dirty sand and gravel, cobbles and boulders

Permit applications under the *Aggregate Resources Act* will be submitted to the MNR to authorize the operation of existing pits and/or creation of new pits. The existing portion of Taylors Pit has an existing permit in place under the *Aggregate Resources Act*. Any alterations to this permit for changes to the Site Plan will be done by the permit holder or an authorized agent of the permit holder.

Construction at each source location will include removal of vegetation cover (where necessary), excavation and stockpiling of till capping (if present), and excavation of sand and gravel for use during Project construction. Following use of these sources, they will be rehabilitated in accordance with MNR's requirements.

A concrete batch plant will be installed at Taylors Pit. This batch plant will be included in the Site Plan submitted in the application for an amendment to the existing Permit for this pit, which will be submitted by the existing permit holder or an authorized agent of the holder.

3.3.4.3 *Impervious Fill Sources*

Impervious fill will be used as the core material in the earth-fill dams at each site. The impervious fill consists of well-graded till material, which is generally a mix of gravel, sands and fines. A total of six potential sources of impervious fill material were located during the site investigation in fall 2011 (Figure 3.16). The characteristics of these sources are identified in Table 3.7.

Table 3.7 Potential Impervious Fill Material Sources

Name/ Owner	New/ Existing	Existing Condition/Vegetation	Dimensions (m) and Potential Volume (m^3)	Groundwater Level relative to Pit Floor	Test Pitted and/or Tested	Comments
T6-A	New	Tableland, heavily forested	500 x 200 x 5 500 000	> 1.5 m	Yes	Suggest creating face off SG6-2, to be investigated
T6-B	New	Tableland, heavily forested	150 x 50 x 5 37 500	> 1.5 m	No	Suggest creating face off SG6-3
T5-A	New	Tableland, heavily forested	50 x 200 x 5 50 000	> 1.5 m	Yes	Suggest creating face off SG5-1
T5-B	New	Tableland, heavily forested	50 x 75 x 5 18 750	> 1.5 m	No	Suggest creating face 20 m from the river in steep bank, to be investigated
T4-A	New	Tableland, clear cut, off logging road	300 x 200 x 5 300 000	> 1.5 m	Yes	Excavation will create a pond
T3-A	New	Tableland, clear cut, off logging road	300 x 100 x5 150 000	> 1.5 m	Yes	Excavation will create a pond

Not all of the potential sources may be required or utilized, but have been included in the ER for completeness. The source requirements will be determined during the detailed design, and permit applications under the *Aggregate Resources Act* will be submitted to the MNR to authorize the creation of new pits for each required source.

Construction at each source location will include removal of vegetation cover, excavation and stockpiling of topsoil capping, excavation of till for use. Following use of these sources, they will be rehabilitated in accordance with MNR requirements. Most of the potential borrow areas will be inundated with the completion of the project and will therefore be rehabilitated as is suitable for these areas.

3.3.5 *Rock Crushing Requirements*

Rock crushing equipment will be installed at the rock quarry noted in Section 3.3.4.1. The crusher will be a portable machine, running on its own tracks, but will be brought to site by flatbed truck and trailer. The rock crusher, which runs on diesel fuel, will be situated on an approximately 100 x 100 m pad of granular material. No water is required during the crushing process. Rock crushed at the quarry site will be stored at the quarry until ready for use at the development sites. An Environmental Compliance Approval from MOE will be obtained prior to the commencement of the rock crusher operation.

3.3.6 Concrete Batch Plant

A concrete batch plant will be installed at the main proposed aggregate source (Taylors Pit – see Figure 3.16) to prepare concrete on-site, as there are no nearby permanent ready-mix concrete batch facilities. Concrete is required for foundations, the powerhouse and overflow spillway.

The batch plant, which uses inputs of aggregate, cement and water to make concrete, will sit on an approximately 100 x 100 m aggregate pad. The plant will run on diesel fuel and will use water extracted from nearby Swallow Lake by direct piping. Swallow Lake is a cold-water lake that was stocked with 6000 Rainbow Trout by the MNR in 2010 to provide angling opportunities (potential effects on the values of the lake due to this water taking are assessed in Section 5.9.1.5). The current engineering estimates indicate that the plant will produce a maximum of 800 m^3 of concrete per day. Concrete preparation would require the use of approximately 200 litres of water per m^3 of concrete. Therefore, the maximum daily water intake at the batch plant is estimated to be 160 000 litres. An estimated total of 8 000 000 litres of water will be required over the duration of the time the batch plant is in operation. A Permit To Take Water will be required from the MOE to authorize this consumptive water taking.

Concrete prepared at the batch plant will be hauled by cement mixer truck to the development sites for immediate use. An Environmental Compliance Approval from MOE will be obtained prior to the commencement of the concrete batch plant operation. The aggregate permit application for Taylors Pit will include the proposed concrete batch plant within the Site Plan for the pit.

3.3.7 Powerhouse, Intake and Tailrace and Dam Construction

Once all of the initial mobilization, infrastructure and site preparation work is complete, construction of the main powerhouse, intake, tailrace and dam components will commence. Construction of these components at each facility will proceed in a phased manner, similar between the four sites.

3.3.7.1 Phase 1

Phase 1 will involve the construction of the powerhouse, tailrace and intake channels on the west bank of the river at each development site. In addition to these long-term Project components, the diversion structures will also be constructed to provide a flow diversion route for the next phase of construction. This includes a portion of the overflow spillway immediately adjacent to the powerhouse as well as the upstream and downstream culvert structures. The flow diversion will consist of three open concrete spillway passages at the existing river level. The diversion design flow will be equivalent to a 1:25- yr flood occurrence over the scheduled Phase 2 in-water construction period.

Phase 1 construction is shown for each site in Figures 3.17 through 3.20.

Existing bedrock at the shoreline of the river will be left in place at the intake upstream from the powerhouse and in the tailrace downstream from the powerhouse to separate the river from the intake and tailrace work areas to facilitate work on those areas under a dry condition at each site. This rock left in place for this purpose is called a “rock plug”. Rock plugs will be removed when cofferdams are removed. At Site 3 - Neeskah and Site 4 - Peeshoo, a cofferdam is required to isolate the Phase 1 construction works near the bank from the main flow of the river. In both cases, cofferdams will run from the west bank downstream of the sites to the rocky outcrop at the bend in the river where the powerhouses are situated. At Site 4 – Peeshoo, the cofferdam will extend upstream to tie into the west bank upstream of the site. The coffer dams will force flow in the river to the east, isolating the work area along the bank.

Cofferdams will be constructed by end dumping coarse rock fill into the river. Once this is installed to a sufficient height and density, the river-side of the cofferdams will be made water tight by placing layers of successively finer filter material and ultimately impervious till. Water from behind the cofferdam will then be pumped into temporary settling ponds for eventual discharge back into the river, creating a dry area in which to construct the powerhouse, overflow spillway section/diversion structure and tailrace channel.

Construction activities will include:

- clearing of vegetation within the embankment dam, powerhouse and spillway footprint
- excavation to the embankment dam, powerhouse and spillway invert elevations, including removal of overburden and rock blasting, as required
- excavating the intake and tailrace channels
- surface preparation for the foundation structures, including grading, removal of weathered bedrock and grouting
- preparation of spillway section, diversion structure and powerhouse formwork
- installation of west bank embankment dam impervious fill, filter material and shell material by end dumping, bulldozing and compacting in a layered fashion
- installation of concrete for portions of spillway being constructed during Phase 1, including energy dissipation blocks and downstream apron (Site 5 - Wahpeestan and Site 6 - Wapoose)
- installation of powerhouse concrete, imbedded turbine components, gates and stop logs in the powerhouse
- removal of downstream cofferdam (Site 3 - Neeskah and Site 4 - Peeshoo) and rock plugs at all four sites.

Once the powerhouse foundation and lower exterior is complete, the turbine and associated equipment will be installed within the water passage. The balance-of-plant equipment, including all electrical and mechanical components will then proceed.

3.3.7.2 Phase 2

Phase 2 construction is shown for each site in Figures 3.17 through 3.20.

Phase 2 will consist of completing the installation of upstream and downstream cofferdams across the river channel to facilitate construction of the remainder of the concrete overflow spillway and the earth dam at all sites. Cofferdams will be constructed by end dumping coarse rock fill into the river from the Phase 1 diversion culverts to the east bank. When this is in place, the upstream face of the upstream cofferdams and the downstream face of the downstream cofferdams will be made water tight by placing layers of successively finer filter material and ultimately till. Small concrete training walls will be necessary to tie the cofferdams into the spillway section and to contain flow within the diversion channel.

Once the coarse rock is placed to a sufficient height and density, it will start to restrict flow in the main river channel and cause the majority of flow to go through the diversion constructed as part of Phase 1. Once this occurs, filter material and impervious cofferdam core will be placed behind the coarse rock fill to complete the cofferdam installation. After this, all flow in the river will be going through the diversion and entering the river downstream of the cofferdam.

Once both downstream and upstream cofferdams are constructed, the area between will be dewatered by pumping water to the settling pond at the sites. Once this is complete, construction of the embankment dam and the remainder of the overflow spillways will proceed. Construction activities will include:

- clearing of vegetation within the embankment dam footprint
- excavation to the embankment dam and concrete spillway invert elevations
- preparation of the dam section foundations (grading, removal of weathered bedrock, grouting)
- installation of embankment dam impervious fill, filter material and shell material by end dumping, bulldozing and compacting in a layered fashion
- preparation of formwork for the overflow spillway
- installation of concrete for spillway, including energy dissipation blocks and downstream apron (Site 5 - Wahpeestan and Site 6 - Wapoose).

Once construction of the dam components is complete at each site, cofferdams will be removed by excavating material out across the river. Portions of the Phase 2 cofferdams at Site 4 – Peeshoo, Site 5 – Wahpeestan and Site 6 – Wapoose will be incorporated into the earth-fill dam structure and will therefore be left in place. All cofferdam portions that are not an integral part of the dam structure will be removed.

The diversion openings in the overflow structure and the powerhouse gates will then be closed in a phased manner to impound the head pond.

3.3.8 Transmission Line

Construction on the transmission line corridor will commence at the northern end of the route (Wapoose) and proceed in a southerly direction. Transmission line construction is anticipated to commence in early winter once the ground has frozen, to avoid water crossing issues, minimize ground disturbance and prevent requirements for temporary access roads.

The construction methodology will include the following:

- Surveying of the centreline and ROW of the proposed route.
- Vegetation clearing, with grubbing conducted in 6-m wide corridor through the centre of the line to provide a vehicle access route. Clearing will likely be conducted by chainsaw, although mechanized equipment (e.g., feller-buncher) may be used. Felled vegetation will be skidded or forwarded to the closest access road point for disposal or reuse.
- Wooden poles will typically be installed by auguring a hole then installing the post and securing as necessary.
- In areas where soils do not have sufficient load bearing capacity, poles will be founded in rock-filled, galvanized steel cribs.
- Guy wires will be required on corner posts.
- The line cable will be strung using standard tension-stringing machinery.

3.3.9 Head Pond Preparation and Filling

Clearing of vegetation in the area of the proposed head ponds will be undertaken by heavy logging equipment (feller-buncher, skidder) where possible, although on higher slopes, chainsaws may be necessary if equipment access is not possible. All trees and shrubs with a diameter greater than 0.05 m located at or below the elevation corresponding to 0.05 m above the proposed TOL for each site will be cleared and removed from the area. No grubbing (i.e., removal of stumps) will take place in this area in order to assist in stabilization of the banks. Stumps will be cut to a maximum of 0.60 m above grade to provide aquatic habitat structure in deeper areas, although in shallower shoreline areas, stumps will be cut as close as possible to ground level to avoid interference with ice and debris movement, as well as to prevent creating a navigational hazard in the head ponds.

Once construction of the dam and powerhouse are complete and the facility is ready to be operationally tested, the head ponds will be filled. Head ponds will be filled by closing the diversion structure openings in a sequential manner partially and therefore partially restricting flow in the river and increasing the water level in the head pond. Once the head pond level has reached a sufficient height, all diversion openings in the spillway will be closed, and all flow will be going through the non-operating powerhouse. The head pond level will be increased until spilling commences, at which time the powerhouse intake gates will be closed and all flow will be spilled, until operational testing of the powerhouse commences.

It is anticipated that head ponds will be filled in sequence, starting with Site 3 – Neeskah and moving in a downstream direction with Site 6 – Wapoose being filled last. Head pond filling will be accomplished by restricting outflow from the facility (i.e., through the Phase 2 diversion channels and the turbines) thereby causing water to be retained upstream from the dam. Per the recommendation of the MOE, the head ponds will be filled by retaining no more than 10% of the flow in the Kabinakagami River if filling is undertaken between September 1 and June 15, or 20% if filling conducted between June 16 and August 31. Head ponds will be filled one after the other.

The expected average flow rate during this time period would be around 30.6 m^3/s. At a filling rate of around 3 m^3/s, the overall duration to fill all four head ponds would be 28.9 days, and the time duration to fill each head pond would be as follows:

- Site 3 - Neeskah - 2.0 days
- Site 4 - Peeshoo - 2.2 days
- Site 5 - Wahpeestan - 17.7 days
- Site 6 - Wapoose - 7.0 days.

3.3.10 Site Rehabilitation

On completion of the construction of each phase of the Project, the Contractor will be required to rehabilitate the disturbed sites. The purposes of site rehabilitation will be to minimize the potential for soil erosion and enhance local site aesthetics, recreational uses and wildlife habitat in the areas disturbed during construction (where feasible). Rehabilitation will include removal of all construction materials and wastes, and the grading and revegetation of all exposed areas that may be prone to erosion. Where natural erosion protection measures may not be possible or practical, suitable physical erosion protection methods will be used. A Rehabilitation Plan will be prepared during the detailed design stage. As part of this Plan, it will be specified that non-native species are not to be used during revegetation efforts and that species that are used should be indigenous to the local area and adapted to the site conditions to the extent possible. Areas to be rehabilitated following construction include:

- construction camp location
- construction material source locations (i.e., aggregate pits)
- rock crusher location
- concrete batch plant location
- staging/laydown area at each facility
- grubbing and un-useable till disposal sites
- works areas at each facility outside the long-term footprint of each site
- temporary east bank access road and temporary bridge approaches.

3.3.11 Waste Management

The following general waste management procedures will be implemented for the Project. However, a detailed WMP will be prepared prior to implementation of construction to detail how all wastes generated on-site will be stored, collected, transported and disposed of in an approved manner. This WMP will be sent to MOE for approval prior to implementation. The waste management operations of the EPC Contractor and the overall performance of the WMP in meeting its objectives will be monitored by the Environmental Inspector throughout the construction period, as discussed in Section 10.

Industrial liquids to be used on site during the construction process include fuels, lubricants, hydraulic fluids, paints, sealants and others. All liquids are to be properly stored in designated areas away (greater than 30 m) from watercourses. All waste industrial liquid will be classified as hazardous or non-hazardous and will be transported off-site, by a MOE approved waste hauler (if required) to a MOE approved disposal site, depending on the waste classification.

Solid wastes generated during construction will include domestic waste such as food and sanitary waste and construction waste such as material packaging and scrap material. All solid wastes must be contained in temporary storage facilities on-site until they are hauled off site by a designated MOE waste-hauler as required throughout the construction period. All municipal waste will be transported to the Hearst municipal landfill disposal site on Highway 583 North, by an MOE licensed hauler. This landfill is licensed by the MOE to accept construction wastes, some contaminated material waste and waste oils. Waste classifications that cannot be accepted by the Hearst municipal landfill will be taken to the closest MOE-approved disposal site. The Constance Lake Waste Disposal Site will not be utilized.

Any waste that can feasibly be reused or recycled will be. Recyclable materials will be taken to the closest MOE-approved recycling centre.

Sanitary facilities in the laydown area at each of the four development sites will include several portable self-contained toilets and washroom facilities in a crew trailer. All sewage wastes at each site will be contained and hauled off site by a designated hauler to an MOE approved disposal area on an as required basis, throughout the construction period.

Sanitary wastes generated at the construction camp will be disposed of in a septic system installed adjacent to the camp location. The septic system may require a permit from the Porcupine Health Unit, or may require MOE approval if the hydraulic capacity of the septic system exceeds 10 000 litres per day.

All cleared trees and shrubs are to be re-used to the extent possible. This includes any merchantable timber, non-merchantable timber and brush. All wood that cannot be sold is to be either used as fish habitat enhancement structure or chipped and used as mulch during project restoration activities. Slash may be burned on the construction site.

Waste rock, excavated earth, organic material and topsoil will be disposed of at designated waste rock/earth and organics/topsoil disposal areas adjacent to each of the four development sites, as shown on Figures 3.12, 3.13, 3.14 and 3.15. These areas will be rehabilitated following completion of disposal activities.

3.4 Operational Aspects of the Proposed Facilities

Once operational, the four facilities will transmit electrical power to the existing Calstock power plant switchyard and 115-kV transmission line along Highway 11, which runs into the HONI Hearst Transformer Station (Figure 1.1), where the power will enter the provincial electricity grid.

The facilities will each operate in a run-of-river mode, which is defined by MNR as a facility that has minimal head pond storage (i.e., no ability to store water in the head pond upstream from the dam for use at a later time) and that passes some or all of the inflow through one or more turbines on a continuous basis, with the remainder, if any, going over the spillway (MNR, 2002). The run-of-river mode means that the facilities will be operated in a manner such that the amount of water entering the head pond will equal the combined flow going through the powerhouse and/or over the spillway, with allowance for local inflows from tributaries draining into the head ponds. Due to the technical limitations of the turbines and water level sensing and control equipment, it may not be possible to ensure that this inflow equals outflow balance occurs continuously, particularly when natural inflow rates are changing, and very small differences in inflow and outflow may exist as the powerhouses adjust to these changing inflows. However, the facility will remain tightly controlled in terms of maintaining the run-of-river nature (per the following discussion on water level control strategies).

Each facility will be operated under a 'water level control' strategy whereby, when natural flow in the river is at or less than the rated flow capacity of 82 m^3/s, which occurs approximately 89% of the time in an average flow year, the powerhouse will be operated to maintain the head pond level 0.05 m below the level of the overflow spillway crest, with all flow passing through the turbines. This head pond water level, measured at a point immediately upstream from each facility, is a constant elevation termed the TOL. This level will be maintained by the use of water level transducers upstream from each facility. Technical limitations of the turbines and the way in which they will respond to changes in head pond water level will prevent the head ponds from being maintained at the TOL continuously, since the turbines will require a response time to adjust to natural changes in flow in the river. Therefore, water levels will be maintained with a narrow band +/- 0.05 m around the TOL, called the Target Operating Zone.

When river flows are less than 20 m^3/s, technical limitations of the turbines may prevent the head pond from being operated within the narrow Target Operating Zone. Northland will attempt to operate within the Target Operating Zone at all times, although head pond water levels may periodically drop below this zone into what is called the Low Water Zone. This zone will extend an additional 0.05 m below the Target Operating Zone to the Absolute Minimum Water Level. This will only occur at flows below 20 m^3/s due to the limitations of the turbines.

During periods of high flow (beyond rated flows of each powerhouse), the head pond water level will increase and start flowing over the overflow spillway. For the 1:2-yr flood, the head ponds will increase by approximately 1.35 m. For the 1:100-yr flood, the head pond levels will increase by between approximately 1.84 m (depending on the site). Northland will have no ability to control head pond water levels once spillage is occurring and they will rise and fall in accordance with natural changes in river flow. The zone above the spillway crest is called the High Water Zone for the purposes of the WMP.

Approximately 3% of the time (although not occurring in every year), the flow in the river will be too small to be used by the turbines (approximately 8 m^3/s or less). In these times, the powerhouses will be shut off and the water level in the head ponds will be allowed to increase and water will flow over the overflow spillway. When flows are approaching values where the powerhouses may have to be shut off, the head ponds will be operated as close to the crest level as possible to minimize the duration between when turbines stop generation and spilling commences. The turbines will pass a minimum of 3 m^3/s (after ceasing generation operations due to low flow) to ensure flow in the river does not completely cease at any point, and this flow rate will be monitored to ensure it is maintained. Once spilling commences, the turbines will cease passing flow altogether. Additional information on such a low water event is provided in Section 5.1.1.3.3.

3.5 Facility Maintenance Activities

Facility maintenance activities include normal activities that are conducted on a regular basis to ensure that equipment is maintained in good operation. Common repairs that could be expected over the life of the facility are also included in this category. Facility maintenance activities include:

- oil changes for transformers and other oil filled equipment
- manual trash rack debris removal
- transmission line corridor and road side vegetation maintenance
- facility cleaning (e.g., floor sweeping, mopping, bathroom cleaning)
- minor concrete repairs on powerhouse or on spillway crest and downstream face
- occasional mechanical and electrical repair of equipment within the powerhouse
- access road grading and/or application of dust control
- snow removal.

A comprehensive facility inspection program will also be developed and implemented to ensure the facility is functioning properly and remedial works will be implemented as necessary based on the results of inspections.

3.6 Decommissioning

Waterpower projects are designed for long life spans, typically in excess of 100 years with ongoing maintenance, repair and upgrade programs. As such, decommissioning of the facility is highly unlikely to happen in less than 100 years. If facility decommissioning is to occur, an environmental assessment process based on the environmental knowledge, standards, and legislative requirements in place at that time would need to be undertaken as required and all necessary permits and approvals would have to be obtained prior to implementation of the decommissioning.