AQUATIC ENVIRONMENT TECHNICAL SUPPORTING DOCUMENT FOR THE UPPER MATTAGAMI PROJECT

Submitted To:

ONTARIO POWER GENERATION

Submitted By:

Mattagami River EA Consulting Team

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EXECUTIVE SUMMARY

Ontario Power Generation Inc. (OPG) is proposing to redevelop three hydroelectric power plants on the Upper Mattagami River: Wawaitin Generating Station (GS) and Sandy Falls GS located within the City of Timmins and Lower Sturgeon GS located north of Timmins. These facilities have been in operation as run-of-the-river plants for over 90 years and are all at the end of their designed service life. The combined existing nameplate capacity of the three generating stations is 18.7 megawatts (MW). The proposed undertaking involving the construction of new powerhouses and various associated infrastructure will provide a combined nameplate capacity of 35 MW, an increase of almost double the capacity. After the newly-built facilities are placed into commercial operation, the existing powerhouses and associated water conveying and electricity connection facilities will be decommissioned.

The proposed hydroelectric power plant redevelopments on the Upper Mattagami River are subject to the Class Environmental Assessment for Modifications to Hydroelectric Facilities prepared under the Ontario *Environmental Assessment Act*. This aquatic environmental assessment is being undertaken as part of this Class Environmental Assessment.

During proposed hydroelectric plant construction, potential effects on the aquatic environment may occur due to in-water construction activities, blasting, soil erosion and turbidity generation, accidental spills and waste generation. Based on an assessment of the available baseline information and potential effects, as well as the implementation of recommended mitigative measures, it is concluded that effects during construction will be minimal, localized and short-term.

During proposed hydroelectric plant operation, potential effects on the aquatic environment may occur due to accidental spills. Based on assessment of the baseline information and potential effects, it is concluded that the operation of the proposed hydroelectric power plants will have minimal effects on the aquatic environment.

Environmental protection during the proposed hydroelectric power plant redevelopments will be ensured by adherence to the site-specific Environmental Management Plans, as well as compliance with regulatory standards and guidelines.

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ACRONYMS AND ABBREVIATIONS

~	Approximately
AP	Acid potential
ARD	Acid rock drainage
BMP	Best Management Practice
$CaCO_3$	Calcium carbonate
CLI	Canada Land Inventory
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COSSARO	Committee on the Status of Species at Risk in Ontario
CPUE	Catch-per-unit-effort
DBC	Design-Build-Contractor
D.O.	Dissolved oxygen
Dr.	Drive
ECGM	Environmental Construction Guidelines Manual
e.g.	For example
ER	Environmental Report
ESA	Environmental Site Assessment
et al.	And others
GS	Generating station
>	Greater than
HADD	Harmful alteration, disruption or destruction (of fish habitat)
Hydro One	Hydro One Networks Inc.
i.e.	That is
LRIA	*Lakes and Rivers Improvement Act*
<	Less than
Max.	Maximum
MDL	Method detection limit
Min.	Minimum
ML/ARD	Metal Leaching and Acid Rock Drainage
MNR	Ministry of Natural Resources
MOE	Ontario Ministry of the Environment
MOEE	Ontario Ministry of Environment and Energy
MRCA	Mattagami Region Conservation Authority
N	North
NHIC	Natural Heritage Information Centre
No.	Number
NP	Neutralizing potential
OPG	Ontario Power Generation Inc.
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
pers. comm.	Personal communication

PWQG	Provincial Water Quality Guideline
PWQO	Provincial Water Quality Objective
S1	Extremely rare in Ontario; usually fewer than 5 occurrences (in a 10-km by 10-km Mercator square grid)
S1S2	Extremely rare to very rare in Ontario
S2	Very rare in Ontario; usually between 5 to 20 occurrences (in a 10-km by 10-km Mercator square grid)
S2S3	Very rare to uncommon in Ontario
S3	Rare to uncommon in Ontario; usually between 20 to 100 occurrences (in a 10-km by 10-km Mercator square grid)
S3S4	Rare to common in Ontario
S4	Common in Ontario; apparently secure, usually more than 100 occurrences (in a 10-km by 10-km Mercator square grid)
S5	Very common in Ontario; demonstrably secure
SAN	Accidental
SARA	*Species at Risk Act*
SE	Exotic; not believed to be a native component of Ontario's fauna
SENES	SENES Consultants Limited
sp.	One species
spp.	A number of species
STP	Sewage Treatment Plant
SVOC	Semi-volatile organic compound
SZN	Not of practical conservation concern as there are no clearly definable occurrences
TPH	Total petroleum hydrocarbons
TS	Transformer station
VOCs	Volatile organic compounds
YOY	Young-of-the-year
W	West

MEASUREMENT UNITS

cm	centimetre
°	degree
°C	degree Celsius
FTU	Formazin Turbidity Unit
GWh	gigawatt-hour
ha	hectare
Kg	kilogram
Kg/ha	kilogram per hectare
km	kilometre
km^2	square kilometre
KV	kilovolt
L/s	litre per second
M	metre
M/km	metre per kilometre
M/s	metre per second
M^3/s	cubic metre per second
mg/L	milligram per litre
mm/s	millimetre per second
MW	megawatt
‘	minute
no./100 mL	number per 100 millilitre
/h	per hour
%	percent
S	second
”	second
μg/L	microgram per litre
μmhos/cm	micromhos per centimetre
$/m^2$	per square metre

GLOSSARY

Acarina	Mites and ticks (water mites).
Acidity	The quantitative capacity of water to neutralize a strong base to a designated pH.
Algae	A group of unrelated simple plant organisms that live in aquatic habitats.
Alkalinity	Measure of a water's capacity to neutralize an acid.
Anaerobic	Condition lacking free oxygen.
Annelida	A phylum of invertebrates comprising the segmented worms.
Aquatic macrophytes	Rooted, usually vascular, aquatic plants, such as water lily, cattail, coontail, etc.
Arachnoidea	A class of primarily terrestrial arthropods including spiders, scorpions, harvestmen, ticks and mites.
Arthropoda	A phylum of invertebrate animals characterized by an outer body layer, the exoskeleton.
Avifauna	Birds.
Benthic	Pertaining to the bottom of aquatic habitats and the organisms that inhabit the bottom.
Benthic Macroinvertebrates	Larger bottom-dwelling organisms, e.g., snails, clams, worms, insect larvae, crustaceans, etc., living on or within the sediment substrate of waterbodies.
Biological Oxygen Demand	Measure of the amount of oxygen required to oxidize the organic matter by anaerobic microbial decomposition to a stable inorganic form
Bivalva (Pelecypoda)	Clams.
Brownian Movement	The random movement of microscopic particles suspended in a gas or liquid.
Bryophyte	Moss
Bulkhead	A steep or vertical wall retaining an embankment, often used to line shorelines and maintain embankment stability and absorb the energy of waves and currents.
Canal	A channel dug or built to carry water.
Capacity	The greatest load which a unit, station or system can supply (usually measured in kilowatts, megawatts, etc.).
Capacity Factor	Ratio of the actual energy produced to the maximum energy which could be delivered under continuous operation at maximum rating.
Ceratopogonidae	Biting midge fly larvae.

Chironomidae (chironomids)	Midge fly larvae.
Chute	A steeply-inclined natural passageway or constructed pipe or channel which conveys water from a higher to a lower level.
Class	A category used in the classification of organisms that consists of similar or closely related orders.
Cofferdam	A temporary dam made of concrete, rockfill, sheet-steel piling, timber/timber-crib or other non-erodible material and commonly utilized during construction to exclude water from an area in which work is being executed.
Coleoptera	Beetles (aquatic).
Conductivity	Numerical expression of a water's ability to conduct an electrical current; the conductivity of water is dependent on its ionic concentrations and temperature.
Dam	A concrete or earthen barrier constructed across a river and designed to control water flow or create a reservoir.
Diatoms	Unicellular algae, usually microscopic, that are characterized by having a cell wall of silica.
Diptera	Flies.
Drawdown	The magnitude of the change in water surface elevation of a well, reservoir, or natural body of water, resulting from the withdrawal of water.
Empididae	Dance fly larvae, dagger fly larvae.
Enchytraeidae	Potworms.
Endangered	A species facing imminent extirpation (no longer existing in the wild in Canada, but occurring elsewhere) or extinction (no longer exists).
Ephemeroptera	Mayfly nymphs.
Epilithic	Attached to rocks.
Epipelic	Associated with (attached to) bottom sediments in waterbodies.
Epiphytic	Attached to vegetation, e.g., larger filamentous algae, mosses and aquatic macrophytes.
Extirpation	Elimination of a species in the wild of a particular area (e.g., Canada), but occurring elsewhere.
Family	A category used in the classification of organisms that consists of one or several similar or closely related genera.
Forebay	The part of a dam's reservoir that is immediately upstream from the powerhouse.
Freshet	High flows in a stream or river, usually occurring in the spring, caused by snow melt, runoff, heavy rains and/or high inflows.

Gain	A cut or groove to receive a timber, as a girder or fastener.
Genus (plural genera)	A group of animals and plants having common structural characteristics distinct from those of all other groups and usually containing several species.
Geotechnical	Concerned with the physical properties of soil, rock and groundwater usually in relation to the design, construction and operation of engineered works.
HADD	Harmful alteration, disruption or destruction (of fish habitat)
Hardness	Related to a water's capability to produce lather from soap (the harder the water, the more difficult it is to lather soap); principally determined by the sum of calcium and magnesium.
Head	The difference in elevation between the water surface at the intake and tailrace.
Headgate (Control Gate)	The gate that controls water flow into a hydroelectric dam.
Headpond	The reservoir from which water is extracted for power generation or spillage.
Hirudinea	Aquatic leeches.
Insecta	Insects.
Intake	A structure which regulates the flow of water into a water-conveying conduit.
Interstitial	Associated with openings particularly between things that are close together.
Ion (ionic)	An atom that is either negatively or positively charged.
Lentic	Slow flowing or still water, e.g., in ponds and lakes.
Lotic	Flowing water, e.g., in streams and rivers.
Lumbriculidae	A family of aquatic annelids (worms) in the order Oligochaeta.
Mirex/Photomirex	Although mirex (a cyclodiene insecticide) is no longer produced or used in North America, it is very persistent in the environment and highly resistant to degradation; it is reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity in experimental animals; mirex can be photochemically converted in the environment to photomirex, a suspected gastrointestinal or liver toxicant.
Mollusca	Molluscs (snails and clams).
Nematoda (nematodes)	A phylum of pseudocoelomate (lacking a true coelum) invertebrates comprising the roundworms, characterized by a smooth narrow cylindrical unsegmented body tapered at both ends.
Oligochaeta	Worms.

Ostracoda	A class of crustaceans with a body enclosed in a bivalved carapace (dorsal part of the exoskeleton).
Overburden	The soil, rock and other material which lies on top of the underlying mineral or other deposit, e.g., bedrock
Penstock	A structure associated with a hydroelectric station, designed to carry water from the intake to the turbine.
Periphyton (Aufwuchs)	The organisms, collectively, that live attached to rocks, gravel, aquatic vegetation and other substrate.
pH	Indicates the balance between the acids and bases in water and is a measure of the hydrogen ion concentration in solution.
Phylum	A major division of the animal kingdom containing classes of animals.
Pier	As part of a hydroelectric station, an abutment extending from the station, either upstream or downstream, and lending foundation support and directionality to water passed through the structure.
Plankton	Minute organisms that drift or float passively with the current of a waterbody.
Platyhelmenthes	A phylum of acoelomate (without a coelum) invertebrates comprising the flatworms, characterized by a flattened unsegmented body.
Plecoptera	Stonefly larvae.
Pneumatic	Involving the mechanic properties associated with air or other gas pressure.
Polychlorinated Biphenyls	A group of biologically persistent organic compounds containing chlorine, previously used in electrical transformers and capacitors because of their insulating capacity and fire resistance; due to their persistence, they are being phased out and destroyed.
Polycyclic Aromatic Hydrocarbons	Widespread organic compounds containing two or more aromatic (benzene) rings, e.g., anthracene, benzo(a)pyrene, naphthalene.
Potamoplankton	Drift plankton (associated with flowing water, i.e., streams and rivers).
Powerhouse	A primary part of a hydroelectric facility where the turbines and generators are housed and where power is produced by falling water rotating turbine blades.
Quonset Hut	A light weight prefabricated structure of corrugated steel having a semicircular cross-section.
Rip Rap	Broken rock/stones used to build a sustaining wall or foundation.
Rotifer	Small, usually microscopic, pseudocoelomate (lacking a true coelum) unsegmented animals, with a ciliated region, the corona, at the anterior end, comprising part of the zooplankton community in waterbodies.
Run-of-the-River	A power plant that has no upstream storage capacity and must pass all flows as they come.

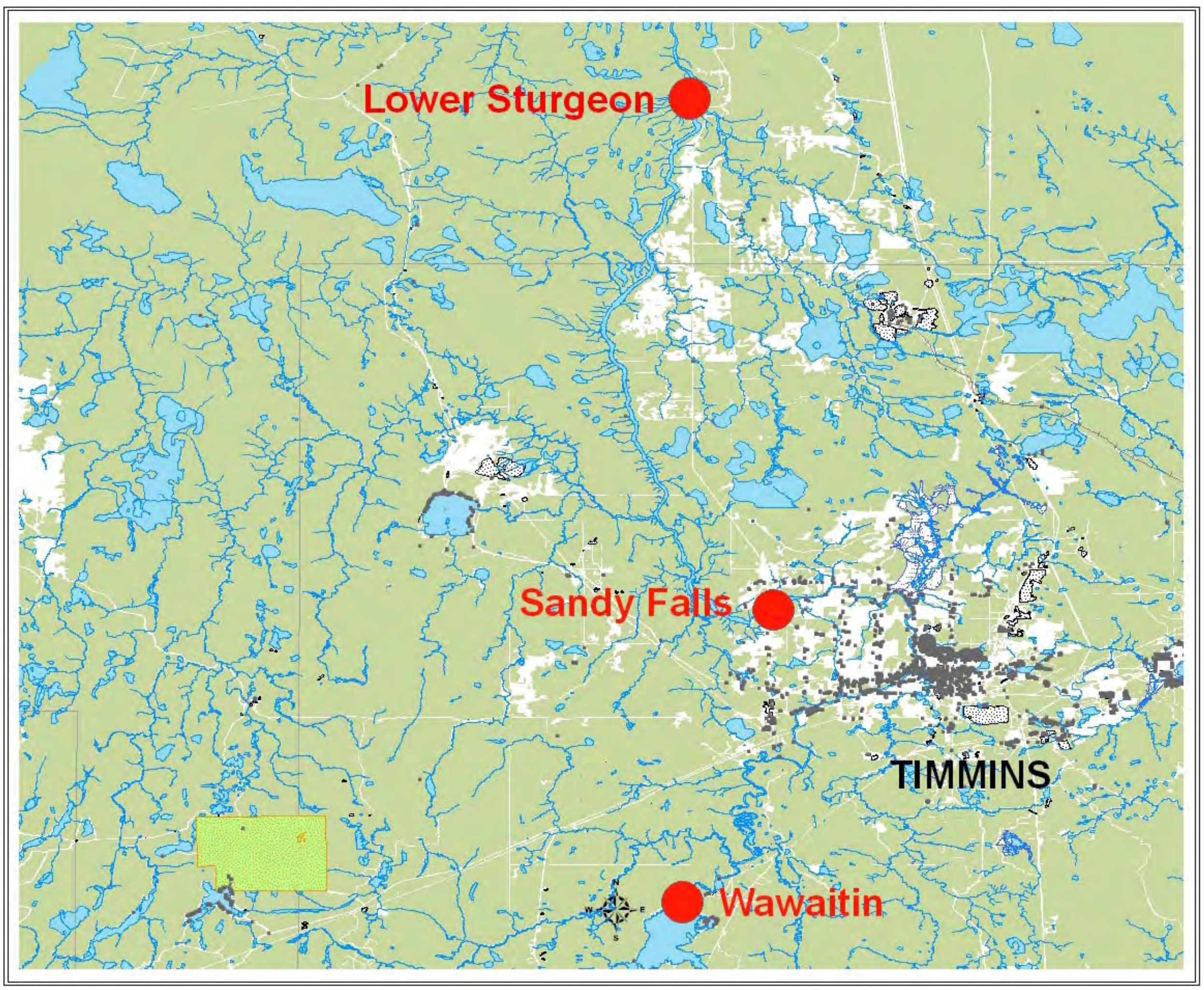
Shannon-Wiener Diversity Index	A measure of the number of species and individuals present at a given location as well as the distribution of those individuals among the various species.
Sill	A horizontal member forming the upper and/or lower foundation, or part of the foundation, of a structure.
Sluiceway (Sluice)	An open channel designed to divert excess water which could be within the structure of a hydroelectric dam or separate of the main dam (see spillway).
Special Concern	A species with characteristics that make it particularly sensitive to human activities or natural events.
Species	A group of closely related individuals which can and normally do interbreed to produce fertile offspring.
Spillway	A passageway, or channel, located near or at the top of a dam through which excess water is released or "spilled" past the dam without going through the turbine(s); as a safety valve for the dam, the spillway must be capable of discharging major floods without damaging the dam while maintaining the reservoir level below some predetermined maximum level.
Stoplog	A gate (sometimes made from squared lumber) which can be placed into an opening to shut off or regulate the flow of water.
Storage Capacity	The volume of water contained between the maximum and minimum allowable levels within a reservoir.
Surge Tank	A structure connected to the penstock(s), designed to avoid damages to water-conveying facilities that might otherwise occur due to pressure surges (water hammer).
Tailrace	A channel through which the water flows away from a hydroelectric plant following its discharge from the turbine(s).
Talus	Sloping mass of rock fragments below a cliff.
Taxon (plural taxa) or Taxonomic Group	One of a hierarchy of levels in the biological classification of organisms: the seven major categories are (in order of decreasing size) kingdom, phylum (or division), class, order, family, genus, species. The taxonomic groups can be high (class level), intermediate (family level) or low (genus or species level).
Terrestrial	Belonging, living on or growing in the earth or land.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Total Kjeldahl Nitrogen	Measure of both ammonia and organic nitrogen.

Transformer	A device that changes electric voltage. In Ontario, electricity typically leaves the generator at 20,000 volts or less, is stepped up to 115,000, 230,000 or 500,000 volts to be transmitted long distances and then stepped down to lower voltages to be distributed to customers. Each change in voltage is accomplished with a transformer.
Trichoptera	Caddisfly larvae.
Tricladida	Planarians, an order of Turbellaria.
Trophic	Level of organization in the food chain, e.g., producers, herbivores, carnivores.
Turbellaria	Free-living flatworms.
Turbidity	A measure of the suspended particles such as silt, clay, organic matter, plankton and microscopic organisms in water which are usually held in suspension by turbulent flow and Brownian movement.
Turbine	A mechanism in an electrical generation facility which converts the kinetic and potential energy of water (in the case of hydroelectric turbines) into mechanical energy which is then used to drive a generator converting mechanical to electrical energy.
Weir	A dam in the river to stop and raise the water.
Young-of-the-year	Fish that hatched during the year when caught.
Zooplankton	That portion of plankton consisting of animals, usually minute crustaceans and other small multicellular and single cellular animals.

1.0 INTRODUCTION

Ontario Power Generation Inc. (OPG) is proposing to redevelop three hydroelectric generating sites on the Upper Mattagami River, Wawaitin Generating Station (GS) and Sandy Falls GS located within the City of Timmins and Lower Sturgeon GS located north of Timmins (see Figure 1.1). These facilities have been in operation as run-of-the-river plants for over 90 years and are all at the end of their designed service life. These three generating stations operate at 25 cycles; however, the power cannot be used locally in Timmins. Instead, it must be transmitted to Sudbury in order to convert the power to 60 cycles and then be injected into the power grid. This has resulted in significant energy losses during the process of transmitting and converting the 25 to 60 cycle power. As well, all three stations are in need of structural and electrical/mechanical repair.

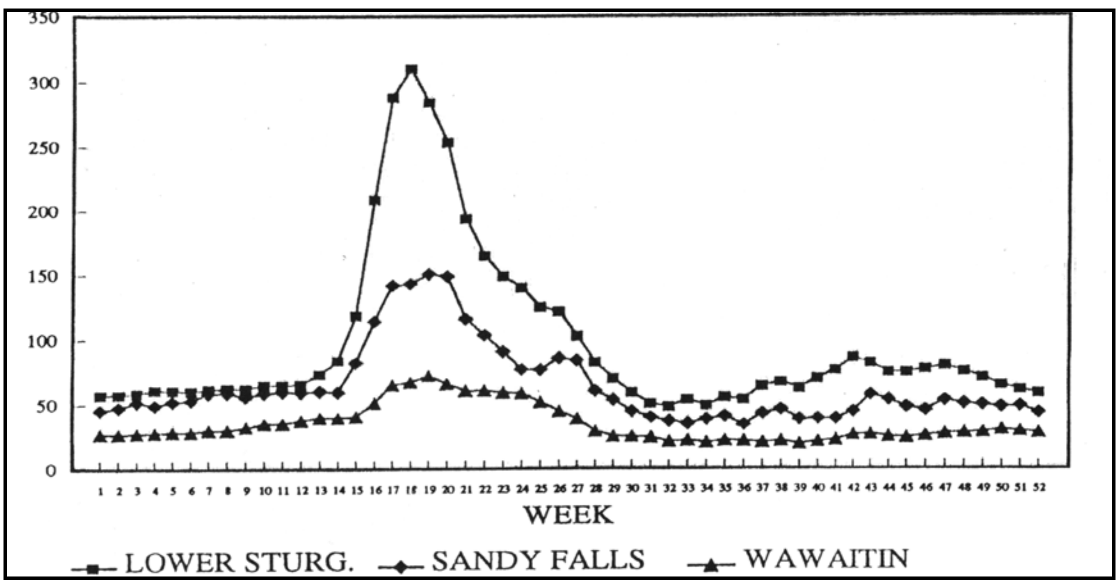
Figure 1.1: Location of Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS



The combined existing nameplate capacity of the three generating stations is 18.7 megawatts (MW). The proposed undertaking involving the construction of new powerhouses and various associated infrastructure will provide a combined nameplate capacity of approximately 35 MW, an increase of approximately 85%. Annual energy production will be improved from 108 gigawatt-hours (GWh) to 180 GWh, a 67% increase. A connection at 27.6 kilovolts (kV) will be made with the local distribution system in the Timmins area. After the newly-built facilities are placed in commercial operation, the existing powerhouses and associated water conveying and electricity connection facilities would be decommissioned and dismantled.

As indicated above, the three hydroelectric facilities on the upper Mattagami River have operated as run-of-the-river plants. Figure 1.2 presents average weekly flow data for the three generating stations. Tributaries entering the Mattagami River between the furthest upstream Wawaitin GS and the furthest downstream Lower Sturgeon GS account for the much larger average flow at the downstream plants. The flatter curve for the Wawaitin GS reflects the greater ability and need to control spring runoff upstream of Timmins by using the control dams at Mattagami Lake and Kenogamissi Lake. The Sandy Falls GS and Lower Sturgeon GS are less able to regulate seasonal water flows.

Figure 1.2: Average Flow Data (m^3/s) for the Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS



As the plants are operated as run-of-the-river facilities, the potential for capacity increases is based on improved equipment efficiencies as well as improved utilization of the available water (less spill). The new facilities will continue to operate under the existing operating regimes that have been long established and more recently formalized in the approved Water Management Plan for the Mattagami River (OPG *et al*., 2006).

In 2000, the Ontario *Lakes and Rivers Improvement Act* (LRIA) was amended to establish the statutory authority of the Ministry of Natural Resources (MNR) to order the preparation of Water Management Plans for operation of waterpower facilities and associated control structures and ensure compliance with the Plans. The intent of the Water Management Plan is to provide certainty and clarity as to how waterpower facilities and control structures are operated with respect to levels and flows so as to balance environmental, social and economic objectives.

The Water Management Plan for the Mattagami River system includes 18 waterpower structures and facilities located along the river system that have influence on levels and flows (OPG *et al.*, 2006). The Plan was the result of a partnership between OPG, the MNR and other private power producers which operate facilities along the river as well as First Nations and the general public, which participated in the form of various advisory committees.

The Water Management Plan was prepared in accordance with the Water Management Planning Guidelines for Waterpower (MNR, 2002). The Water Management Planning Guidelines were approved by the Minister of Natural Resources on 14 May 2002. The LRIA requires compliance by facility operators with the operating regimes established in the Water Management Plan for the Mattagami River System and a compliance monitoring program has been established for the Mattagami River.

1.1 PROJECT DESCRIPTION

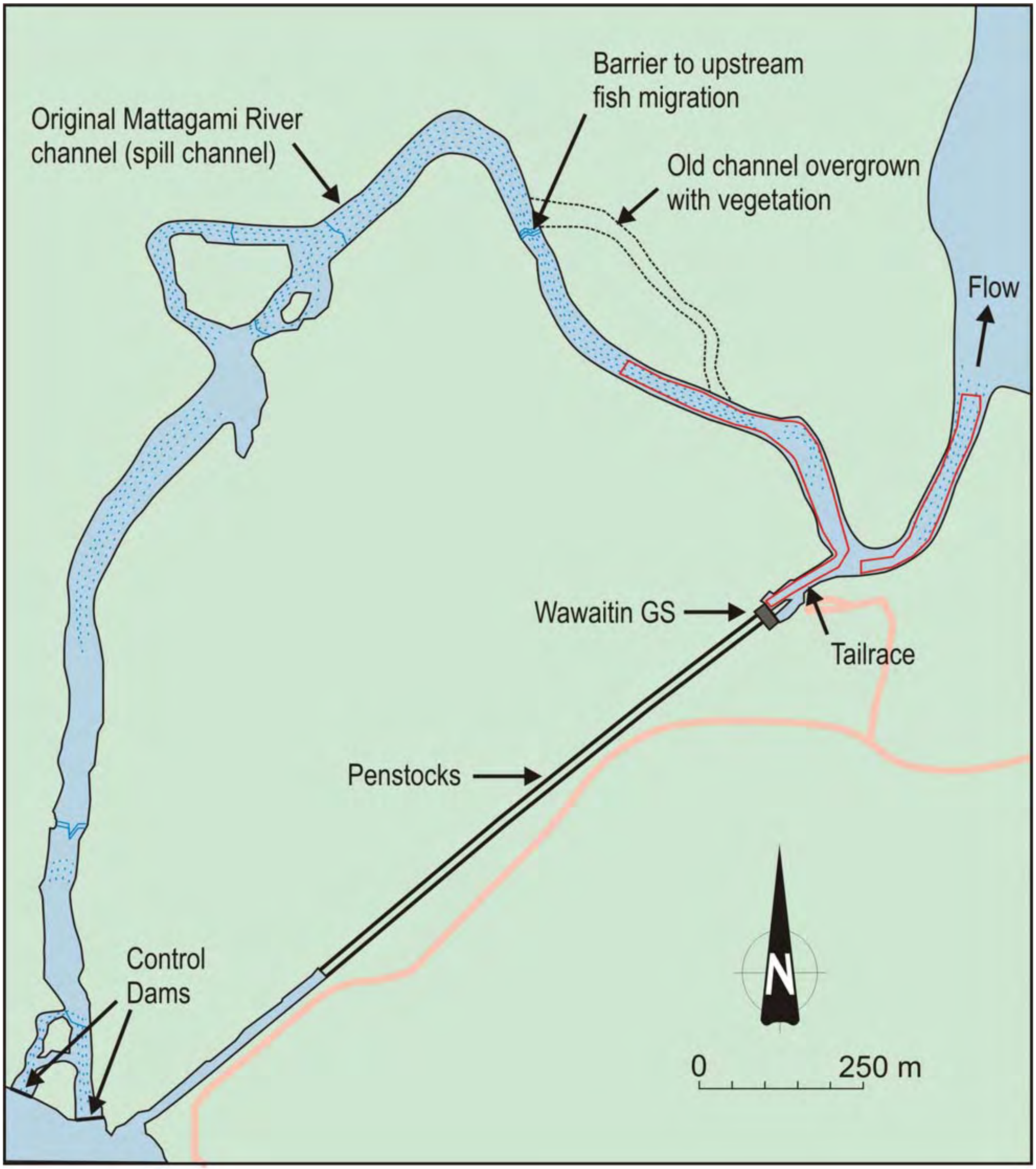
1.1.1 Wawaitin Generating Station

The 10.4-MW Wawaitin GS is located within the City of Timmins municipal boundaries approximately 25 km southwest of the urban centre (see Figure 1.1.). The plant, placed in service in 1912, is accessed by a municipal road. Photograph 1.1 depicts the Wawaitin GS.

Photograph 1.1: Wawaitin GS

The Wawaitin GS has a main dam at the northern end of Kenogamissi Lake (see Figure 1.3) with two concrete control structures, which have a total of 12 sluices that have timber stoplogs and two stoplog lifters (KGS Group, 2003). The east and west control dams are 42.7 m and 29 m long, respectively. The two control dam sluiceways discharge into a spillway bypass channel which in turn discharges into the Mattagami River just downstream of the concrete powerhouse. The spillway is the original river bed which extends for a distance of approximately 2.6 km to the north of the intake canal and penstocks which convey water to the Wawaitin GS powerhouse.

Figure 1.3: Current Facilities, Wawaitin GS



The intake canal extends 360 m from Kenogamissi Lake to the intake structure (see Figure 1.3). The canal is 14 m wide, with concrete walls over its entire length on the north side and a boulder bank over most of its south side. Water is conveyed from the intake structure to the powerhouse via two 800-m long underground penstocks, consisting of 2.7-m diameter pipelines (one wood stave and the other fibre-reinforced plastic and steel). The two penstocks are connected to individual steel surge tanks part way to the powerhouse. Beyond the surge tanks, the two penstocks are split into four smaller separate steel penstocks with diameters ranging from 2.1 to 2.4 m leading to the four generating units located in the powerhouse. Water from the Wawaitin GS is returned to the Mattagami River via an approximately 115-m long tailrace.

The Wawaitin GS depends on upstream storage at the Kenogamissi Lake and Mattagami Lake control dams and has a relatively small upstream drainage area of 3,527 km^2 (KGS Group, 2003). Based on recently completed Dam Safety Analysis (based on 1999 MNR Guideline), the total Inflow Design Flood has been established as 1:100 year return period with a value of 381 m^3/s. The annual drawdown is a managed process with water spilled to supply downstream plants and to capture spring runoff. The two control dams spill water through the original river channel when flows exceed the 40 m^3/s capacity of the generating station, which occurs approximately 23% of the time. When flows are less than 40 m^3/s, the generating station is capable of taking all river flow.

The existing powerhouse is operated remotely. Plant operation is controlled to ensure optimal energy production, while satisfying concerns of Kenogamissi Lake cottagers regarding water levels and flooding concerns downstream at Timmins. Typically, water levels are not allowed to fluctuate more than 0.4 m in Kenogamissi Lake during the summer, with sufficient water passage through the Wawaitin GS and/or spilling to ensure adequate downstream supply to Timmins and the pulp and paper mill in Smooth Rock Falls. Water level fluctuations must all be in compliance with the Water Management Plan (OPG *et al.*, 2006).

<u>Proposed Facilities</u>

The proposed Wawaitin GS is planned to be located adjacent and to the north of the existing powerhouse (see Figures 1.4 and 1.5). The proposed Wawaitin GS will have two generating units with a total nominal capacity of 15 MW.

Figure 1.4: Proposed Facilities, Wawaitin GS

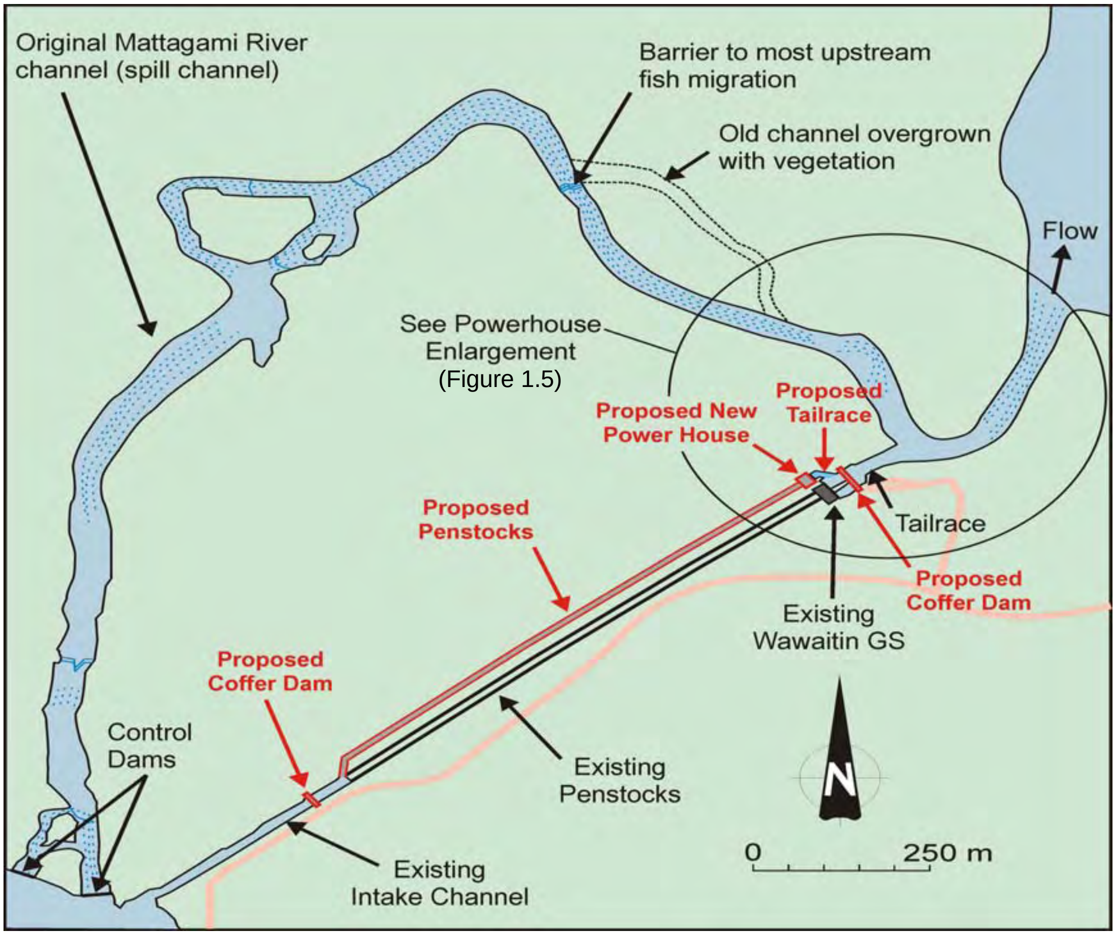
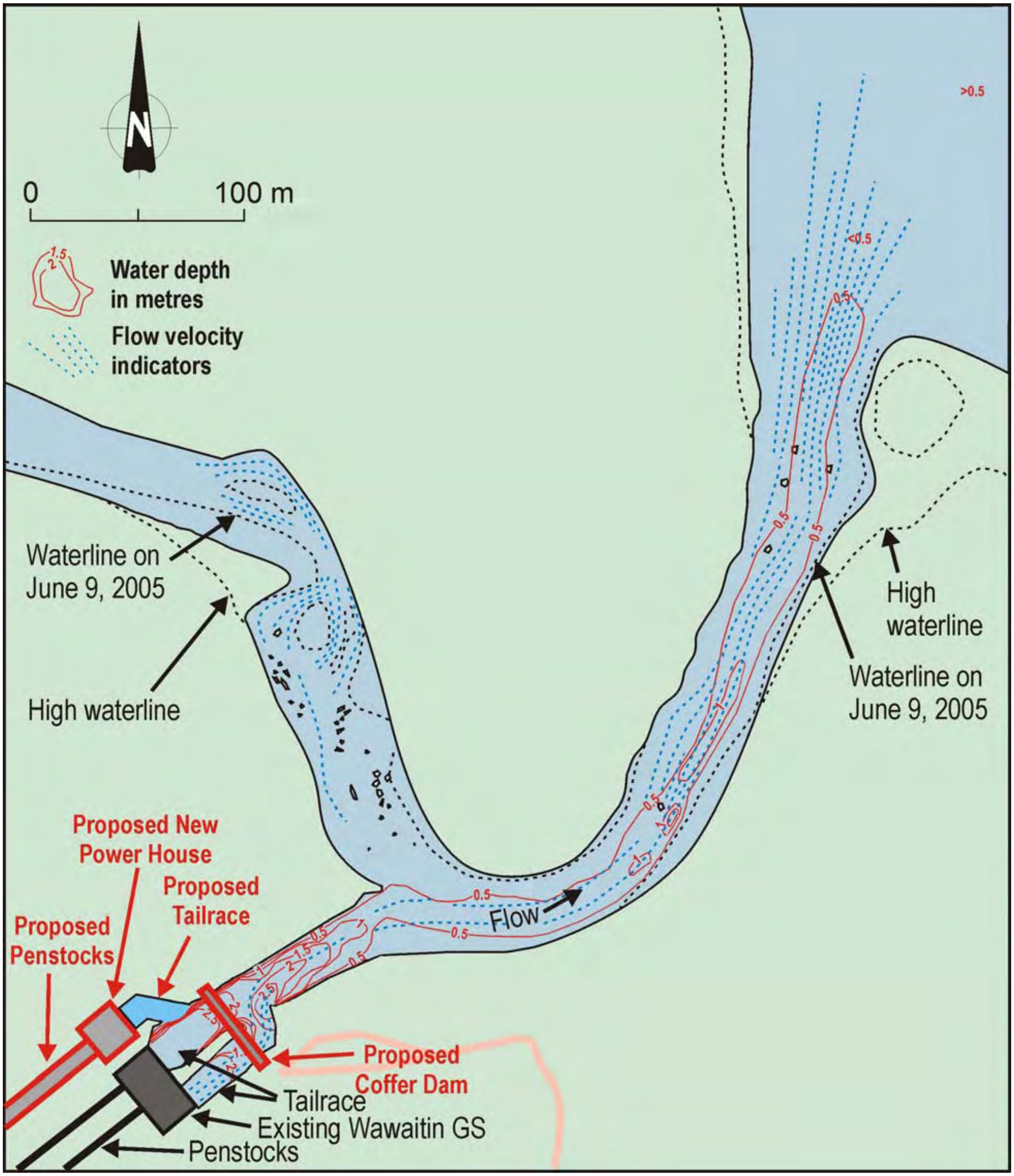


Figure 1.5: Proposed Facilities, Wawaitin GS Powerhouse



Water in the existing intake canal would be conveyed through new intake structure via a new steel penstock about 850 m in length to the new powerhouse. This penstock will be buried parallel to the north of the existing twin penstocks that feed the existing Wawaitin GS.

A new tailrace section, approximately 10 m wide, 7 m deep and 30 m long, will be excavated from the new powerhouse to the existing tailrace to facilitate return of water from the proposed Wawaitin GS.

Geotechnical studies at the new powerhouse, along the new penstock and tailrace locations have been undertaken. These studies indicate an overburden depth of about 1.4 to 17 m (Hatch Acres, 2006a). With an approximate tailrace section depth of 7 m, limited blasting of the bedrock will likely be required for the construction of the new powerhouse. On-land excavation will terminate back of the shoreline to provide a barrier for water intrusion. This plug will be removed after nearshore excavation is completed. Sampling of the rock has indicated that it is not acid generating (Martin, 2006).

Water depth in this existing tailrace segment is approximately 2.5 m (Coker and Portt, 2006a), necessitating excavation of the shoreline to accommodate water discharge from the deeper new tailrace section. Coker and Portt (2006a) reported that the existing tailrace segment has a bottom of cobble, boulder, gravel and sand. Sediment depth to bedrock is unknown, but is expected to be shallow.

A temporary cofferdam will be constructed around the tailrace segment to be excavated (see Photograph 1.2). Once the cofferdam is constructed, the area enclosed by the cofferdam will be pumped dry to facilitate nearshore excavation. Blasting of the bedrock will likely be required with the rock fragments removed by backhoe. Once excavation is completed, the shoreline plug will be removed followed by the removal of the temporary cofferdam. The cofferdam is expected to be in place approximately 12 to 14 months and is estimated to dewater an area of about 0.3 ha (2,950 m^2). The approximate location of the cofferdam is indicated on Photograph 1.2.

Photograph 1.2: Proposed Cofferdam Location, Wawaitin GS Tailrace

The main dams, intake canal and spillways and associated equipment are in good condition but some refurbishment is required. There is a need to de-water a portion of the intake canal to undertake the construction of the new intake and the conversion of the old intake into a gravity structure and also to remove the remnants of an obsolete structure that is impeding the flow of water into the canal. This cofferdam will be in place 3 to 6 months and is estimated to be dewater an area of approximately 630 m^2 (0.06 ha). The approximate location of this temporary cofferdam is indicated on Photograph 1.3.

Photograph 1.3: Proposed Cofferdam Location, Wawaitin GS Intake Canal

The proposed facilities will be connected to the local Hydro One Networks Inc. (Hydro One) distribution system at 27.6 kV to feed into the Ontario electricity grid.

Upon completion of the new generating station, the existing powerhouse with its four generating units will be decommissioned and all sections of the structure above grade will be removed. Existing surge tanks and aboveground penstock sections will be removed and backfilled. The buried penstock sections will either be excavated or filled in. The obsolete electrical switching equipment and transformers will also be removed.

Table 1.1 provides a summary of the existing and proposed plant operating characteristics. The gross head, i.e., the difference in elevation between the water surface at the intake and the tailrace, will remain the same. However, the rated flow through the Wawaitin GS will increase from 40 to 45 m^3/s, decreasing the frequency of river bypass (spill) from approximately 23% to 10% of the time. Overall, downstream river flows will not change from historical operations. The facility will continue to operate as a run-of-the-river site.

TABLE 1.1: EXISTING AND PROPOSED PLANTS OPERATIONAL SUMMARY

	Wawaitin GS		Sandy Falls GS		Lower Sturgeon GS	
Parameter	**Existing**	**Proposed**	**Existing**	**Proposed**	**Existing**	**Proposed**
Number of Units	4	2	3	1	2	2
Capacity (MW)	10.4	15	3.0	5.5	5.3	14
Annual Energy Production (GWh)	54.4	67.9	16.9	28.4	37.0	57.0
Gross Head (m)	37.8	37.8	9.6	9.6	12.9	12.9
Rated Flow (m^3/s)	40	45	44	65.4	56	123
Capacity Factor (%)[1]	59.7	57.0	85.0	66.0	79.0	66.0

[1] Ratio of the actual energy produced to the maximum energy which could be delivered under continuous operation at maximum rating.

1.1.2 Sandy Falls Generating Station

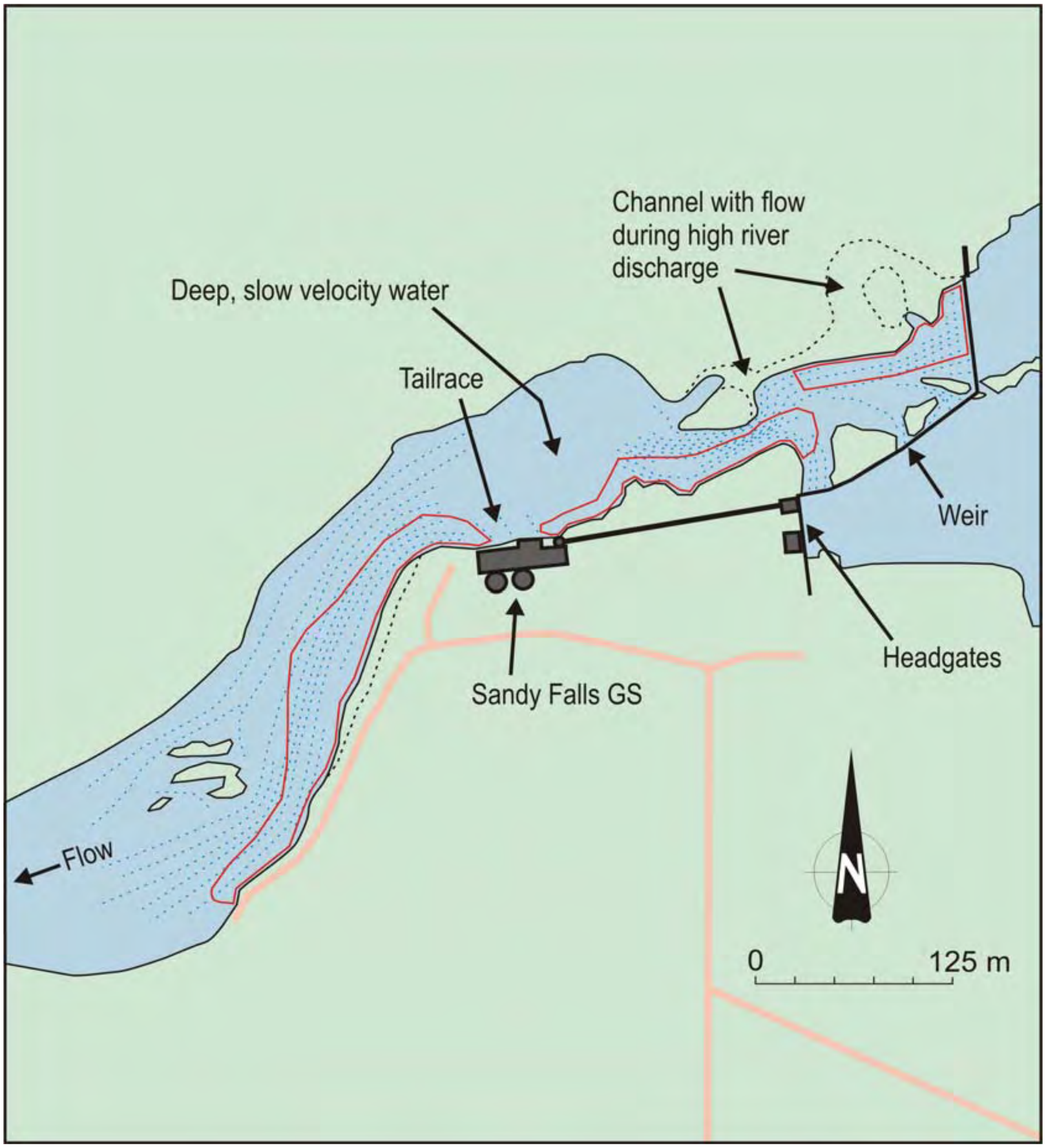
Current Facilities

The 3-MW Sandy Falls GS is located within the Timmins municipal boundaries approximately 10 km northwest of the urban centre (see Figure 1.1). The plant, placed in service in 1911, is well accessed by municipal roads. Photograph 1.4 depicts Sandy Falls GS.

Photograph 1.4: Sandy Falls GS

The Sandy Falls GS receives water upstream of a 216-m long spillway weir dam across the Mattagami River (see Figure 1.6). The dam consists of an overflow spillway in two sections, two extremely small log chutes and a concrete intake structure (Gestion Conseil S.C.P. inc., 2003). Water is conveyed to the powerhouse via three 150-m long steel penstocks (one 3.5-m diameter above ground and two 2.4-m diameter below ground) and three surge tanks. The powerhouse is a wooden frame structure with galvanized sheeting atop of a concrete foundation.

Figure 1.6: Current Facilities, Sandy Falls GS



Excess water is spilled over the weir dam and through a set of rapids when flows exceed the 44 m^3/s capacity of the existing generating station. This occurs approximately 48% of the time. The water diverted through the Sandy Falls GS is returned to the river at a point between the upstream steep, mostly bedrock rapids below the weir dam, and the downstream gentler-sloped cobble, gravel and sand rapids.

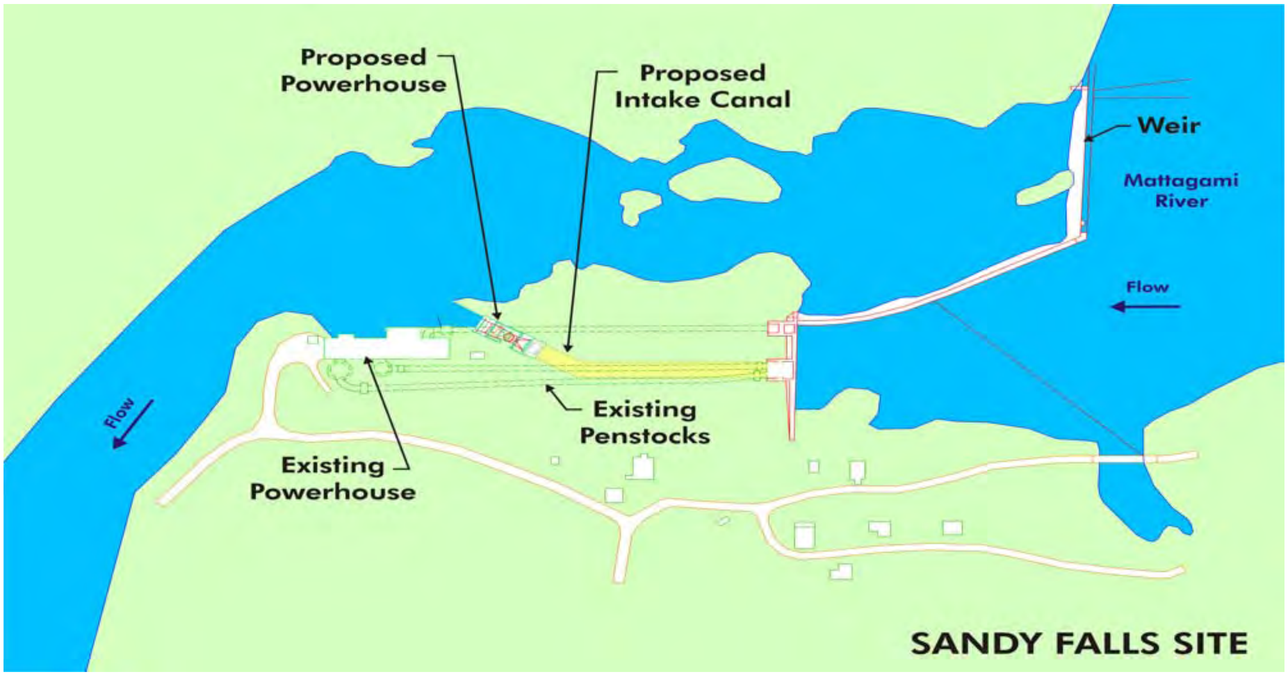
The discharge capacity of the weir dam is provided by two free overflow spillway sections: the central spillway and the spillway wall of the intake canal. The total discharge capacity is 596.2 m^3/s which is above the inflow design flood value of 557 m^3/s.

As a run-of-the-river plant, the Sandy Falls GS utilizes available water only. Water levels in the headpond are not controlled by plant operation, but are the result of natural water level fluctuations and/or upstream controls and activities. Water levels are maintained to provide sufficient water for Timmins by drawing down the upstream storages when inflows drop in late summer.

Proposed Facilities

Initially, the new powerhouse was to be located to the west of the old powerhouse (Gestion Conseil S.C.P. inc., 2003). However, based on a walleye spawning survey undertaken by Coker and Portt (2005a), it was determined that the originally proposed powerhouse discharge location would impinge on important walleye spawning habitat. As a result, an alternative site was selected (Gestion Conseil S.C.P. inc., 2006) that would not impact the walleye spawning habitat. The proposed Sandy Falls GS is located adjacent to the east of the existing powerhouse (Figure 1.7) and the new powerhouse will enclose one generating unit with a nameplate capacity of 5.5 MW. A water canal will connect the new powerhouse to the existing intake structure.

Figure 1.7: Proposed Facilities, Sandy Falls GS



Refurbishment of the intake structures and weir dam will be facilitated by the construction of a temporary cofferdam extending from the intake to the old log sluice on the left side of the central spillway (Gestion Conseil S.C.P. inc., 2003). Once the cofferdam is constructed, the area enclosed by the cofferdam will be pumped dry to facilitate refurbishment of the intake structure. Refurbishment will primarily involve the application of a new concrete cover on all exposed surfaces (including the downstream dam face) which have undergone significant deterioration. The dam will also require grout injections to the dam concrete/bedrock joints, construction joints and any other leakage locations. Once refurbishment is completed, the temporary cofferdam will be removed. This cofferdam will be in place for approximately 6 months and will dewater an area of approximately 870 m^2 (0.09 ha). The location of the cofferdam is indicated on Photograph 1.5.

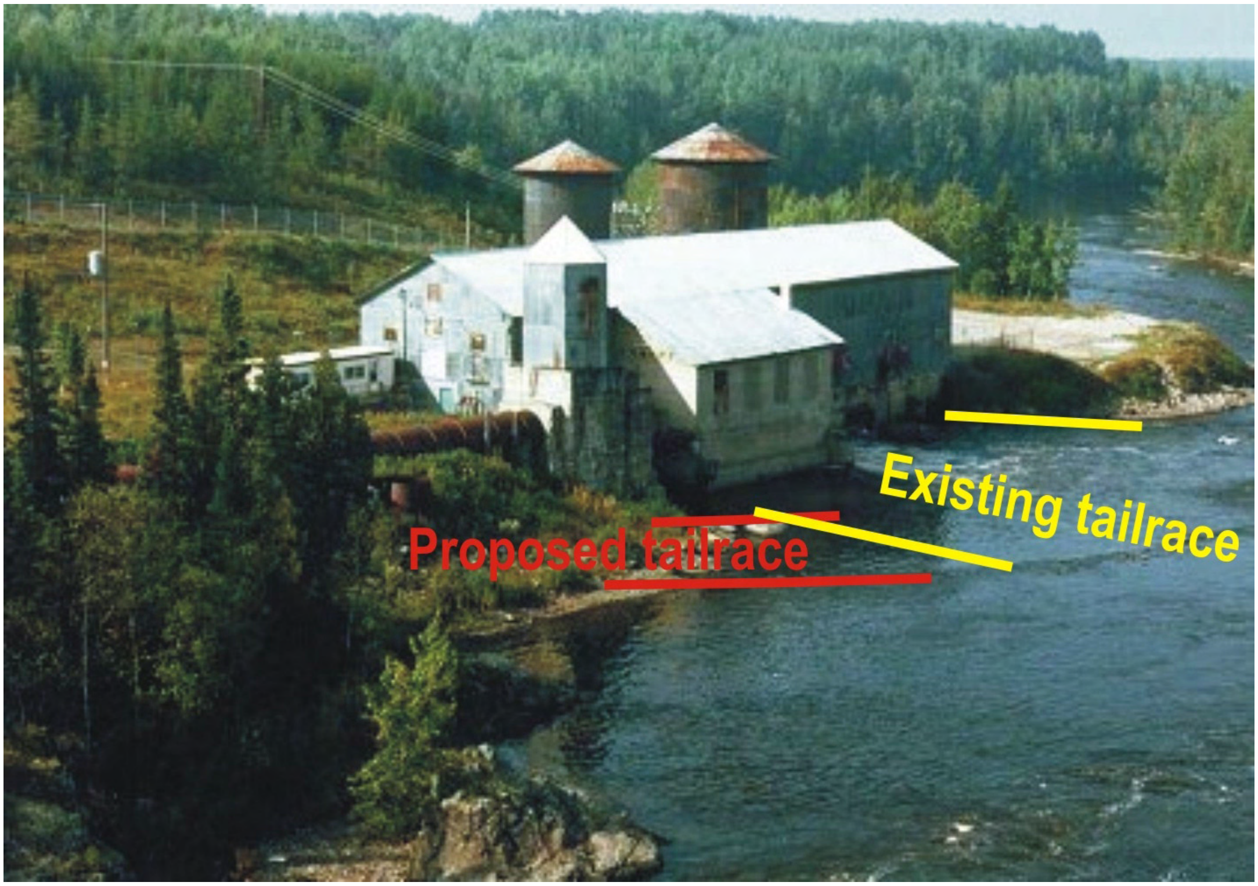
Photograph 1.5: Proposed Cofferdam Location, Sandy Falls GS Intake and Weir Dam

Excavation and slope stabilization will be required for the new powerhouse foundation and underground tailrace canal. The tailrace canal will discharge towards the existing tailrace in the river. The tailrace canal will be about 7 m wide and 4 to 6 m high. Bedrock blasting to facilitate tailrace canal construction will likely be required. During tailrace canal construction, a plug will be maintained at the outlet location to prevent water ingress. At the outlet location, water depths are 0.5 to 1 m with cobble, gravel and sand overlying bedrock (Coker and Portt, 2006b). As a result, blasting and excavation will be required in the nearshore to a depth of 4 to 6 m to accommodate water discharge from the new powerhouse to the existing tailrace. It is anticipated that the excavated area will extend approximately 20 m offshore widening from 7 to 14 m. Photograph 1.6 shows the existing tailrace and the approximate location of the proposed tailrace. A temporary cofferdam will be installed around the area to be excavated with the water pumped out to facilitate excavation. This cofferdam will be in place for approximately 12 to 14 months and will dewater an area of approximately 500 m^2 (0.05 ha). Once excavation is completed and the tailrace canal outlet plug demolished, the temporary cofferdam will be removed.

Geotechnical studies at the new powerhouse and tailrace locations have been undertaken. These studies indicate an overburden depth of about 3 to 4.5 m (Hatch Acres, 2006b). Sampling of the rock has indicated that it is not acid generating (Martin, 2006).

A new electrical substation, composed mainly of new switchgear and new dry type power transformer, will be built inside the new powerhouse. The proposed facilities will be connected to the Hydro One Timmins TS at 27.6 kV to feed into the Timmins local distribution system.

Photograph 1.6: Sandy Falls GS Existing Tailrace and Approximate Location of Proposed Tailrace



Upon completion of the new generating station, the existing powerhouse with its three generating units will be decommissioned. The existing surge tanks and aboveground penstock will be removed and backfilled. The buried penstocks will either be excavated or filled in. The obsolete electrical switching equipment and transformers will also be removed.

A summary of the existing and proposed plant operating characteristics is provided in Table 1.1. The gross head will remain the same. However, the rated flow through the generating station will increase from 44 to 65.4 m^3/s, decreasing the frequency of river overflow from approximately 48% to 30% of the time. However, discharge from the proposed plant will occur at the steep, mostly bedrock rapids below the dam upstream of the current discharge location. As the proposed plant will continue to operate as a run-of the-river facility, the river flow and level will continue to be managed as per the Water Management Plan (OPG *et al.*, 2006).

1.1.3 Lower Sturgeon Generating Station

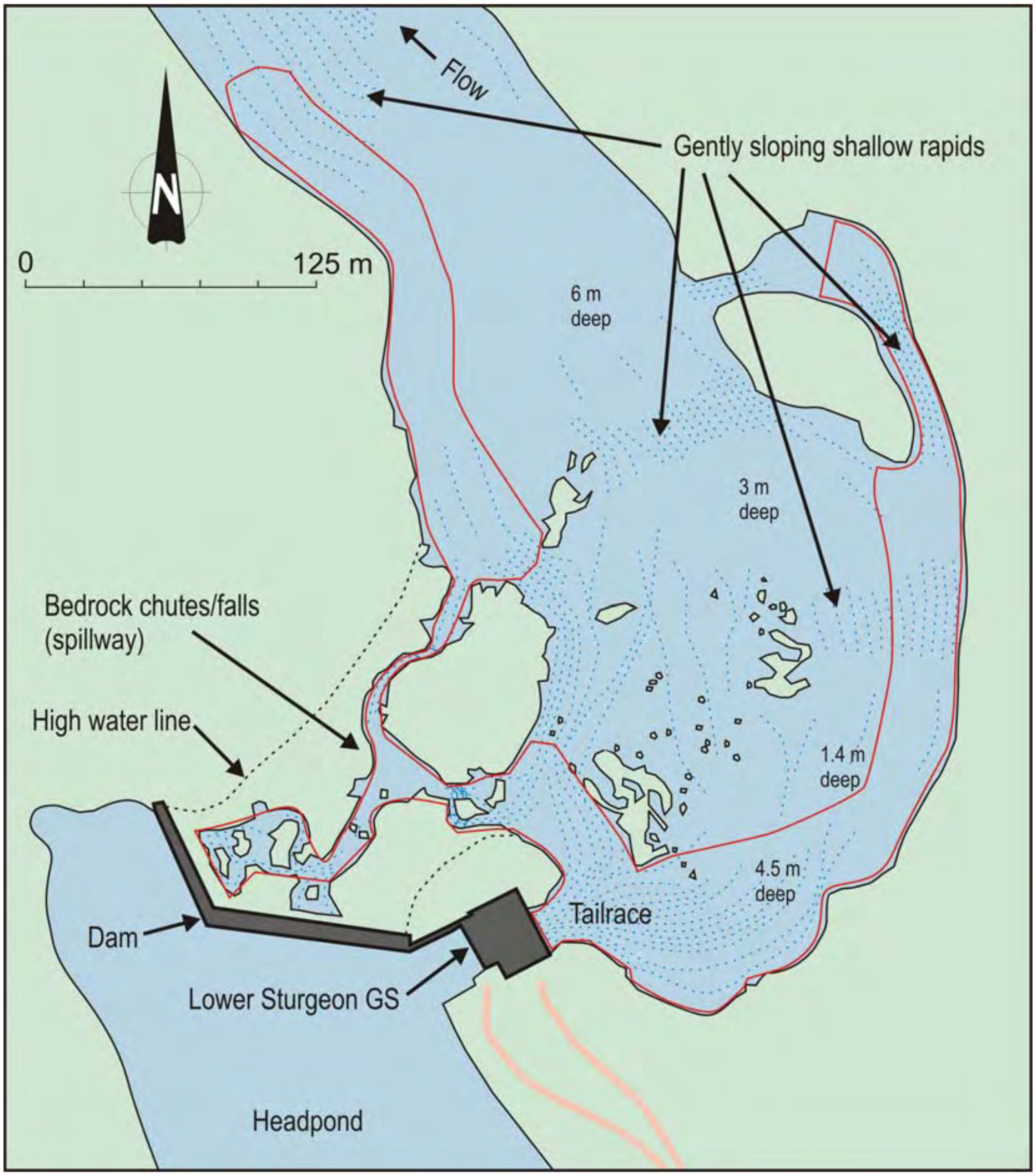
<u>Current Facilities</u>

The 5.3-MW Lower Sturgeon GS is located in the unorganized Township of Mahaffy, District of Cochrane, approximately 48 km north of Timmins (see Figure 1.1). The plant, placed in service in 1923, is accessed by a road west of Highway No. 655. Photograph 1.7 depicts the Lower Sturgeon GS.

Photograph 1.7: Lower Sturgeon GS

The Lower Surgeon GS has a dam, 165 m in length, constructed in three differently angled sections, extending across rock outcrops along almost the entire width of the river (Figure 1.8). The dam incorporates a series of 16 sluiceways with one equipped with a heated control gate and the other 15 with wooden stoplogs (AMSL, 2003).

Figure 1.8: Current Facilities, Lower Sturgeon GS



Water flows from the upstream headpond into the powerhouse through concrete intakes and discharges back to the river from the downstream side of the powerhouse. The powerhouse is of tile construction, steel frame, concrete roof and steel sash.

The Lower Sturgeon GS bypasses a series of bedrock chutes/falls, approximately 120 m wide and ranging from approximately 75 to 100 m in length. Water is spilled through the dam when river flows exceed the 56 m^3/s capacity of the plant, which occurs about 65% of the time. A series of gently sloping rapids with deeper low-velocity sections in between occurs downstream of the bedrock chutes/falls.

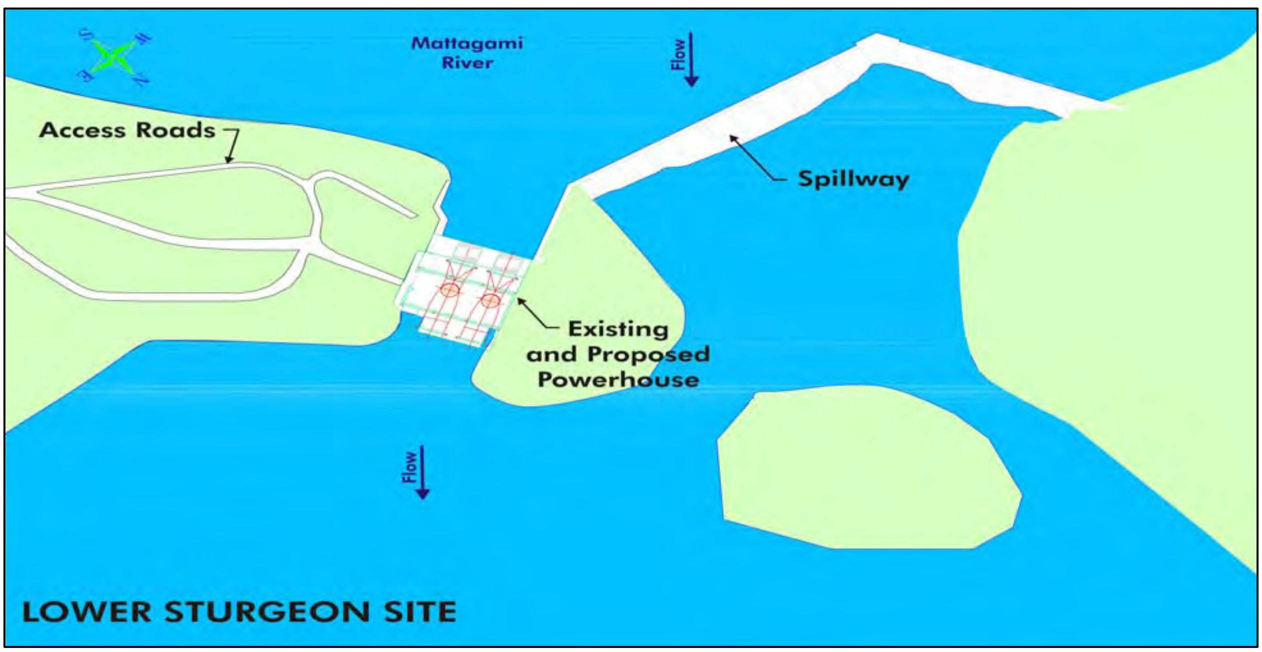
The discharge capacity of the sluiceway consisting of 15 log sluices and one power gate is 1,438 m^3/s which is above the inflow design flood value of 1,070 m^3/s.

As a run-of-the-river plant, there is no drawdown of the headpond. Any upstream water level fluctuations are the result of either natural water levels and/or upstream controls or activities. In most years, sufficient water exists to operate the plant at full-load on a continuous basis. During very dry summers, OPG attempts to pass at least 15 m^3/s of water at all times for dilution of effluent discharge at the pulp and paper mill at Smooth Rock Falls. In late winter, the forebay is drawn down to provide water to Little Long GS downstream.

Proposed Facilities

The proposed Lower Sturgeon GS is planned to be located on the same footprint as the existing powerhouse (Figure 1.9). The proposed new powerhouse will enclose two generating units with a station capacity of 14 MW.

Figure 1.9: Proposed Facilities, Lower Sturgeon GS



Some excavation of the power intake channel, which will involve blasting and rock fragment removal, will be undertaken behind a cofferdam at the headpond inlet location. Excavation and slope stabilization will be required for the powerhouse foundation and underground tailrace. Blasting and excavation will be required in the nearshore to a depth of 4 to 6 m, extending approximately 20 m offshore and widening from 7 to 14 m to create the new tailrace. Temporary cofferdams on both the upstream and downstream sides will need to be constructed around the areas to be excavated with the water pumped out to facilitate excavation. Both cofferdams are likely to be in place for 12 to 14 months with the upstream and downstream cofferdam dewatering areas of approximately 520 m^2 (0.05 ha) and 1,080 m^2 (0.11 ha), respectively. Once the construction of the new powerhouse is completed the temporary cofferdams will be removed. The approximate location of the temporary cofferdam on the downstream side of the powerhouse is indicated on Photograph 1.8.

Photograph 1.8: Proposed Cofferdam Location, Lower Sturgeon GS Tailrace

Geotechnical studies at the new powerhouse and tailrace locations have been undertaken. Overburden depth ranges from 0 to 7 m (Hatch Acres, 2006c). Sampling of the rock has indicated that it is not be acid generating (Martin, 2006).

Dam refurbishment will also be required (AMSL, 2003). With the headpond water level lowered to the minimum possible (within the operating range as stated in the WMP) and water discharged through the sluiceways, each sluiceway will be repaired. After surface preparation new concrete will be placed over any deteriorated areas. In addition the concrete around the log gains and sills for sluiceway stoplogs will be refurbished.

The proposed facilities, including a new substation, will be connected to the Hydro One Laforest TS at 27.6 kV to feed into the Timmins local distribution system.

The existing and proposed plant operating characteristics are summarized in Table 2.1. The gross head will remain the same. However, the rated flow through the generating station will increase from 56 m^3/s to 123 m^3/s, decreasing the frequency of dam spillage from approximately 65% to 26% of the time. The site will remain as a run-of-the-river facility and will continue to operate as per the existing Water Management Plan (OPG *et al.*, 2006).

1.2 DESCRIPTION OF THE STUDY AREAS

The proposed hydroelectric power plant redevelopments are located on the upper Mattagami River, with the Wawaitin GS and Sandy Falls GS within the municipal limits of Timmins and the Lower Sturgeon GS located north of Timmins. The site locations are shown on Figure 1.1.

In the baseline description of the aquatic environment, reference will be made to regional, local and project-specific study areas. These study areas are defined as follows.

Regional Study Area

The regional setting is generally defined by the Mattagami River watershed (see Figure 1.9). The regional setting provides for the baseline description of this watershed and the associated general land and water uses affecting the aquatic environment.

Local Study Area

The local study area extends from Kenogamissi Lake upstream of the Wawaitin GS to Smooth Rock Falls downstream of the Lower Sturgeon GS (Figure 1.10). The local setting encompasses the area possibly affected by the construction and operation of the proposed undertakings, and provides for the environmental baseline description of water quality, aquatic biota and specific water uses, e.g., recreational boating, sportfishing, municipal and industrial uses, etc.

Site-Specific Study Areas

The site-specific study areas encompass the Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS properties (see Figures 1.3, 1.5 and 1.7, respectively) and provide for the environmental baseline descriptions of sediments, aquatic vegetation, benthic macroinvertebrate communities and fisheries resources.

1.3 STUDY APPROACH

The baseline setting for the aquatic environment was prepared based on literature review and personal contacts. Environmental baseline conditions have been summarized by Sears (1992) and OPG *et al.* (2006). This information was augmented and updated by data requested from the MNR, the Ontario Ministry of the Environment (MOE) and Mattagami Region Conservation Authority (MRCA). Moreover, site-specific studies have been undertaken addressing aquatic vegetation, benthic macroinvertebrates and fisheries resources. The fisheries resources study reports are provided in Appendix 1.

This technical supporting document addresses the aquatic environment to be affected by the construction and operation of the proposed hydroelectric power plant redevelopments. Other technical supporting documents address the terrestrial environment, archaeology, socio-economics, First Nation consultation and public consultation.

Figure 1.10: Mattagami River Watershed Generating Stations and Dams

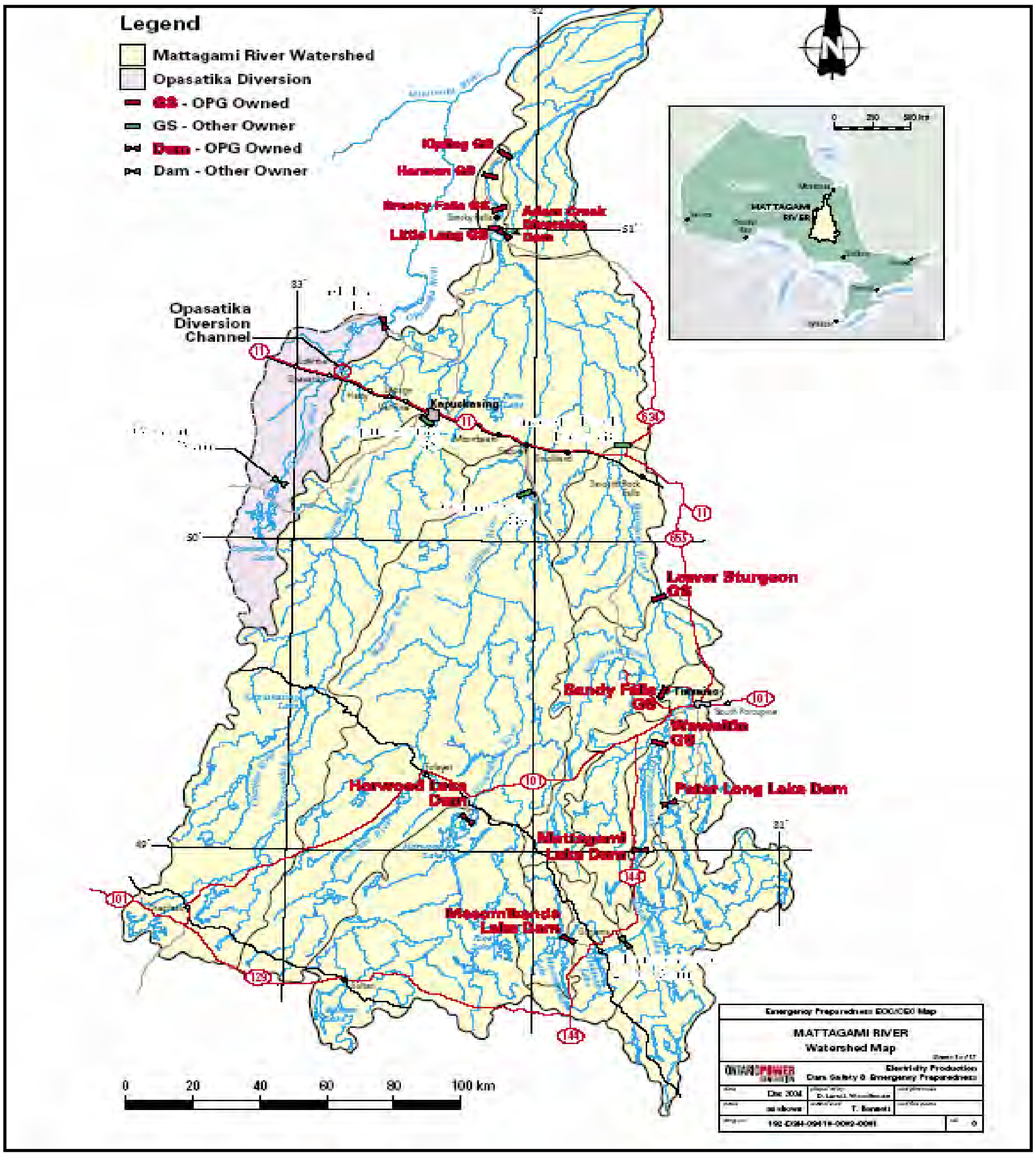
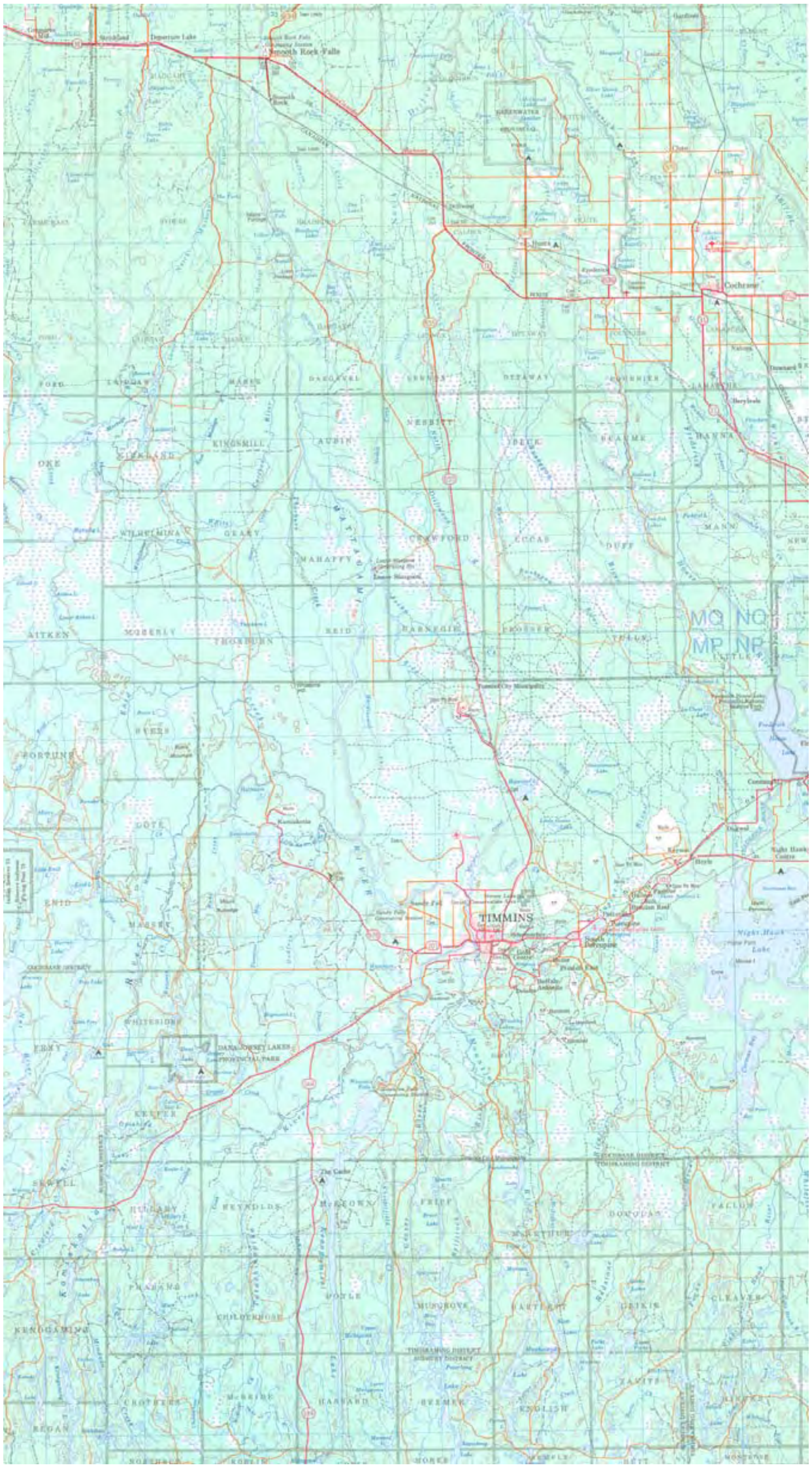


Figure 1.11: Local Study Area



1.4 STRUCTURE OF REPORT

This report was prepared by Environment & Energy Limited (EEL) as a Technical Support Document to the Environmental Report (ER) (SENES, 2006) prepared pursuant to the Class Environmental Assessment for Modifications to Hydroelectric Facilities (Ontario Hydro, 1993). The ER provides a description of the proposed undertaking, summarizes the overall baseline environmental setting and anticipated environmental effects, recommends appropriate mitigative measures to minimize or obviate these effects, and describes agency, public and First Nation consultation.

This Supporting Document is organized into four chapters:

- Chapter 1.0 **Introduction** – provides a description of the Project, a description of the study areas and the study approach;
- Chapter 2.0 **Baseline Aquatic Environment Conditions** – describes the baseline aquatic environment conditions in the study areas;
- Chapter 3.0 **Impact Assessment and Mitigative Measures** – details the assessment of aquatic environment effects, presents mitigative measures to minimize or obviate these effects and delineates the net effects; and
- Chapter 4.0 **Summary and Conclusions** – summarizes the potential effects and recommended mitigative/remedial measures.

2.0 BASELINE AQUATIC ENVIRONMENT CONDITIONS

2.1 WATER RESOURCES

2.1.1 Site Surface Hydrology

At the three hydroelectric facilities, surface water drainage is towards the Mattagami River (Monczka, 1995; Gartner Lee, 2001a,b).

On the Wawaitin GS property, a drainage ditch with flowing water originates just south of the road adjacent to the canal headworks (Monczka, 1995). This ditch flows to the south and then back to the north where it flows through concrete culverts under the pipeline and penstock to the Mattagami River. In addition, a drain with flowing water that originates from the area of the short surge tank occurs on the east side of the main road.

On the Lower Sturgeon GS property, a ditch runs parallel to the east side of the access road north of the Quonset hut (Gartner Lee, 2001b).

2.1.2 Groundwater Hydrology

Groundwater is generally shallower in the Great Clay Belt area than in the Canadian Shield area due to greater permeability and water retention capability. Groundwater yields in the overburden are generally less than 1 L/s (MNR, 1984). These well yields are suitable for domestic purposes. In areas of organic deposits, the watertable may come within 1 m of the surface.

Semec (2000) reported that at the Wawaitin GS groundwater levels are shallow, ranging from 0.24 to 3.41 m below the ground surface in the transformer yard and 0.82 to 2.38 m in the decommissioned gas pump area. Groundwater flow is due north towards the tailrace channel and the Mattagami River.

2.1.3 Mattagami River

2.1.3.1 Hydrology

The Mattagami River occurs within the Moose River drainage basin of the Hudson Bay Drainage System (Figure 2.1). The Moose River drainage basin drains approximately 109,000 km^2 traversing three physiographic regions (see Figure 2.2): the Canadian Shield, the Great Clay Belt and the Hudson Bay Lowlands (Brousseau and Goodchild, l989).

The Mattagami River extends approximately 418 km from its headwaters at Mesomikenda Lake, draining other major tributaries such as the Groundhog River, Grassy River, Kapuskasing River, Ivanhoe River, Makami River, Remi River, Opasatika River, Hull Creek and Lost River to its confluence with the Moose River (OPG *et al.*, 2006). The Mattagami River and its tributaries drain approximately 35,612 km^2.

Total drainage areas upstream of the Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS are 3,527 km^2, 6,472 km^2 and 8,414 km^2, respectively (ERDE, 1998a,b,c). The downstream distances from Wawaitin GS to Sandy Falls GS and Lower Sturgeon GS are approximately 37 km and 74 km, respectively. The downstream distance from Lower Sturgeon GS to Smooth Rock Falls GS is approximately 60 km.

Based on historical hydrological data, greatest streamflow occurs during the spring freshet in April, May and June with the lowest flows occurring generally during the summer near Timmins and winter at Smooth Rock Falls (see Table 2.1). Maximum, mean and minimum daily discharges of the upper Mattagami River near Timmins are depicted in Figure 2.3. Extreme maximum and minimum monthly flows near Timmins were 295 m^3/s in May 1979 and 17.9 m^3/s in September 1991, respectively. Extreme maximum and minimum daily flows at this same location were 539 m^3/s on 21 May 1996 and 9.69 m^3/s on 14 August 1992, respectively.

Figure 2.1: Moose River Drainage Basin

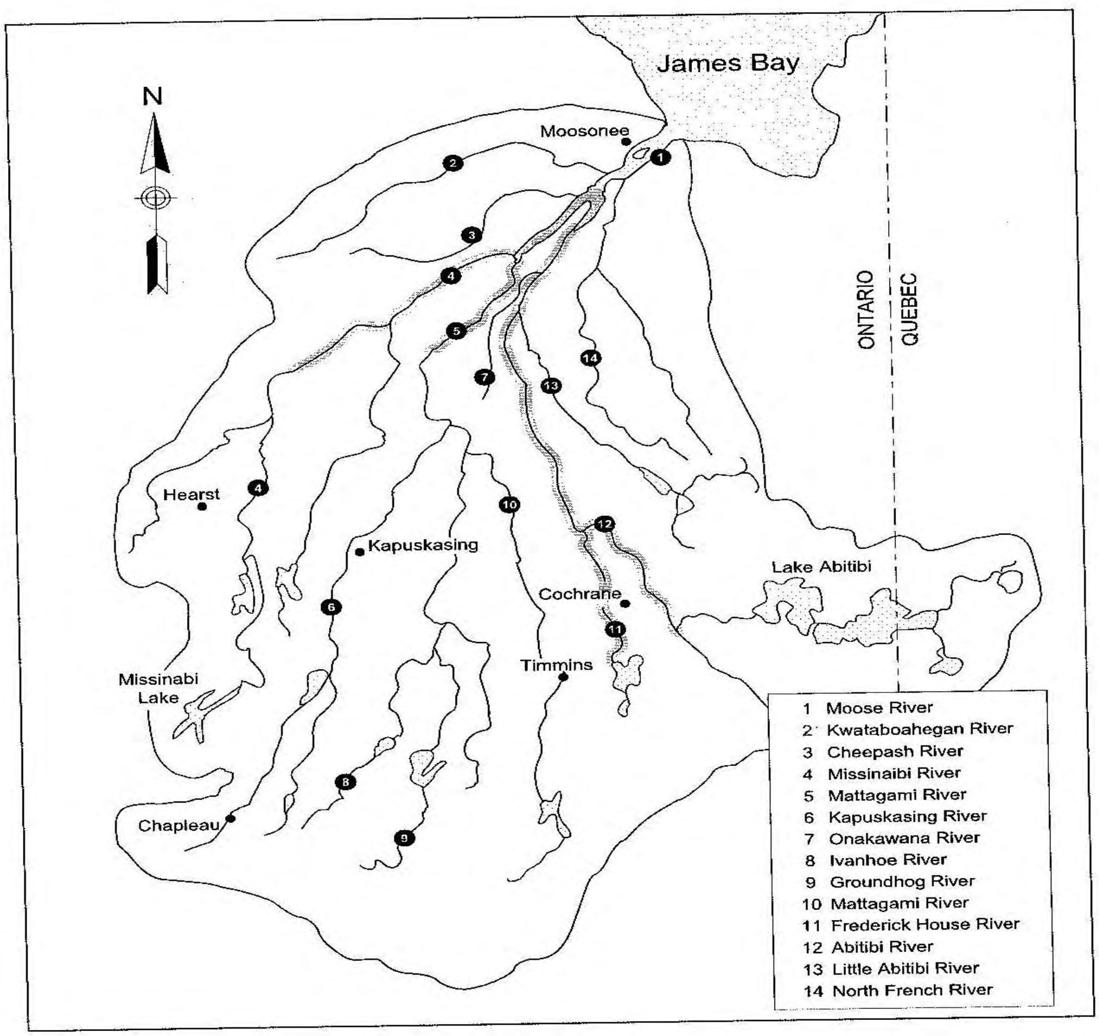


Figure 2.2: Major Physiographic Regions of the Moose River Basin

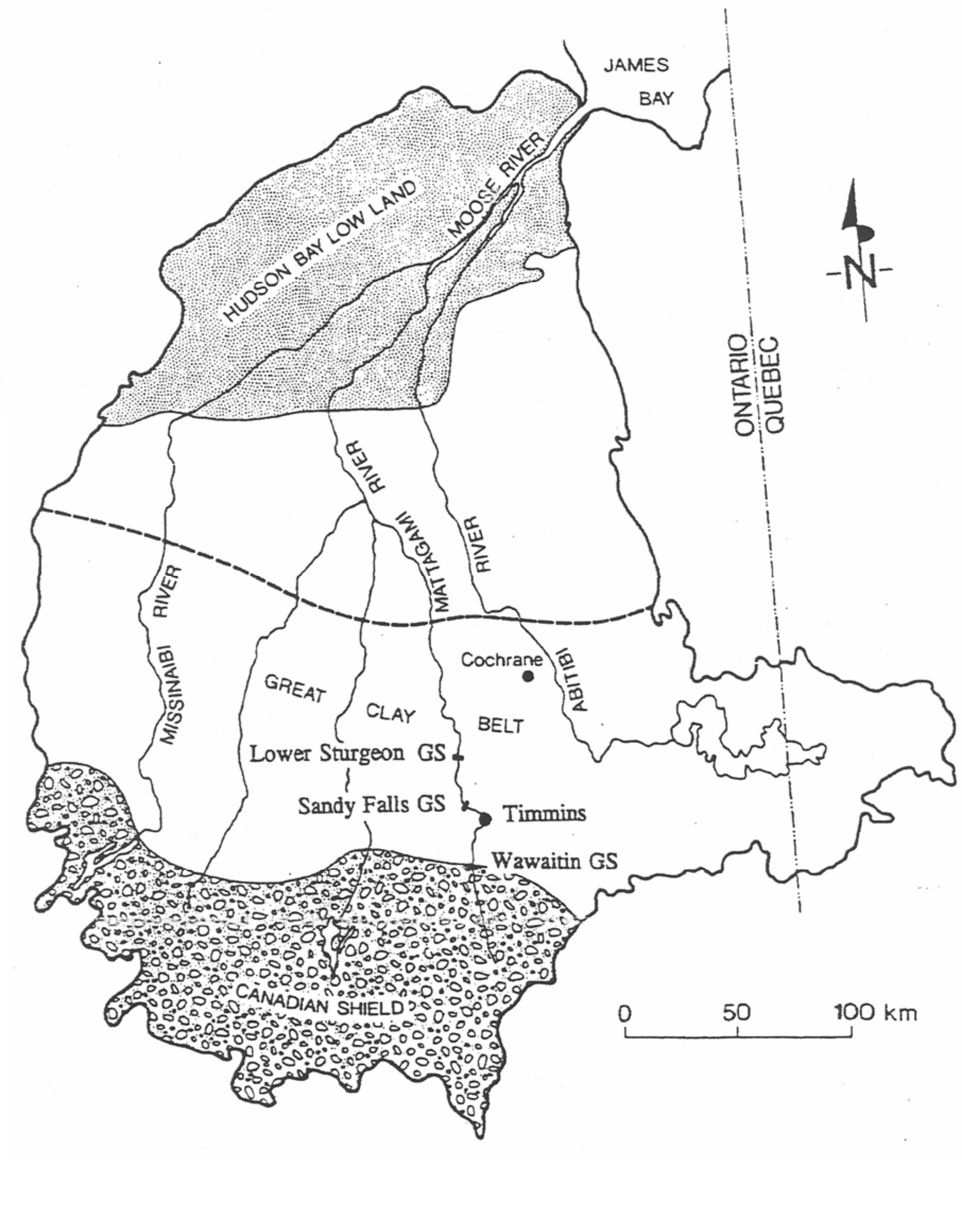


TABLE 2.1: MONTHLY AND ANNUAL MEAN DISCHARGES (m^3/s) OF THE MATTAGAMI RIVER[1]

Location	Period of Record	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Near Timmins[2]	1969 - 1997	63.5	69.7	66.2	76.9	138	90.9	49.7	36.5	35.4	42.7	50.4	55.3	64.6
At Smooth Rock Falls[3]	1920 - 1997	54.8	55.1	62.1	180	320	160	96.4	64.5	76.8	98.3	92.6	66.4	111

[1] Source: http://www.wsc.ec.gc.ca/staflo/index_e.cfm?cname=flow_monthly.cfm
[2] Location: 48°24'15"N; 81°26'54"W; drainage area of 5,540 km^2.
[3] Location: 49°16'4"N; 81°38'30"W; drainage area of 10,000 km^2.

Figure 2.3: Maximum and Minimum Daily Discharge for the Mattagami River Near Timmins (1969-1997)

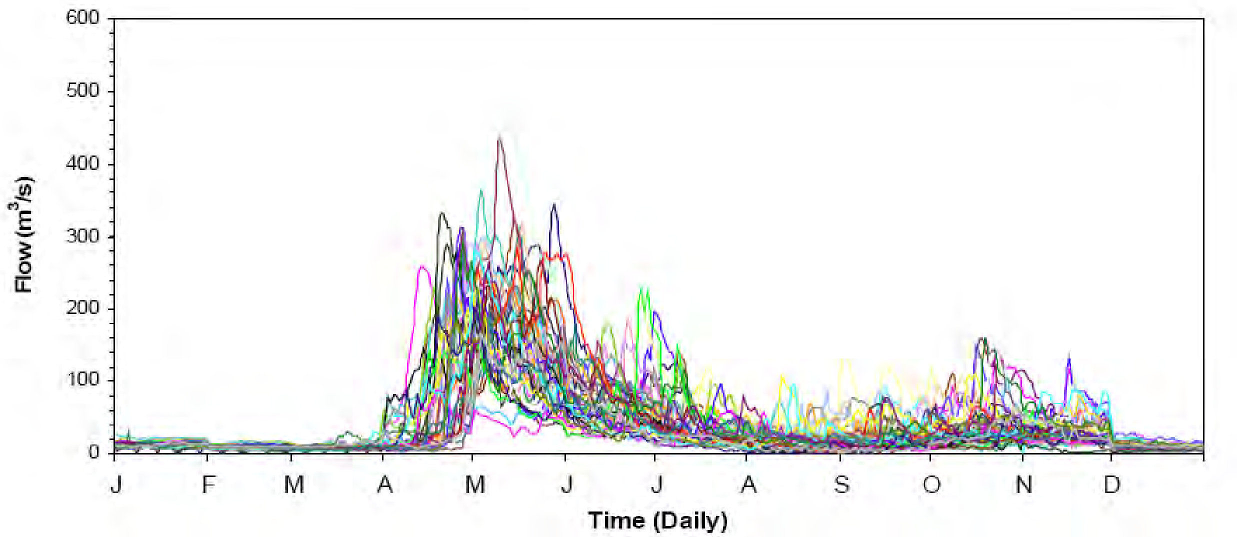
Annual daily flow hydrographs from 1972 to 1995 for the Mattagami River at Wawaitin Falls, Sandy Falls and Lower Sturgeon Falls are depicted in Figure 2.4. Annual flow metrics based on the 23 years of data for the three locations are presented in Table 2.2.

TABLE 2.2: ANNUAL FLOW METRICS FOR THE MATTAGAMI RIVER AT WAWAITIN FALLS, SANDY FALLS AND LOWER STURGEON FALLS[1]

Descriptive Metric	Value		
	Wawaitin Falls	Sandy Falls	Lower Sturgeon Falls
Drainage Area (km^2)	3,466	6,348	8,409
Mean Annual Flow (m^3/s)	39.4	76.3	100.0
20% Time Exceeded Flow (m^3/s)	55.5	106.0	140.0
Median Flow (m^3/s)	18.5	38.4	50.1
80% Time Exceeded Flow (m^3/s)	9.6	19.0	24.7
Month of Maximum Median Flow	May	May	May
Month of Minimum Median Flow	March	March	March

[1] Source: OPG *et al.* (2006).

Figure 2.4: Annual Daily Flow Hydrographs from 1950 to 1995 for the Mattagami River at Wawaitin Falls, Sandy Falls and Lower Sturgeon Falls



As indicated in Section 1.0, tributaries entering the upper Mattagami River between the furthest upstream Wawaitin GS and the furthest downstream Lower Sturgeon GS account for the much greater average flows at the downstream plants (see Figure 1.2). The flatter curve for the Wawaitin GS as shown on Figure 1.2 reflects the greater ability and need to control spring runoff upstream of Timmins by using the control dams at Mattagami Lake and at Kenogamissi Lake.

Operation of the Wawaitin GS is controlled to ensure optimal energy production, regulate water levels in Kenogamissi Lake and prevent downstream flooding, as well as ensure an adequate municipal supply of water to Timmins and industrial supply to the pulp and paper mill in Smooth Rock Falls (Sears, 1992). While meeting these needs, extreme changes in flow volume can occur in the spillway. When flows are less than 40 m^3/s and the station is capable of taking all of the river flow, zero flow will occur through the spillway. As indicated in Section 1.1.1, additional flow is directed through the spillway about 23% of the time. The greatest flows occur in May, when the mean average daily spillway flow is approximately 30 m^3/s based on 1950 to 1992 data (Sears, 1992). The absolute maximum spillway flow during this period of record was approximately 370 m^3/s.

As indicated in Sections 1.1.2 and 1.1.3, the Sandy Falls GS and Lower Sturgeon GS are run-of-the-river plants only utilizing available water with excess water spilled over the dams approximately 60% and 65% of the time, respectively. Any upstream water level fluctuations are the result of either natural water levels and/or upstream controls or activities.

Flows in this section of the Mattagami River are influenced by the operation of water control structures at the three generating stations and the Mattagami Lake Dam at Mattagami Lake, and to a lesser extent by the headwater Mesomikenda Lake Dam (see Figure 1.9). The headwater and mainstream storage reservoirs on the upper Mattagami River are drawn down 2 to 4 m during the late fall and winter in order to maintain downstream flows, and periodically in the spring for flood control.

Although controls occur both upstream and downstream and provided that the downstream Sandy Falls GS could allow full discharge of peak river flows, the water levels upstream at Timmins would not be lowered appreciably (Dillon, 1987).

More recently, Dillon (2000) confirmed that the most significant runoff events (resulting in various degrees of flooding) generally occur in late spring, when snowmelt combines with rainfall to produce peak flow rates. In addition to high rainfall/snowmelt, the spring discharges are increased by frozen and/or saturated ground, which greatly reduces the infiltration rate and increases surface runoff. Significant peak flows occurred in 1928, 1939, 1945, 1947, 1960, 1979, 1983 and 1996. The extreme flooding event in the spring of 1960 in Timmins resulted in 200 homes flooded, 2,000 residents evacuated and total damage of $1.5 million. The destruction and disruption caused by this event resulted in the creation of the Mattagami River Valley Conservation Authority in 1961, which became the MRCA in 1974. For the most recent severe flood event in 1996, the actions of the MRCA since 1961, including the removal of buildings from the floodplain and implementation of fill and construction regulations for floodplain land, resulted in reducing overall flood damage. Moreover, although the existing dams/reservoirs were not specifically built for flood control, they nevertheless do have a positive influence on the degree and frequency of flooding in Timmins.

River freeze-up generally occurs at the end of November, whereas ice break-up usually occurs in April (MNR, 1984). The freeze-up and break-up dates are approximate and will vary according to ambient temperature, channel width and orientation, and water flow.

2.1.3.2 Morphology and Bathymetry

The Mattagami River traverses three physiographic regions: the Canadian Shield, the Great Clay Belt and the Hudson Bay Lowlands (Brousseau and Goodchild, 1989).

On the Canadian Shield, the upper Mattagami River has irregular gradients and is typically less than 100 m wide extending further within in-stream lakes such as Lake Mattagami and Lake Kenogamissi (Seyler, 1997). The river channel is tightly contained with bedrock outcrops common and manifested as extensive riffle and rapid areas. Inflowing tributaries are generally small.

Within the Great Clay Belt, gradients are more regular with bedrock outcrops tending to occur along significant faults. River channels are contained within well-defined, narrow flood plains. Long meandering runs occur between rapids and falls. Channel widths generally vary between 100 and 200 m.

An escarpment marks the beginning of the Hudson Bay Lowlands. This bedrock fault is manifested as the Lower Mattagami GS complex (Smoky Falls). North of this point, the Mattagami River tends to consist of long, straight reaches punctuated by numerous riffle areas and by sand and gravel shoals. Gradients are typically 0.5 to 1 m/km. Channel is shallow, with a width of about 200 m.

The riverbank downstream of the three generating stations shows little or no evidence of erosion and is gently sloped with a dense vegetation cover. Table 2.3 summarizes the composition of the shoreline surveyed upstream and downstream of the three generating station locations. At the Sandy Falls GS and Lower Sturgeon GS, the shorelines consist predominantly of clay/silt (73.1%) and mixed soils/till (90.3%), respectively. No other material comprises more than 5% of the shoreline at the two locations. At the Wawaitin GS, shoreline composition is more variable consisting of sand/fine soils (50.0%), boulders/mixed soils (16.5%), rock outcrop/bedrock (7.4%), organics/fine soils (7.0%) and rip rap/landfill (5.1%). The predominant shoreline vegetation types at the Wawaitin GS are trees (37.5%), trees/offshore vegetation (28.2%) and wetland (15.4%), with bedrock occurring along 7.4% of the shoreline (see Table 2.4). At the Sandy Falls GS, trees and trees/offshore vegetation together are present along 76.6% of the shoreline. Trees occur along 84.7% of the shoreline at the Lower Sturgeon GS.

Based on a survey of the estimated 26.455 km of headpond/tailrace shoreline at the Wawaitin GS, ERDE (1998a) reported that only 45 m (or 0.2%) had "severe erosion" conditions (see Table 2.5). This short shoreline segment occurs on Crown land. Of the estimated 22.235 km of Sandy Falls GS forebay/tailrace shoreline surveyed by ERDE (1998b), "severe erosion" conditions were noted along 510 m (or 2.3%) on Crown and private lands. For Lower Sturgeon GS, "severe erosion" conditions were noted along about 30 m and 20 m of Crown and OPG lands (or about 0.2% total), respectively, of the estimated 26.850 km of riverbank surveyed (ERDE, 1998c).

There have been no public complaints relating to OPG operations affecting shoreline conditions, water levels and flooding (ERDE, 1998a,b,c).

TABLE 2.3: SHORELINE COMPOSITION, WAWAITIN GS HEADPOND/TAILRACE, SANDY FALLS GS FOREBAY/TAILRACE AND LOWER STURGEON GS FOREBAY/TAILRACE[1]

Shoreline Material Type	Wawaitin GS		Sandy Falls GS		Lower Sturgeon GS	
	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore
Rock Outcrop/Bedrock	1.965	7.4	0.905	4.1	0.395	1.5
Soil Veneer/Bedrock	0.050	0.2	0.260	1.2	0.0	0.0
Soil Veneer/Cobbles	0.0	0.0	0.0	0.0	0.050	0.2
Concrete/Steel/Timber	1.085	4.1	0.350	1.6	0.225	0.8
Sand	1.070	4.1	0.695	3.1	0.0	0.0
Sand/Fine Soils	13.210	50.0	0.0	0.0	0.0	0.0
Sand/Mixed Soils	0.510	1.9	0.0	0.0	0.0	0.0
Mixed Soils/Till	0.0	0.0	0.765	3.4	24.240	90.3
Mixed Soils/Cobbles	0.0	0.0	0.0	0.0	1.085	4.0
Mixed Soils/Gravel	0.0	0.0	0.0	0.0	0.050	0.2
Mixed Soils/Bedrock	0.0	0.0	0.085	0.4	0.130	0.5
Landfill	0.0	0.0	0.015	0.1	0.0	0.0
Rip Rap/Cobbles/Boulders	0.275	1.0	0.105	0.5	0.0	0.0
Rip Rap/Landfill	1.325	5.1	0.0	0.0	0.0	0.0
Boulders/Fine Soils	0.0	0.0	0.260	1.2	0.0	0.0
Boulders/Landfill	0.0	0.0	0.160	0.7	0.0	0.0
Boulders/Mixed Soils	4.350	16.5	0.670	3.0	0.0	0.0
Boulders/Bedrock	0.060	0.2	0.090	0.4	0.0	0.0
Cobbles/Mixed Soils	0.0	0.0	0.0	0.0	0.170	0.6
Gravel/Cobbles	0.100	0.4	0.0	0.0	0.0	0.0
Gravel/Fine Soils	0.100	0.4	0.020	0.1	0.0	0.0
Gravel/Mixed Soils	0.0	0.0	0.545	2.4	0.205	0.8
Clay/Silt	0.0	0.0	16.250	73.1	0.0	0.0
Fine Soils/Mixed Soils	0.0	0.0	0.085	0.4	0.0	0.0
Fine Soils/Bedrock	0.0	0.0	0.210	0.9	0.0	0.0
Fine Soils/Sand	0.0	0.0	0.765	3.4	0.0	0.0
Organics/Fine Soils	1.860	7.0	0.0	0.0	0.0	0.0
TOTAL	26.455	100.00	22.235	100.0	26.850	100.0

[1] Source: ERDE (1998a,b,c)

TABLE 2.4: SHORELINE VEGETATION TYPE, WAWAITIN GS HEADPOND/TAILRACE, SANDY FALLS GS FOREBAY/TAILRACE AND LOWER STURGEON GS FOREBAY/TAILRACE[1]

Shoreline Vegetation Type	Wawaitin GS		Sandy Falls GS		Lower Sturgeon GS	
	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore
Trees (moderate/dense)	9.920	37.5	14.465	65.1	22.740	84.7
Trees/Bush	0.430	1.6	0.250	1.1	0.620	2.3
Trees/Offshore Vegetation	7.455	28.2	2.555	11.5	0.110	0.4
Trees/Wetland	0.0	0.0	0.030	0.1	0.0	0.0
Trees/Grass/Pasture	0.600	2.3	0.470	2.1	0.185	0.7
Grass/Pasture/Farmland	0.535	2.0	0.505	2.3	0.460	1.7
Grass/Offshore Vegetation	0.050	0.2	0.0	0.0	0.0	0.0
Bush/Shrub Growth	0.730	2.7	0.995	4.5	0.895	3.3
Bush/Grass	0.225	0.9	0.455	2.0	0.950	3.6
Bush/Trees	0.0	0.0	0.350	1.6	0.195	0.7
Bush/Offshore Vegetation	0.155	0.6	0.605	2.7	0.0	0.0
No Vegetative Cover	0.325	1.2	0.410	1.8	0.300	1.1
Wetland	4.065	15.4	0.070	0.3	0.0	0.0
Offshore Vegetation	0.0	0.0	0.170	0.8	0.0	0.0
Unclassified (bedrock)	1.965	7.4	0.905	4.1	0.395	1.5
TOTAL	26.455	100.0	22.235	100.0	26.850	100.0

[1] Source: ERDE (1998a,b,c)

TABLE 2.5: SHORELINE EROSION CONDITIONS, WAWAITIN GS HEADPOND/TAILRACE, SANDY FALLS GS FOREBAY/TAILRACE AND LOWER STURGEON GS FOREBAY/TAILRACE[1]

Shoreline Erosion/Failure Condition	Wawaitin GS		Sandy Falls GS		Lower Sturgeon GS	
	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore	Shoreline Length (km)	% Shore
No Erosion (bedrock)	3.595	13.6	0.525	2.4	0.375	1.4
Very Minor (acceptable)	20.395	77.1	18.420	82.8	24.070	89.6
Very Minor/Old Scar	0.0	0.0	0.225	1.0	0.115	0.4
Moderate (active)	0.455	1.7	1.650	7.4	1.845	6.9
Severe (excessive)	0.045	0.2	0.065	0.3	0.030	0.1
Severe/Old Scar	0.0	0.0	0.080	0.4	0.0	0.0
Severe/Active Failure	0.0	0.0	0.365	1.6	0.020	0.1
Unclassified (bedrock)	1.965	7.4	0.905	4.1	0.395	1.5
TOTAL	26.455	100.0	22.235	100.0	26.850	100.0

[1] Source: ERDE (1998a,b,c)

2.2 AQUATIC ENVIRONMENT RESOURCES

2.2.1 Water Quality

Based on its good water quality, the Mattagami River is the source of the Timmins potable water supply. Tables 2.6, 2.7 and 2.8 present water quality data for the Mattagami River at the Highway No. 101 bridge in Timmins, at the Timmins Waterworks Plant intake and downstream of the Timmins Sewage Treatment Plant (STP), respectively. The mean concentrations of all applicable parameters were below the Provincial Water Quality Objectives (PWQOs) and Guidelines (PWQGs), with the following exceptions:

- aluminum exceeded the PWQO at the Highway No. 101 bridge (however, it is unlikely that the aluminum analyses were based on clay-free samples as required for comparison with the PWQO);
- total phosphorus exceeded the interim PWQO in 1975 at the Waterworks Plant intake, as well as for three of the four sampling years downstream of the Timmins STP; and
- fecal coliform and total coliform exceeded the previous PWQGs (MOE, 1984), which have been replaced by a PWQO for *Escherichia coli* (MOEE, 1994), downstream of the STP.

In-situ water quality measurements were taken during the fisheries and benthic macroinvertebrate surveys in June 2006 with the data presented below:

	Wawaitin GS	Sandy Falls GS	Lower Sturgeon GS
Water Temperature (°C)	20.3	21.5	20.2
Dissolved Oxygen (mg/L)	7.98	6.46	6.90
Oxygen Saturation (%)	89	76	77
Conductivity (µmhos/cm)	75	102	123
pH (units)	8.09	8.1	8.2

The dissolved oxygen (D.O.) concentrations and oxygen saturation levels were above the PWQOs for the protection of coldwater (i.e., 5 mg/L D.O. and 57% saturation at 20°C) and warmwater (i.e., 4 mg/L D.O. and 47% saturation at 20°C) biota. The D.O. concentrations were lower and the conductivity levels higher at Sandy Falls GS and Lower Sturgeon GS, likely reflecting nutrient and other constituent loadings from upstream Timmins resulting in increased oxygen demand and ionic concentrations. The pH values were within the PWQO range of 6.5 to 8.5 to protect aquatic life.

TABLE 2.6: MATTAGAMI RIVER WATER QUALITY AT HIGHWAY NO. 101 BRIDGE (RIVERSIDE DR.), TIMMINS

Parameter	Concentration (mg/L unless otherwise indicated)							PWQO[3]
	1987-1992[1]	1994[2]			1995[2]			
	Mean	Mean	Min.	Max.	Mean	Min.	Max.	
Dissolved Oxygen	9.39(22)[4]	10.1(7)	7.5	12.0	9.7(10)	8.0	11.5	See below[5]
Alkalinity	42.2(23)	39(10)	27	43	51(10)	30	150	-
Conductivity (umhos/cm)	110(24)	89(10)	64	100	92(9)	73	106	-
Hardness	50(2)	45(10)	35	50	50(9)	37	59	-
pH (units)	7.6(24)	7.7(10)	7.5	7.8	7.7(10)	7.5	7.8	6.5-8.5
Particulate (Non-filterable) Residue	3.0(14)	<4.2(10)	<1.0	9.0	<5.8(10)	<1.0	25	-
Turbidity	2.54(18)	-	-	-	-	-	-	-
Total Reactive Ammonia	0.02(23)	<0.02(10)	<0.01	<0.04	<0.021(10)	<0.01	0.06	-
Unfiltered Reactive Nitrite	-	-	-	-	<0.004(9)	<0.002	0.011	-
Unfiltered Reactive Nitrate	-	-	-	-	0.054(9)	<0.014	0.094	-
Filtered Total Reactive Nitrates	-	0.07(10)	<0.02	0.24	0.10(10)	<0.16	0.50	-
Total Kjeldahl Nitrogen	0.488(24)	0.39(10)	0.32	0.51	0.447(10)	0.317	0.790	-
Reactive Phosphate	-	-	-	-	<0.003(9)	<0.001	0.006	-
Total Phosphorus	0.012(24)	0.012(10)	0.006	0.023	0.016(10)	0.008	0.051	0.03[6]
Sulphate	6.37(24)	4.8(10)	4.1	6.5	4.6(8)	3.55	6.62	-
Cyanide	<0.001(21)	-	-	-	-	-	-	-
Phenols (µg/L)	0.2(8)	-	-	-	-	-	-	5
Calcium	-	-	-	-	22(9)	11	85	-
Chloride	1.5(9)	-	-	-	-	-	-	-
Magnesium	-	-	-	-	5.7(9)	2.4	26	-
Sodium	1.60(1)	-	-	-	-	-	-	-
Aluminum (µg/L)	110(4)	-	-	-	183(10)	82	460	75[6,7]
Arsenic (µg/L)	<1.0(15)	-	-	-	-	-	-	100
Cadmium (µg/L)	-	-	-	-	<0.22(10)	<0.20	<0.31	0.2
Chromium (µg/L)	-	-	-	-	<0.6(10)	<0.20	1.8	100
Cobalt (µg/L)	-	-	-	-	<0.85(10)	<0.5	4	0.6
Copper (µg/L)	2.0(19)	<1.4(10)	<0.06	<2.3	<3.3(10)	<0.95	17	5
Iron (µg/L)	200(19)	234(10)	130	430	241(10)	120	450	300
Lead (µg/L)	3(15)	<2.1(10)	<1.0	<4.0	<0.29(10)	<2.0	<10.0	10
Manganese (µg/L)	-	-	-	-	21(9)	12	32	-
Molybdenum (µg/L)	-	-	-	-	<0.6(10)	<0.2	3.4	10[8]
Nickel (µg/L)	1(1)	<1.2(10)	<1.0	<2.0	<5.6(10)	<1.0	46	25
Zinc (µg/L)	4(15)	<1.9(10)	<1.0	<3.0	<4.5(10)	<1.0	20	30

1 Source: Sears (1992).
2 Source: S. Sunderani, MOE, 2006, pers. comm.
3 PWQO = Provincial Water Quality Objective (MOEE, 1994).
4 Number in brackets is the number of samples analyzed.
5 For warmwater biota: 7 mg/L at 0°C, 6 mg/L at 5°C, 5 mg/L at 10°C and 15°C, 4 mg/L at 20°C and 25°C.
6 Interim PWQO.
7 At pH >6.5 to 9.0, the Interim PWQO is 75 mg/L based on total aluminum measured in clay-free samples.

TABLE 2.7: MATTAGAMI RIVER WATER QUALITY AT TIMMINS WATERWORKS PLANT INTAKE[1]

Parameter	Concentration (mg/L unless otherwise indicated)												PWQO[2]
	1974			1975			1976			1977			
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	
Fecal Coliform (no./100 mL)	98(11)[3]	0	700	20(11)	0	130	7(12)	0	37	<110(12)	<40	920	100/100[4]
Total Coliform (no./1,000 mL)	659(11)	5	3,000	431(11)	0	3,500	387(12)	0	4,000	<534(12)	<200	4,400	1,000/100[4]
Dissolved Oxygen	9.5(11)	5.0	13.0	10.1(12)	7.0	14.0	9.3(12)	3.0	11.0	6.9(11)	5.0	9.0	See below
Biological Oxygen Demand (5-day)	0.9(11)	0.2	2.0	1.1(12)	0.4	2.8	1.6(12)	0.2	1.0	1.1(11)	0.4	3.0	-
Acidity	4.1(11)	2.0	10.0	3.2(11)	1.0	6.0	4.1(12)	1.0	16.0	2.3(12)	1.0	4.0	-
Alkalinity	40(11)	32	56	39(11)	28	59	41(12)	25	59	62(12)	26	258	-
Conductivity (µmhos/cm)	99(11)	78	143	110(12)	82	215	127(12)	70	335	113(12)	74	250	-
Hardness	47(11)	36	80	51(11)	37	97	50(12)	35	76	52(12)	31	121	-
pH (units)	7.3(11)	6.5	7.9	7.4(11)	7.1	7.8	7.73(12)	7.40	8.10	7.61(11)	7.15	8.26	6.5-8.5
Colour (Hazen colour unit)	30(11)	0.3	60	42(11)	15	65	39(12)	30	60	50(11)	40	70	-
Filtered Residue	66(110	51	120	75(11)	52	140	100(5)	46	218	-	-	-	-
Particulate (Non-filterable) Residue	<12(11)	0	20	20(10)	1	128	5(11)	1	17	32(12)	1.2	152	-
Total Residue	77(11)	61	110	103(11)	56	300	95(10)	65	219	105(12)	1.2	152	-
Turbidity (FTU)	2.4(11)	1.1	6.3	3.1(12)	1.0	8.0	1.8(12)	0.9	3.0	7.1	1.4	53	
Total Reactive Ammonia	0.02(110	<0.01	0.09	0.04(12)	<0.01	0.21	0.020(12)	<0.002	0.092	0.026(12)	0.004	0.080	-
Filtered Reactive Nitrite	0.006(11)	0.003	0.015	0.006(12)	0.002	0.026	0.003(12)	0.001	0.006	0.003(12)	0.001	0.010	-
Filtered Reactive Nitrate	0.04(11)	<0.01	0.14	0.29(12)	<0.01	1.80	0.061(12)	<0.005	0.204	0.079(12)	<0.005	0.490	-
Total Kjeldahl Nitrogen	0.42(11)	0.32	0.64	0.47(12)	0.31	0.85	0.30(12)	0.14	0.41	0.51(12)	0.24	1.30	-
Reactive Phosphate	0.004(11)	0.001	0.010	0.009(12)	0.002	0.031	0.003(12)	0.001	0.009	0.003(12)	0.001	0.010	-
Total Phosphorus	0.027(11)	0.008	0.088	0.043(12)	0.007	0.120	0.012(12)	0.004	0.018	0.018(11)	0.010	0.034	0.03[6]
Calcium	-	-	-	-	-	-	14(7)	11	20	17.4(5)	9.2	36.0	-
Chloride	1.2(11)	1.0	2.0	3.8(12)	1.0	24.0	1.9(12)	0.6	10.0	1.4(12)	1.0	3.8	-
Iron	0.64(11)	0.2	2.0	0.83(11)	0.15	5.7	0.21(12)	0.05	0.36	0.93(12)	0.12	7.22	0.3
Magnesium	-	-	-	-	-	-	3.2(7)	2.5	4.5	3.7(5)	2.0	7.5	-

1 Source: S. Sunderani, MOE, 2006, pers. comm.
2 PWQO = Provincial Water Quality Objective (MOEE, 1994).
3 Number in brackets is the number of samples analyzed.
4 Previous Provincial Water Quality Guideline (MOE, 1984).
5 For warmwater biota: 7 mg/L at 0°C, 6 mg/L at 5°C, 5 mg/L at 10°C and 15°C, 4 mg/L at 20°C and 25°C.
6 Interim PWQO.

TABLE 2.8: MATTAGAMI RIVER WATER QUALITY, DOWNSTREAM OF TIMMINS STP[1]

Parameter	Concentration (mg/L unless otherwise indicated)												PWQO[2]
	1978			1979			1980			1981			
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	
Fecal Coliform (no./100 mL)	1,385(11)[3]	<40	12,000	-	-	-	-	-	-	-	-	-	100/100[4]
Total Coliform (no./1,000 mL)	8,689(11)	200	80,000	-	-	-	-	-	-	-	-	-	1,000/100[4]
Dissolved Oxygen	5.9(12)	3.0	11.0	7.2(10)	5.0	11.0	8.8(16)	4.0	14.1	9.8(16)	7.1	15.0	See below[5]
Biological Oxygen Demand (5-day)	1.0(10)	0.4	1.5	0.5(3)	0.2	1.0	0.6(14)	0.2	1.0	-	-	-	
Alkalinity	-	-	-	-	-	-	-	-	-	41(14)	35	50	-
Conductivity(umhos/cm)	106(11)	91	120	99(11)	78	124	106(16)	90	157	103(15)	86	118	-
pH (units)	-	-	-	-	-	-	7.58(14)	7.25	7.80	-	-	-	6.5-8.5
Filtered Residue	67(9)	59	78	65(11)	51	81	69(16)	59	102	-	-	-	-
Particulate (Non-filterable) Residue	5(11)	1	15	18(11)	2	104	3.5(16)	2	5	-	-	-	-
Total Residue	73(11)	63	85	83(11)	54	163	72(16)	62	106	-	-	-	-
Turbidity (FTU)	2.4(10)	1.5	3.5	3.9(11)	1.2	14	2.2(16)	1.3	3.2	1.5(16)	0.50	3.0	-
Total Reactive Ammonia	0.077(10)	0.008	0.138	0.086(11)	0.010	0.252	0.055(16)	0.022	0.102	0.051(15)	0.004	0.246	-
Filtered Reactive Nitrite	0.006(10)	0.002	0.023	0.005(11)	0.002	0.012	0.004(16)	0.002	0.008	0.012(15)	0.001	0.350	-
Filtered Reactive Nitrate	0.109(10)	0.415	0.015	0.146(11)	0.016	0.813	0.063(16)	0.003	0.462	0.122(15)	0.002	0.360	-
Filtered Total Reactive Nitrates	-	-	-	-	-	-	-	-	-	0.134(14)	0.040	0.365	-
Total Kjeldahl Nitrogen	0.52(10)	0.42	0.59	0.57(11)	0.24	1.64	0.40(16)	0.30	0.80	0.47(15)	0.30	0.72	-
Reactive Phosphate	0.014(10)	0.003	0.028	0.011(11)	0.002	0.022	0.010(16)	0.001	0.029	0.020(15)	0.001	0.005	-
Total Phosphorus	0.035(11)	0.026	0.053	0.041(11)	0.022	0.125	0.025(16)	0.009	0.068	0.039(15)	0.014	0.063	0.03[6]
Chloride	1.65(11)	1.20	2.70	1.96(11)	1.20	3.35	1.45(16)	0.95	5.60	1.55(16)	1.15	3.30	-
Phenols (µg/L)	-	-	-	-	-	-	-	-	-	<1.1(14)	<1.0	2.0	5[6]
Arsenic (µg/L)	-	-	-	-	-	-	<1(13)	<1	<1	-	-	-	100
Cadmium (µg/L)	-	-	-	-	-	-	<4(12)	<0.1	<5	-	-	-	0.2
Copper (µg/L)	-	-	-	-	-	-	<10(13)	<1	50	2(15)	<1	6	5
Lead (µg/L)	-	-	-	-	-	-	<22(13)	<1	<30	5(15)	<3	29	20
Nickel (µg/L)	-	-	-	-	-	-	<15(13)	<2	4	-	-	-	25
Zinc (µg/L)	-	-	-	-	-	-	<10(13)	1	<10	4(15)	<1	17	30

1 Source: S. Sunderani, MOE, 2006, pers. comm.
2 PWQO = Provincial Water Quality Objective (MOEE, 1994).
3 Number in brackets is the number of samples analyzed.
4 Previous Provincial Water Quality Guideline (MOE, 1984).
5 For warmwater biota: 7 mg/L at 0°C, 6 mg/L at 5°C, 5 mg/L at 10°C and 15°C, 4 mg/L at 20°C and 25°C.
6 Interim PWQO.

Turbidity levels are generally higher in the Great Clay Belt section compared to the upstream Canadian Shield section of the Mattagami River due to increased concentration of suspended clay particles, particularly during the spring freshet and rainfall events.

As indicated in Section 1.1, bedrock on the three proposed redevelopment sites is not acid generating (Martin, 2006). Based on modified acid base accounting analyses, all rock samples tested had a low potential for acid rock drainage (ARD). Acid potential (AP) is calculated from sulphide sulphur content. The sulphide sulphur levels ranged from <0.01 to 0.02%, 0.01 to 0.05% and 0.06 to 0.10% in bedrock samples from the Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS properties, respectively. A sulphide sulphur level of less than 0.3% is used as a draft guideline by Price (1997) as having low potential for ARD, unless the rock has elevated metal levels and/or the levels of neutralizing potential (NP) are low. The NP/AP ratio is commonly used to assess the potential for ARD. Based on this ratio, one of the Lower Sturgeon GS rock samples had low potential for ARD, whereas the remaining rock samples from the three proposed redevelopment sites had negligible potential.

Phase I Environmental Site Assessments (ESAs) were undertaken previously at each of the three generating stations (Monczka, 1995; Gartner Lee, 2001 a, b). Based on the Phase I ESA findings for Sandy Falls GS and Lower Sturgeon GS, no further investigations were required. At Wawaitin GS, after implementation of a remediation program, no further work was required. Details of the ESA findings are provided below.

Based on a Phase I Environmental Site Assessment (ESA), Monczka (1995) identified possible groundwater contamination by oil, PCBs, arsenic trioxide, gasoline, lead, creosote and/or unknown chemicals at a number of locations within the Wawaitin GS property. In addition, unknown contamination was possible from an active (opened in 1978) waste disposal site east (upgradient) of the Wawaitin GS property. As there is a high potential for off-site contaminant migration, as well as potential for contaminants to migrate towards the station property, it was recommended that a Phase II ESA be conducted.

The Phase II Site Investigations involved soil sampling in the areas of the switchyard, powerhouse, transformer yard, battery house, oil house, decommissioned gas pump, surge tanks and coal cinder piles (Semec, 1999, 2000). The findings of these studies are presented in the Terrestrial Environment Technical Support Document.

The Phase II ESA also involved the installation of a total 15 groundwater monitoring/sampling wells in the areas of the powerhouse, transformer yard, oil house and decommissioned gas pump, as well downgradient from the municipal landfill located about 500 m southeast of the Wawaitin GS (Semec, 1999, 2000). Groundwater samples collected from these wells were analyzed for total petroleum hydrocarbons (TPH) (diesel), TPH (heavy oils), metals, pentachlorophenol, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs) and/or polycyclic aromatic hydrocarbons (PAHs). In addition, samples of a groundwater spring on the Wawaitin GS property were analyzed for TPH (diesel), TPH (heavy oils), metals, pentachlorophenol, PCBs and/or PAHs, whereas surface samples of the Mattagami River were analyzed for TPH (diesel), TPH (heavy oils), metals, PCBs and/or PAHs. The groundwater chemistry results were compared against the MOEE (1997) Table A (potable groundwater) criteria for industrial/commercial sites with coarse-textured soils. However, the domestic water wells on the Wawaitin GS property have been demolished and contaminant migration to off-site water wells is unlikely as groundwater flow appears to be towards the Mattagami River. As a result, the analytical data were also compared with the MOEE (1997) Table B (non-potable groundwater) criteria. The surface water analytical data were compared with the PWQOs (MOEE, 1994).

The lead concentration (23 µg/L) in the groundwater sample collected in the powerhouse area exceeded the MOEE (1997) Table A criterion of 10 µg/L but not the Table B criterion of 32 µg/L.

Arsenic concentrations (26 to 42 µg/L) in all four groundwater samples collected from the transformer yard were above the Table A criterion of 25 µg/L but below the Table B criterion of 480 µg/L. Lead concentrations (15 and 20 µg/L) in two of three samples analyzed were above the Table A criterion but below the Table B criterion. The TPH (diesel) concentration (3,100 µg/L) in one of two samples analyzed exceeded the Table A criterion of 1,00 µg/L.

One groundwater sample collected in 1999 in the decommissioned gas pump area had concentrations of benzo(a)anthracene, chrysene and benzo(b)fluoranthene above their respective MOEE (1997) Table A criteria, whereas benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene and benzo(a)pyrene concentrations were above both their respective Table A and B criteria. However, there were no exceedances of Table A criteria for these PAHs in five groundwater samples collected in 2000.

There were no exceedances of Table A criteria by parameters analyzed in groundwater samples collected in the oil house area (one sample), downgradient from the municipal landfill (three samples) and from the spring (two samples).

Although small amounts of transformer oil, arsenic and lead may be entering the Mattagami River via the groundwater, there was no detectable effect on surface water quality. The concentrations of cadmium, iron and zinc in a few surface water samples exceeded their respective PWQOs; however, it was concluded in the Phase II ESA that these exceedances were isolated occurrences, not representative of the overall surface water chemistry, and most likely not site related.

PCB concentrations in all groundwater and surface water samples were below the laboratory method detection limit (MDL).

Subsequently, a Screening Level Risk Assessment (SLRA) was undertaken to assess whether the contaminants present on the Wawaitin GS property were likely to be associated with any adverse health or environmental risks (Ager, 2000, 2001). As indicated above, lead, arsenic, TPH (diesel) and PAH concentrations in some groundwater samples collected within the Wawaitin GS property exceeded the MOEE (1997) Table A criteria for potable groundwater. Since domestic water wells on the property have been demolished, exposure to on-site groundwater is not considered to represent a relevant exposure pathway at the present time. Moreover, migration of contaminated groundwater to off-site water wells is unlikely because the groundwater appears to be flowing towards the Mattagami River (i.e., not to water wells that may occur in the area). However, if a well were to be installed on the Wawaitin GS property at some future date, ingestion of contaminated groundwater could potentially be associated with adverse health impacts.

With the decommissioning of the station service transformers, installation of a new oil spill containment system for the main power transformers and transformer yard soil remediation, no further work was required on the Wawaitin GS property.

Based on a Phase I ESA of the Sandy Falls GS property, Gartner Lee (2001a) reported that there is potential for water discharged from the powerhouse to the Mattagami River to contain oil since there is no oil-water separator or oil-detecting system in place for the cooling water and turbine floor trench discharges. A septic tank covered under a Certificate-of-Approval (C-of-A) issued by the MOE for sanitary discharges from the lunchroom is pumped out by a contractor on an as needed basis. Based on the Phase 1 ESA findings, no further investigations were required.

The Phase I ESA for the Lower Sturgeon GS property indicated that there was a potential environmental issue with respect to localized water quality associated with discharges of sewage effluent and transformer cooling water, as well as potential discharge of oil via drains and sumps from the powerhouse to the Mattagami River (Gartner Lee, 2001b). The sewage treatment system, transformer cooling water oil-water separators/alarm systems, as well as the portable oil skimmer, drain oil control valve and sump oil detector/alarm systems, are covered under C-of-As issued by the MOE. Based on the Phase 1 ESA findings, no further investigations were required.

On the Lower Sturgeon GS property, there was also a potential for environmental issues with respect to groundwater and localized surface water quality associated with the waste disposal site located on a slope along the shores of Jocko Creek which outlets to the Mattagami River about 600 m upstream of the dam (Gartner Lee, 2001b).

As part of the testing program, water samples were collected from the penstocks at the Sandy Falls GS and Wawaitin GS sites, and tested for PAHs and semi-volatile organic compounds (SVOCs). The results of the laboratory testing indicated that all parameter concentrations in the penstock water sample from the Wawaitin GS site were below the laboratory MDLs which are considerably below the MOE (2004) Table 3 standards. For the water sample from the Sandy Falls GS site, the concentrations of 12 PAH parameters were above their MDLs with the concentrations of three parameters being at or slightly below the MOE (2004) Table 3 standards. As there was a concern that a wood particle may have been present in the first Sandy Falls GS penstock water sample, a second sample was collected for analysis. The laboratory results for this sample indicated that all parameter concentrations were below the laboratory MDLs. The water testing results indicate that water leaking from the penstocks would not be a source of contaminants to the soil and groundwater.

2.2.2 Sediments

Sediments in the Mattagami River within the Great Clay Belt can be expected to be predominantly silt and clay, particularly in the in-stream lakes and slower moving sections of the river. Sediment type immediately upstream of the three generating stations is unknown; however, it likely consists of finer sediments overlying bedrock and/or boulder bottom (Sears, 1992).

The spillway channel at Wawaitin GS has a bedrock base that is covered by boulders and cobble along more than half of its length (Coker and Portt, 2006a). Substrates of gravel, cobble or finer materials are rare. The tailrace has a bottom of cobble and gravel with the interstitial spaces filled with finer material. Downstream of the Wawaitin GS, the river bottom consists primarily of cobble and some boulder on a bedrock base.

In the rapids downstream of the Sandy Falls GS tailrace, the river bottom consists primarily of cobble, gravel and sand with some boulder on a bedrock base (Coker and Portt, 2006b). Upstream, a steep mostly bedrock rapids occur below the river to the tailrace.

At the Lower Sturgeon GS downstream of the bedrock chutes/falls spillway, there are shallow rapids along each shoreline with a deeper low-velocity section in the middle of the river (Coker and Portt, 2006c). Substrate consists of bedrock, boulder, cobble, and/or sand and gravel.

A more detailed description of substrate type and distribution downstream of the three generating stations is provided in Section 2.2.6.1.

Based on the good water quality of the Upper Mattagami River and predominantly coarse sediment type (particularly downstream of the generating stations), the sediments can be expected to have low concentrations of contaminants. This is supported by high benthic macroinvertebrate diversity values downstream of the generating stations (see Section 2.2.5).

2.2.3 Aquatic Vegetation

Within the Great Clay Belt, aquatic vegetation in the main channel of the Mattagami River is sparse, often consisting of a narrow fringe less than 1 m wide (Seyler, 1997). This is due to the steep-sided channel morphology, turbidity and annual water level fluctuations which range from 2 to 4 m.

Wild rice which occurs in the Craft Creek mouth area, a tributary stream which drains into the Mattagami River approximately 5 km upstream of the Sandy Falls GS, has a local value as a food resource.

Coker and Portt (2006a) reported horsetail (*Equisetum*) along the water edge of the shallow lentic (lake-like) section of the river downstream of the Wawaitin GS. No submergent aquatic plants were observed. Coker and Portt (2006b) observed no aquatic plants downstream of the Sandy Falls GS. At the Lower Sturgeon GS, wild celery (*Vallisneria* sp.) and pondweed (*Potamogeton* spp.) are sparsely scattered in small patches or individual plants along the east shore opposite the station (Coker and Portt, 2006c).

Three aquatic plant species considered to be significant by the MNR were listed in the Mattagami River Watershed Management Plan (see Table 2.9). None of these species are considered to be endangered, threatened or of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2006) or the Committee on the Status of Species at Risk in Ontario (COSSARO) (MNR, 2006). Examination of the MNR Natural Heritage Information Centre (NHIC, 2006) database indicated that there were no records of these three species within a 5-km radius of the three proposed redevelopment sites. Similarly, based on the *Species at Risk Act* (SARA) Schedule 1 Species at Risk Web Mapping Application (Environment Canada, CWS, 2004) database, no aquatic vegetation species at risk have documented occurrences overlapping the local study areas of the three proposed redevelopment sites.

TABLE 2.9: SIGNIFICANT AQUATIC PLANT SPECIES RECORDED IN THE MATTAGAMI RIVER WATERSHED[1]

Common Name	Scientific Name	Habitat Requirements	Provincial Rank[2]
Yellow dryas	*Dryas drummondii*	Calcareous cliffs, talus and river-gravels	S1
Roundleaf monkey-flower	*Mimulus glabratus*	Swamps, shores and shallow water along streams adjacent to open, meadow-like areas	S1
Creeping rush	*Juncus subtilis*	Margins and shores of ponds and streams	S3

[1] Source: OPG *et al.* (2006).
[2] NHIC (2006): S1 = extremely rare in Ontario, usually five or fewer occurrences in the province or very few remaining individuals and often especially vulnerable to extirpation; S3 = rare to uncommon in Ontario, usually between 20 and 100 occurrences, but with a large number of individuals in some populations and may be susceptible to large-scale disturbances.

2.2.4 Plankton

There are two algal communities in most lotic (fast river) systems: the potamoplankton, or drift plankton, and the periphyton (Aufwuchs), or benthic algae.

Lakes on lotic systems are the major source of potamoplankton, with diatoms almost universally the most important constituents (Williams and Scott, 1962).

However, the periphyton is by far the more important algal community in terms of the ecology and productivity of rivers. This community can be divided into three types (Round, 1973). The epilithic type consists of benthic algae attached to rocks. The epiphytic type is attached larger filamentous algae, bryophytes (mosses) and aquatic macrophytes. The epipelic type is a rich algal flora, mainly composed of diatoms, associated with the bed sediments.

Similarly, lakes are the major source of zooplankton with rotifers the dominant taxon in rivers (Williams, 1966). Zooplankton species recorded in the Mattagami River are presented in Table 2.10.

TABLE 2.10: ZOOPLANKTON SPECIES RECORDED IN THE MATTAGAMI RIVER[1]

Taxon
Cl. Cladorera
F. Bosminidae
Bosmina longirostris
Eubosmina tubicens
F. Chydoridae
Eurycercus lamellatus
F. Daphnidae
Ceriodaphnia reticulata
Daphnia
D. pulex
D. rosea
Simoecephalus serrulatus
S. vetulus
F. Leptodoridae
Leptodora kindti
F. Polyphemidae
Polyphemus pediculus
F. Sididae
Latona setifera
Sida crystallina
Cl. Copepoda
F. Cyclopidae
Diacyclops nanus
Eucyclops serralatus
Macrocyclops fuscus

[1] Source: Fiset (1995).

2.2.5 Benthic Macroinvertebrates

The composition of the benthic fauna has been the most widely used indicator of water quality. This is because the macroinvertebrates form relatively sedentary communities in the sediments, thereby reflecting the character of both the water and the sediment. Alteration of benthic community structure is used to assess the trophic or general pollutional status of a waterbody. This assessment is usually based on interpretation of indicator species, changes in the relative numbers of individuals and species, and/or the derivation of a species diversity or community comparison index.

Appendix 2 provides a list of the benthic macroinvertebrate taxa recorded in the Mattagami River. The occurrence of numerous species of the relatively more sensitive benthic macroinvertebrate groups, Ephemeroptera (mayfly larvae), Plecoptera (stonefly larvae) and Trichoptera (caddisfly nymphs), attests to the good water quality of the Mattagami River (see Section 2.2.1).

Coker and Portt (2006c) reported the collection of mayfly larvae, caddisfly nymphs, blackfly larvae and chironomids (midgefly larvae) in drift nets set downstream of the Lower Sturgeon GS to capture larval fish.

Table 2.11 presents the benthic macroinvertebrate community composition downstream of the three generating stations.

TABLE 2.11: BENTHIC MACROINVERTEBRATE COMMUNITY COMPOSITION DOWNSTREAM OF THE WAWAITIN GS, SANDY FALLS GS AND LOWER STURGEON GS

Taxon	Density/m^2		
	Wawaitin GS	Sandy Falls GS	Lower Sturgeon GS
P. Nematoda	65	97	129
P. Platyhelminthes			
Cl. Turbellaria			
O. Tricladida	-	-	32
P. Annelida			
Cl. Oligochaeta			
F. Enchytraeidae	32	-	-
F. Tubificidae			
Bothrioneurum vejdovskyanum	-	1,197	32
Limnodrilus hoffmeisteri	-	291	-
immatures without hair chaetae	-	97	-
F. Lumbriculidae			
Lumbriculus variegatus	-	744	65
Cl. Hirudinea			
F. Hirudinidae			
Nephelopsis obscura	-	97	32
F. Glossiphoniidae			
Glossiphonia complanata	-	32	-
indeterminate	-	32	-
P. Arthropoda			
Cl. Arachnoidea			
O. Acarina	32	-	-
Cl. Ostracoda	-	-	65
Cl. Insecta			
O. Coleoptera			32
F. Elmidae			
Stenelmis larvae	32	1,068	-
F. Psephenidae			
Psephenus	-	-	129
O. Ephemeroptera			
F. Caenidae			
Caenis	-	65	-
O. Plecoptera			
F. Perlidae			
immature	-	32	-
O. Trichoptera			
F. Hydropsychidae			
Cheumatopsyche	-	-	32
Hydropsyche	32	-	-
F. Hydroptilidae			
Hydroptila	-	32	-
pupae	-	-	65
F. Leptoceridae			
Ceraclea	65	-	-
Oecetis	-	324	32

TABLE 2.11: BENTHIC MACROINVERTEBRATE COMMUNITY COMPOSITION DOWNSTREAM OF THE WAWAITIN GS, SANDY FALLS GS AND LOWER STURGEON GS (Cont'd)

Taxon	Density/m²		
	Wawaitin GS	Sandy Falls GS	Lower Sturgeon GS
O. Diptera			
F. Ceratopogonidae			
Bezzia	-	32	-
Probezzia	-	-	32
pupae	32	-	-
indeterminate	32	-	-
F. Chironomidae			
chironomid pupae	-	129	97
S.F. Chironominae			
Cryptochironomus	-	65	-
Dicrotendipes	-	32	-
Microtendipes	-	65	-
Nilothauma	-	32	-
Parachironomus	-	32	-
Polypedilum	-	32	-
P. scalaenum	-	32	194
Tanytarsus	-	259	-
S.F. Orthocladiinae			
Cricotopus	-	388	-
Cricotopus/Orthocladius	-	291	-
Heterotrissocladius	-	97	-
S.F. Tanypodinae			
Conchapelopia	-	-	129
Thienemannimyia complex	-	32	-
F. Empididae			
pupae	-	-	32
P. Mollusca			
Cl. Gastropoda			
F. Lymnaeidae			
Fossaria	32	-	-
F. Physidae			
Physella	-	32	129
Cl. Bivalva (Pelecypoda)			
F. Sphaeriidae			
Cyclocalyx (Pisidium)	-	97	-
Sphaerium striatinum	-	32	65
TOTAL NUMBER OF ORGANISMS	354	5,787	1,291
TOTAL NUMBER OF TAXA	8	29	16
SHANNON-WIENER DIVERSITY INDEX	3.82	3.81	3.10

[1] Based on a composite of triplicate samples collected with a T-sampler in June 2006.

The benthic macroinvertebrate community downstream of the Wawaitin GS was characterized by eight taxa with a total density of 354 organisms per m^2. The Shannon-Wiener diversity index value was 3.82 indicative of unpolluted conditions (good water quality). There were no dominant major taxa, with caddisfly nymphs, nematodes and ceratopogonids (biting midge fly larvae) representing 27.4, 18.4 and 18.1% of the benthic community, respectively. The remaining major taxa each comprised approximately 9% of the community.

The benthic macroinvertebrate community downstream of the Sandy Falls GS was characterized by significantly more taxa (29) and higher density (5,787/m^2) than downstream of the Wawaitin GS, with the higher productivity likely reflecting nutrient inputs from upstream Timmins. The Shannon-Wiener diversity index value (3.81) was comparable to that downstream of the Wawaitin GS indicative of good water quality. Although there were no dominant taxa, species composition reflected the more productive conditions, with tubificid oligochaetes (sludge worms), chironomids (midge fly larvae), the aquatic beetle *Stenelmis* and the blackworm *Lumbriculus variegatus* representing 27.4, 25.7, 18.5 and 12.9% of the benthic community, respectively.

The benthic macroinvertebrate community downstream of Lower Sturgeon GS had intermediate number of taxa (16) and density (1,291/m^2) with a somewhat lower Shannon-Wiener diversity index value of 3.10, still reflective of good water quality. Chironomids were the dominant taxon comprising 32.5% of the community, with nematodes, the aquatic beetle *Psephenus*, caddisfly nymphs and the snail *Physella* each representing about 10% of the benthic community. The remaining taxa comprised less than 10% of the community. The species composition, number of taxa and total density are reflective of lower secondary production due to further distance downstream of Timmins.

2.2.6 Fisheries Resources

The Mattagami River provides coolwater fish habitat, with walleye the most important fish species common throughout the river (Seyler, 1997). Northern pike and white sucker are also common throughout the river. Lake sturgeon has been documented downstream of Lower Sturgeon GS (Sturgeon Falls). Cypress Falls, a suspected spawning area located upstream of the Missinaibi River confluence, form an impossible barrier for upstream migration of lake sturgeon. Lake whitefish have been documented between Wawaitin GS and Lower Sturgeon GS as well as other upstream and downstream locations. Smallmouth bass occur only in the upper reaches of the Mattagami River generally upstream of the Kenogamissi Falls Dam. This non-native species has been introduced to selected headwater lakes on the Canadian Shield since the 1920s (Seylor, 1997). Longnose sucker have been documented downstream of the Sandy Falls GS, whereas shorthead redhorse occur in the lower reaches downstream of the OPG Mattagami GS Complex (see Figure 1.9). Other common fish species include yellow perch, burbot, mottled sculpin and various minnows.

Seyler (l997) reported the presence of 28 resident fish species in the Mattagami River proper, with brook trout also present in those smaller tributaries providing coldwater habitat (Table 2.12).

TABLE 2.12: FISH SPECIES RECORDED IN THE MATTAGAMI RIVER[1]

Common Name	Scientific Name	Status
Lake sturgeon	*Acipenser fulvescens*	River resident, lower reaches only
Goldeye	*Hiodon alosiodes*	River resident, lower reaches only
Lake chub	*Couesius plumbeus*	River resident
Common shiner	*Luxilus cornutus*	In-stream lakes resident
Golden shiner	*Notemigonus crysoleucas*	River resident
Emerald shiner	*Notropis atherinoides*	River resident
Blacknose shiner	*N. heterolepsis*	In-stream lakes resident
Spottail shiner	*N. hudsonius*	River resident
Fathead minnow	*Pimephales promelas*	River resident
Longnose dace	*Rhinichthys cataractae*	River resident
Fallfish	*Semotilus corporalis*	River resident, lower reaches only
Pearl dace	*S. margarita*	River resident
Longnose sucker	*Catostomus catostomus*	River resident
White sucker	*C. commersoni*	River resident
Shorthead redhorse	*Moxostoma macrolepidotum*	River resident, lower reaches only
Northern pike	*Esox lucius*	River resident
Cisco (Lake herring)	*Coregonus artedi*	River resident
Lake whitefish	*C. clupeaformis*	River resident
Brook trout	*Salvelinus fontinalis*	Present in tributaries, occasional residents in in-stream lakes
Burbot (Ling)	*Lota lota*	River resident
Trout-perch	*Percopsis omiscomaycus*	River resident
Brook stickleback	*Culaea inconstans*	River resident
Ninespine stickleback	*Pungitius pungitius*	River resident
Mottled sculpin	*Cottus bairdi*	River resident
Smallmouth bass	*Micropterus dolomieu*	Introduced, upper reaches only
Yellow perch	*Perca flavescens*	River resident
Walleye	*Sander vitreus*	River resident
Johnny darter	*Ethestoma nigrum*	River resident
Logperch	*Percina caprodes*	River resident

[1] Source: Seyler (1997).

Site-specific electrofishing surveys were undertaken downstream of the three generating stations during the summer of 2005 and 2006 (see Table 2.13). A total of 18 fish species were captured. Longnose dace, trout-perch, mottled sculpin and logperch were collected at all three locations. Spottail shiner and young-of-the-year (YOY) white sucker were collected downstream of the Wawaitin GS and Sandy Falls GS. Yellow perch were collected downstream of Wawaitin GS (YOY) and Lower Sturgeon GS. Lake chub, emerald shiner, mimic shiner (*Notropis* *volucellus*) and juvenile burbot were collected downstream of the Sandy Falls GS and Lower Sturgeon GS. Golden shiner, YOY cisco and YOY northern pike were only captured downstream of the Wawaitin GS; brassy minnow (*Hybognathus hankinsoni*) were collected only downstream of the Sandy Falls GS; and Iowa darter (*Etheostoma exile*), johnny darter and juvenile smallmouth bass were only collected downstream of the Lower Sturgeon GS. Three of the 18 species, mimic shiner, brassy minnow and Iowa darter, were not included in the list of species recorded for the Mattagami River (see Table 2.12).

TABLE 2.13: FISH SPECIES AND NUMBERS COLLECTED BY ELECTROFISHING IN THE MATTAGAMI RIVER DOWNSTREAM OF THE WAWAITIN GS, SANDY FALLS GS AND LOWER STURGEON GS, 2005 and 2006[1]

	Wawaitin GS		Sandy Falls GS		Lower Sturgeon GS	
Common Name	2005	2006	2005	2006	2005	2006
Lake chub			1		2	2
Brassy minnow				2		
Golden shiner		1				
Emerald shiner			1		4	
Spottail shiner		3		1		
Mimic shiner				2	6	1
Longnose dace	31		1	2	2	
White sucker	5	53		24		
Northern pike	4	1				
Cisco		1				
Burbot			3	2		2
Trout-perch	3		1			3
Mottled sculpin	12		12	2	25	2
Smallmouth bass						2
Yellow perch		1				3
Iowa darter					1	
Johnny darter					4	5
Logperch		3		12	5	23

[1] Source: Coker and Portt (2006a,b,c, d, e, f).

A number of fisheries resources surveys of Kenogamissi Lake, immediately upstream of the Wawaitin GS have been undertaken by the MNR Timmins District (Burkhardt, 1990a,b; Michell, 1992, 1994; Piché, 1995 1996a,b, 1997, 1998). Kenogamissi Lake was formed by the construction of two dams on the upper Mattagami River: one at Wawaitin Falls and the other at Kenogamissi Falls. Kenogamissi Lake, with a maximum depth of 26.2 m, encompasses an area of 2,608.9 ha with 174 km of shoreline and 6.7 km of island shoreline (Piché, 1996a). It is the second largest coolwater lake in MNR Timmins District (Burkhardt, 1990a). Sportfish species present are white sucker, northern pike, cisco, lake whitefish, burbot, smallmouth bass, yellow perch and walleye (Burkhardt, 1990a,b; Michell, 1992, Piché, 1996a). Table 2.14 presents fish composition, abundance and catch-per-unit-effort (CPUE) based on index gillnetting studies for Kenogamissi Lake between 1991 and 1997. Generally, walleye and yellow perch were the most abundant fish species captured followed by northern pike. Lower numbers of cisco and lake whitefish with infrequent very low numbers of white sucker and smallmouth bass, were also captured. Based on index trapnetting data, walleye, northern pike, lake whitefish and white sucker were the most common species captured together with a few burbot and yellow perch in 1989 and cisco in 1995 (see Table 2.15). Based on a 1993 index trapnetting study, Michell (1994) reported the following CPUEs by fish species: white sucker – 0.11 fish/h; northern pike – 0.10; walleye – 0.07; lake whitefish – 0.05; cisco – 0.04; yellow perch - <0.01; and smallmouth bass - <0.01. The discrepancy between white sucker and yellow perch catch data reflects their different catch susceptibility by gear types.

TABLE 2.14: FISH COMPOSITION, ABUNDANCE AND CPUE BASED ON INDEX GILLNETTING IN KENOGAMISSI LAKE, 1994-1997[1]

Species	1991			1992			1993			1994			1995			1996			1997		
	Number Caught	%	CPUE[2]	Number Caught	%	CPUE	Number Caught	%	CPUE	Number Caught	%	CPUE	Number Caught	%	CPUE	Number Caught	%	CPUE	Number Caught	%	CPUE
White sucker	0	0.0	0.00	0	0.0	0.00	2	0.7	0.01	0	0.0	0.00	0	0.0	0.00	1	0.3	<0.01	0	0.0	0.00
Northern pike	33	11.0	0.33	51	17.3	0.36	57.	19.5	0.25	32	23.0	0.20	40	14.6	0.25	51	14.7	0.37	50	15.7	0.40
Cisco (Lake herring)	56	18.6	0.56	6	2.0	0.04	1	0.3	<0.01	0	0.0	0.00	24	8.8	0.15	48	13.8	0.35	15	4.7	0.12
Lake whitefish	34	11.3	0.34	9	3.1	0.06	18	6.2	0.08	5	3.6	0.03	10	3.6	0.06	4	1.1	0.03	4	1.3	0.03
Smallmouth bass	1	0.3	0.01	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Yellow perch	72	23.9	0.72	128	43.5	0.90	123	42.1	0.54	49	35.3	0.31	129	47.1	0.80	101	29.0	0.74	119	37.4	0.96
Walleye	105	34.9	1.04	100	34.0	0.70	91	31.2	0.40	53	38.1	0.33	71	25.9	0.44	143	41.1	1.04	130	40.9	1.05
Total	301	100	3.00	294	99.9	2.06	292	100	1.28	139	100	0.87	274	100	1.71	348	100	2.54	318	100	2.56

[1] Source: Burkhardt (1992); Piché (1995, 1996b, 1997, 1998); B. Burkhardt, MNR Timmins District, 2006, pers. comm.
[2] CPUE = catch-per-unit-effort (number of fish/h).

TABLE 2.15: FISH COMPOSITION, ABUNDANCE AND CPUE BASED ON INDEX TRAPNETTING IN KENOGAMISSI LAKE, 1989 AND 1995[1]

Species	1989			1995		
	Number Caught	%	CPUE[2]	Number Caught	%	CPUE
White sucker	73	17.7	0.06	95	26.4	0.08
Northern pike	106	25.7	0.08	92	25.6	0.08
Cisco (Lake herring)	0	0.0	0.00	2	0.5	<0.01
Lake whitefish	111	26.9	0.09	61	16.9	0.05
Burbot	1	0.2	<0.01	0	0.0	0.00
Yellow perch	5	1.2	<0.01	0	0.0	0.00
Walleye	117	28.3	0.09	110	30.6	0.09
Total	413	100	0.32	360	100	0.30

[1] Source: Burkhardt (1990b); Piché (1996a).
[2] CPUE = catch-per-unit-effort (number of fish/h).

During the underwater video surveys, walleye and suckers were observed in the deeper portions of the river downstream of the Sandy Falls GS and Lower Sturgeon GS, whereas longnose sucker and trout-perch were observed in the tailrace of the Wawaitin GS (Coker and Portt, 2006a,b,c).

Of the fish species listed in Tables 2.12 and 2.13, only lake sturgeon and goldeye are considered to be rare to uncommon by the MNR (nhic.mnr.gov.on.ca/nhic_.cfm). Neither species is considered at risk federally by COSEWIC (2006) or provincially by COSSARO (MNR, 2006).

As indicated in Figure 2.5, there are nine man-made barriers on the entire Mattagami River. These dams, as well as Cypress Falls, impede upstream movement of many fish species. In some cases where barriers have been constructed, natural impediments to movement probably existed prior to development, e.g., Sandy Falls, Sturgeon Falls. The downstream movement of species and mixing of stocks likely continues despite in-stream development.

The river sections downstream of the Sandy Falls GS and Lower Sturgeon GS have been designated as Fish Sanctuaries by the MNR. The sanctuary below Sandy Falls extends approximately 2 km downstream to protect spawning populations of walleye and northern pike. The Sturgeon Falls sanctuary extends approximately 12 km downstream to protect spawning walleye, lake sturgeon and northern pike. There is also a Fish Sanctuary at the southern end of Lake Kenogamissi to protect spawning walleye, lake whitefish and northern pike extending approximately 3 km downstream of the Upper Dam. For all three sanctuaries, fishing for any species is prohibited from 01 April to 14 June (MNR, 2005).

Although lake sturgeon are not known to have occurred upstream of Sandy Falls, 50 lake sturgeon from the Little Long Reservoir on the lower Mattagami River were transferred upstream of Sandy Falls in 2002 (OPG *et al.*, 2006). Thirteen of these fish were radiotagged and some of these are known to have passed downstream over the Sandy Falls dam (Coker and Portt, 2006b). Some of these fish may still reside between the Wawaitin GS and Sandy Falls GS.

In 1985, the MNR conducted an intensive gill netting program on the Mattagami River between the Lower Sturgeon GS and Lower Rapids (approximately 34 km downstream). Lake sturgeon were not captured in 40 gill nets set within 7 km downstream of the Lower Sturgeon GS, with 36 of these sets within 1.8 km of the station. Based on mark-recapture data, it was estimated that about 114 lake sturgeon were residents in this river section (Payne, 1987). The estimated biomass of lake sturgeon in this river section was 2.0 kg/ha compared with 7.1 kg/ha and 13 to 22 kg/ha for the Abitibi River and Frederick House River, respectively.

Based on a suggestion by the MNR in 2005, a lake sturgeon spawning survey using drift netting was conducted downstream of the Lower Sturgeon GS (Coker and Portt, 2006c). Although no YOY lake sturgeon were captured three larval walleye were. Although historical lake sturgeon spawning has been recorded at this location, their numbers were found to be very low during a l985 survey (MNR files). Based on these data and the very limited area of habitat that will be altered by the proposed redevelopment, it was concluded that additional lake sturgeon spawning surveys were not warranted.

Fish consumption advice based on a combination of species, fish size and contaminant concentrations has been provided by the MOE for waterbodies throughout Ontario since 1979. Mercury is the major contaminant of fish in inland waters of the province. A summary of the most recent fish consumption advisories for Kenogamissi Lake and the upper Mattagami River is provided in Table 2.16. The maximum recommended number of meals of sport fish per month is eight for the general population (MOE, 2005). Since young children and developing fetuses are affected by contaminants at lower concentrations than the general population, children under 15 and women of child-bearing age are advised to consume fish only in the eight and four meals per month categories. Top predators, such as northern pike and walleye, usually have the highest mercury concentrations. Smaller, younger fish and fish that are not top predators, such as yellow perch, have lower contaminant concentrations.

TABLE 2.16: SUMMARY OF FISH CONSUMPTION ADVISORIES[1]

Fish Species	Fish Length (cm)												
	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	>75
Kenogamissi Lake													
Northern pike[2]						8[3](8)[4]	8(4)	8(4)	8(0)	4(0)	4(0)	4(0)	2(0)
Lake whitefish[5]		8(8)	8(8)	8(8)	8(8)	8(8)							
Walleye[2]				8(4)	8(4)	4(0)	4(0)	2(0)	2(0)				
Mattagami River (below Sandy Falls)													
White sucker[6]				8(8)	8(8)	8(4)	8(4)	8(4)	8(4)				
Longnose sucker[7]				8(8)	8(8)	8(8)	8(4)	8(0)					
Northern pike[6]				8(4)	8(4)	8(4)	8(4)	8(4)	8(0)	4(0)	4(0)		
Walleye[6]			8(4)	8(4)	8(4)	4(0)	4(0)	4(0)	4(0)	4(0)			
Mattagami River (downstream of Sturgeon Falls)													
White sucker[6]						8(8)	8(4)	8(4)					
Redhorse sucker[6]							8(4)	8(0)					
Northern pike[6]							8(4)	8(4)	8(4)	8(4)			
Walleye[6]	8(8)	8(8)	8(4)	8(4)	8(4)	8(4)	8(4)						
Mattagami River (Loon Rapids)													
Northern pike[7]						8(4)	8(4)	4(0)	4(0)				
Walleye[7]			8(8)	8(4)	8(4)	8(4)	4(0)	4(0)					

1 Source: MOE (2005).
2 Based on mercury, other metals, PCBs, mirex/photomirex and pesticides.
3 Number of meals of that size fish that can be consumed each month by the general population.
4 Bracketed number of meals of that size fish that is advised for consumption by women of child-bearing age and children under 15.
5 Based on mercury, PCBs, mirex/photomirex and pesticides.
6 Based on mercury and other metals.
7 Based on mercury.

2.2.6.1 Fish Habitat and Communities

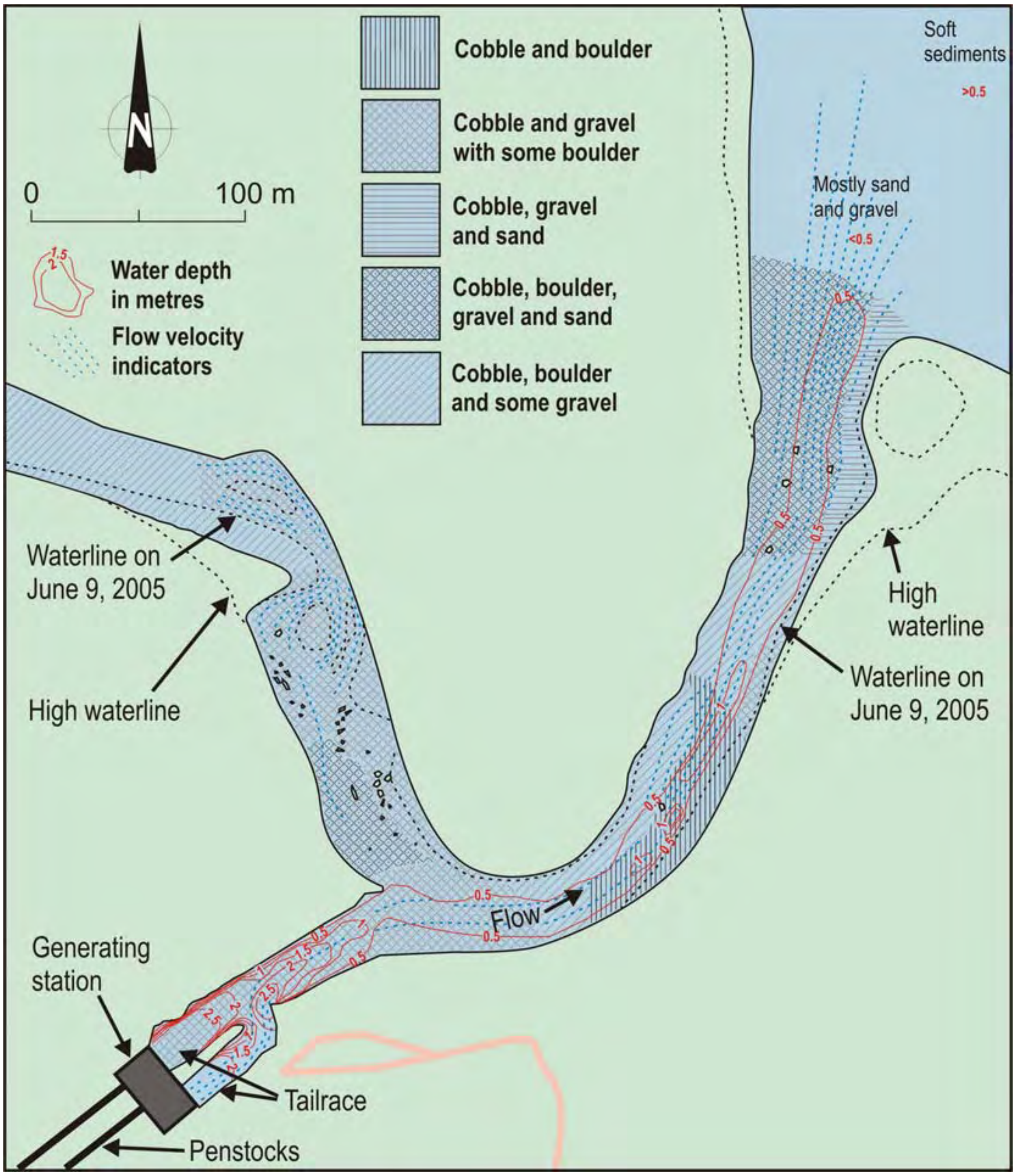
Wawaitin GS

Existing habitat at the Wawaitin GS likely to be affected by the proposed redevelopment consists of the spillway, the tailrace and the Mattagami River downstream of the confluence of the spillway and tailrace (Coker and Portt, 2006a). The 2.6 km-long spillway for the Wawaitin GS is the original Mattagami River channel that conveyed all river flow prior to power plant construction. The elevation difference between Kenogamissi Lake and the tailrace confluence is approximately 38.4 m. Consequently, the spillway channel has a steep slope, long sections of rapids, four low waterfalls and one more substantial waterfall. These waterfalls likely pose seasonal or complete barriers for some species of fish. The spillway has a bedrock base that is covered by boulders and cobble along more than half of its length (see Figure 2.5). Habitat conditions in the spillway are greatly influenced by flow. As indicated in Section 2.1.3.1, flow in the spillway can experience extreme changes in flow volume, i.e., from zero flow when the Wawaitin GS is capable of taking all the Mattagami River flow to a mean average daily flow of approximately 30 m^3/s during the freshet.

The rather simple fish community identified within the spillway channel in 2005 (Coker and Portt, 2006a), consisting of longnose dace, mottled sculpin and white sucker, is consistent with the extreme variation in flow that occurs periodically through the spillway, as well as the barrier to fish movement. One YOY northern pike was also collected in the lower reach of the spillway channel.

The tailrace of the Wawaitin GS is a steep-sided channel, excavated through bedrock, that is approximately 115 m long with a maximum depth of 2.5 m (Figure 2.5). Water depth decreases to approximately 1 m at the spillway channel confluence. Substrate is mostly gravel and cobble with a few boulders; however, the occurrence of fine gravel and debris, and a layer of epipelic growth, results in a rather closed substrate, particularly closer to the station. This substrate provides little habitat structure. A number of longnose sucker and a school of trout-perch were observed by underwater video in the tailrace in 2005 (Coker and Portt, 2006a).

Figure 2.5: Aquatic Habitat Downstream of the Wawaitin GS



Downstream of the tailrace and spillway channel confluence, the Mattagami River conveys its full flow in a “typical” natural channel for approximately 390 m, and then widens into a broad and shallow lentic section. Substrate throughout is a patchy mixture of primarily cobble and gravel, with some boulder and sand (Figure 2.5). The shallow lentic area has fine substrate, whereas in the transition area between the faster flowing lotic and slower moving lentic conditions, the water is very shallow and substrate is primarily sand and gravel. This section of rapids/riffle extending from the spillway channel confluence to the lentic area provides a variety of swift-water habitats due to the diversity of flow velocities, depths and substrate size. This section provides habitat for a variety of fish species that reside in fast water, such as golden shiner, spottail shiner, longnose dace, white sucker, YOY cisco, mottled sculpin, trout-perch, YOY yellow perch and logperch (Coker and Portt, 2006a,d). This area also has suitable substrate that provides extensive areas of potential walleye and sucker spawning habitat (as evidenced by the presence of many YOY white sucker in 2005 and 2006), as well as spawning habitat for smaller fishes such as trout-perch. The YOY northern pike captured in the quieter shallow rearing habitats along the shore in 2005 and 2006 likely originated from lentic spawning areas downstream.

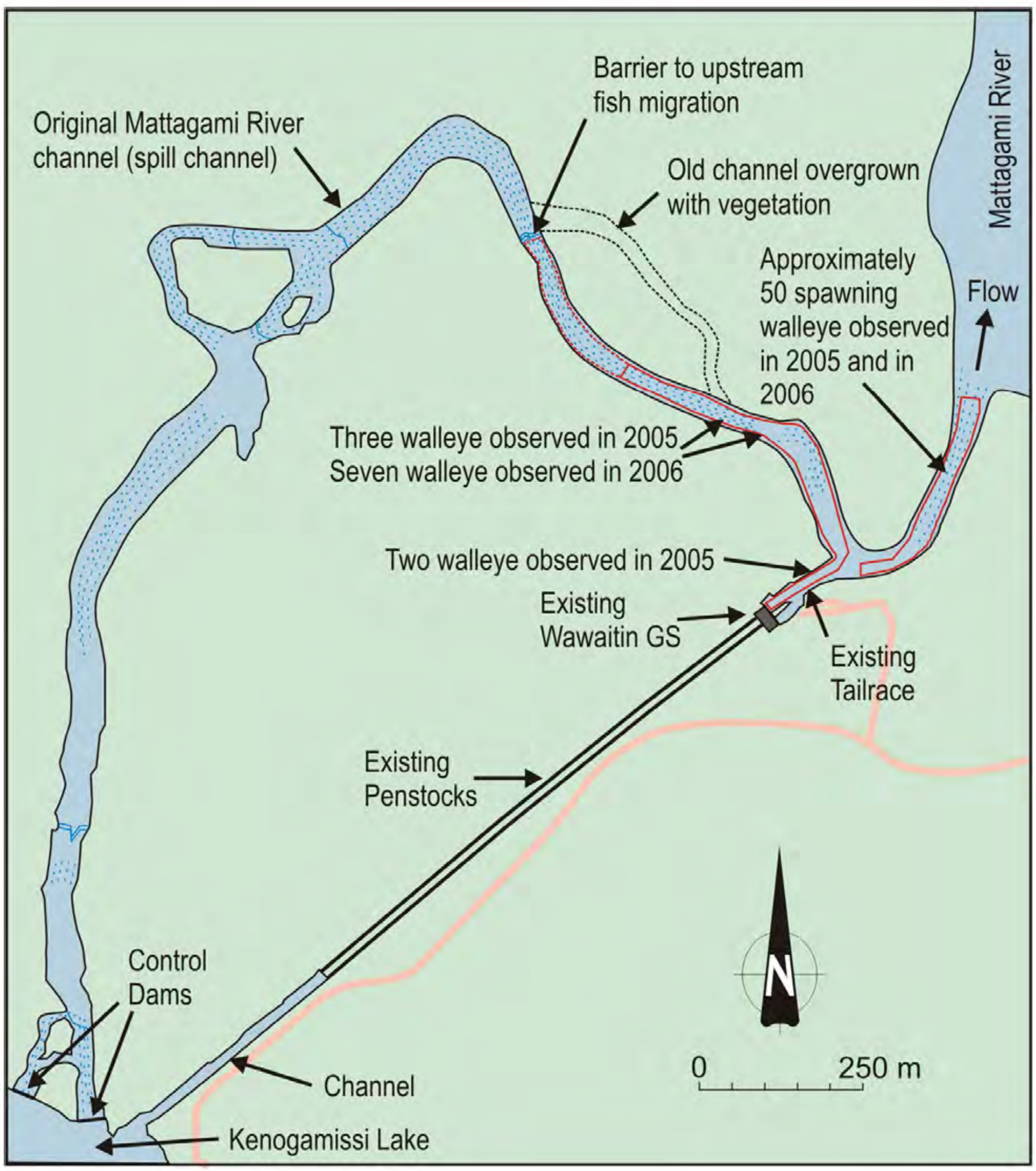
This rapids/riffle area downstream of the Wawaitin GS appear to be the only rapids along 43 km of the Mattagami River downstream to the weir dam at Sandy Falls that provide spawning habitat for walleye (Coker and Portt, 2005b, 2006g). Based on review of topographic maps, rapids also occur in the Grassy River and the Tatachikapika River approximately 12 and 7 km upstream, respectively, of their confluence with the Mattagami River; however, the significance of these rapids as walleye spawning areas is unknown. At Wawaitin GS, walleye can access the rapids downstream of the tailrace, the tailrace upstream to the generating station, and the lower 676 m of the spillway channel, at which point a barrier prevents farther upstream migration. Walleye typically spawn at temperatures of 5.6 to 11.1°C over boulder to coarse gravel (Scott and Crossman, 1973), generally in water less than 1.2 m deep (Smith, 1985), and in velocities from 0.3 to 1.0 m/s (McMahon et al., 1984). The tailrace does not appear to provide suitable habitat for walleye spawning, as it is too deep and has a bottom of cobble and gravel with the interstitial spaces filled with finer material. The spillway channel downstream of the migration barrier, as well as the rapids downstream of the confluence of the tailrace and spillway channel, have suitable substrate and provide extensive areas of potential walleye spawning habitat. As flow velocities throughout these two areas will vary depending upon river discharge, optimal walleye spawning habitat will also vary in location and extent.

On 06 May 2005, approximately 50 spawning walleye were observed by Coker and Portt (2005b) on the east side of the river in the rapids downstream of the confluence of the tailrace and spillway channel (see Figure 2.6). Two and three single walleye were observed along the edge of the tailrace and in the lower 400 m of spillway channel examined, respectively.

The walleye spawning survey was repeated on 01 May 2006 (Coker and Portt, 2006g). Approximately 50 spawning walleye were again observed in the same area as 2005, i.e., from the east side of the river in the rapids downstream of the confluence of the tailrace and the spill channel (see Figure 2.6). No walleye were observed within the tailrace. Seven single walleye were observed in the lower 300 m of the spill channel, upstream of its confluence with the tailrace. No walleye, or other fishes, were observed in the remainder of the spill channel up to the 4-m barrier that is located 676 m upstream of the confluence with the tailrace.

In summary, although extensive potential spawning areas for walleye were identified downstream of the Wawaitin GS and in the lower portion of the spill channel, walleye were only observed in the spring of 2005 and 2006 spawning in the rapids downstream of the confluence of the generating station tailrace and spill channel. Based on the nature of the habitat in the tailrace, it is unlikely that it ever provides significant spawning habitat for walleye. The accessible portion of the spillway may provide walleye spawning habitat when flow conditions are appropriate. Although flow velocity and substrate appeared to be appropriate for spawning in the spring of 2005 and 2006, the flow volume (<1 m^3/s) may have been too small to entice walleye to enter relative to the flow volume in the rapids downstream. Potential spawning habitat for suckers and walleye occurs at the shallower downstream end of the tailrace where the substrate is more open. However, spawning fish were not observed during the spawning surveys (Coker and Portt, 2005b, 2006g).

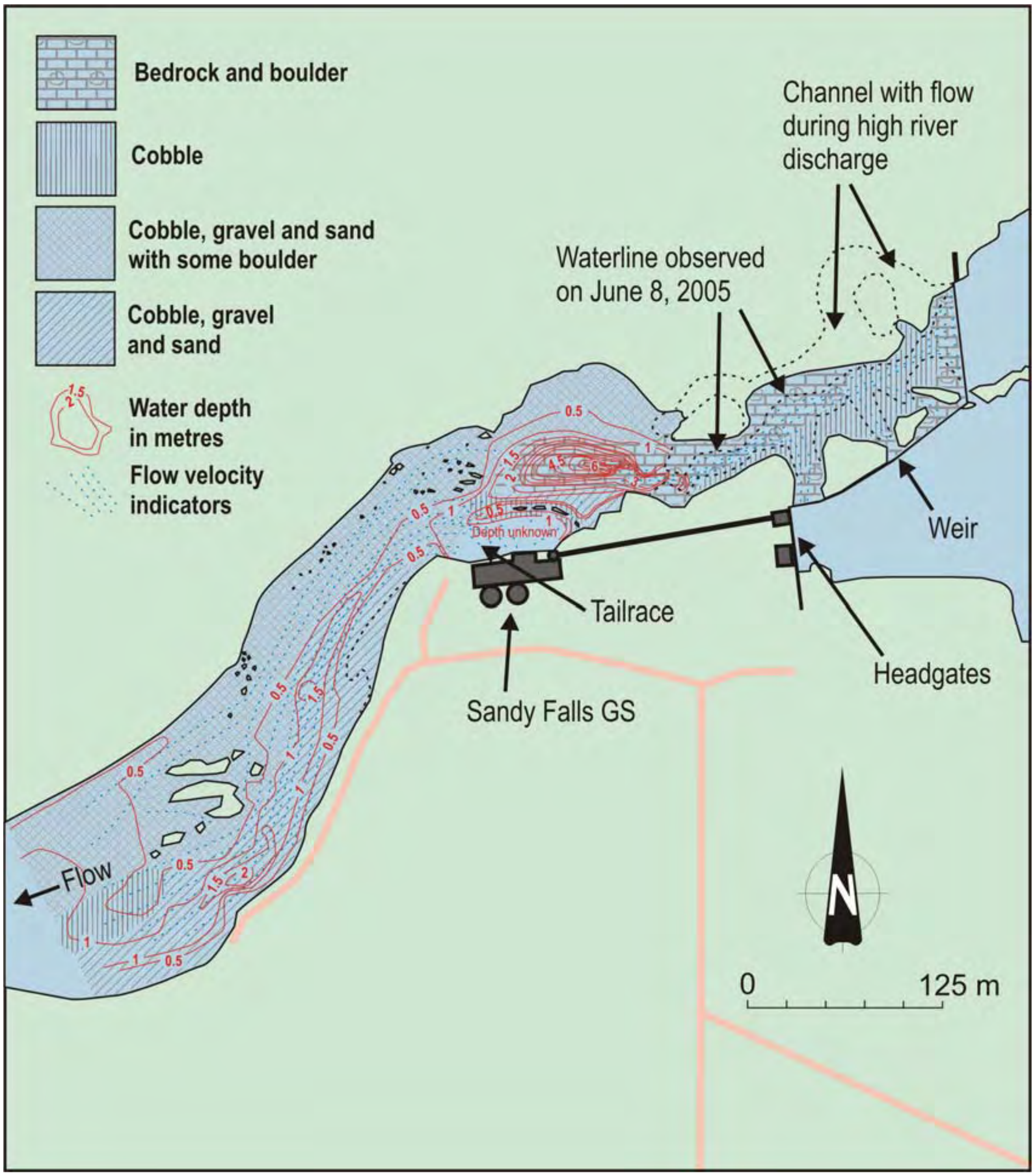
Figure 2.6: Walleye Spawning Survey Observations, Wawaitin GS



Sandy Falls GS

Within the spill channel immediately downstream of the Sandy Falls dam, habitat is subjected to flows that vary widely, depending on the total river flow and the proportion that passes through the Sandy Falls GS. This river section consists of bedrock chutes and boulder and cobble rapids (see Figure 2.7), and combined with the variable flow, is not likely very productive habitat (Coker and Portt, 2006b).

Figure 2.7: Aquatic Habitat Downstream of the Sandy Falls GS



The deeper area in the vicinity of the Sandy Falls GS tailrace is likely the result of scouring by flows exiting the spill channel. Substrate consists of bedrock and boulders (Figure 2.7). Larger fish (walleye and suckers) were observed by video in 2005 (Coker and Portt, 2006b).

Downstream of this deep area for approximately 250 m, the river is rather shallow with swift flows and mostly cobble, gravel and sand substrate. Lake chub, emerald shiner, spottail shiner, mimic shiner, longnose dace, YOY white sucker, juvenile burbot, trout-perch, mottled sculpin and logperch were collected in the offshore riffle areas and/or quieter shallow habitats along the nearshore during the 2005 and/or 2006 surveys (Coker and Portt, 2006b,e).

The rapids downstream of the Sandy Falls GS tailrace provide important spawning habitat for a number of fish species, including walleye, white sucker, longnose sucker and trout-perch. In fact, they are the only rapids along the 40.5-km section of the Mattagami River from the Sandy Falls GS to the Lower Sturgeon GS that provide spawning habitat for walleye (Coker and Portt, 2005a) (see Figure 2.8). Immediately upstream (to the east) of the tailrace, water depth is greater (~5 m) and flow is less than that usually required for walleye spawning. With some difficulty due to rapid flows, walleye could access the steeper rapids that extend from upstream of the tailrace to the base of the weir; however, the rapid flow velocities and boulder and bedrock that dominate this area do not provide good walleye spawning habitat.

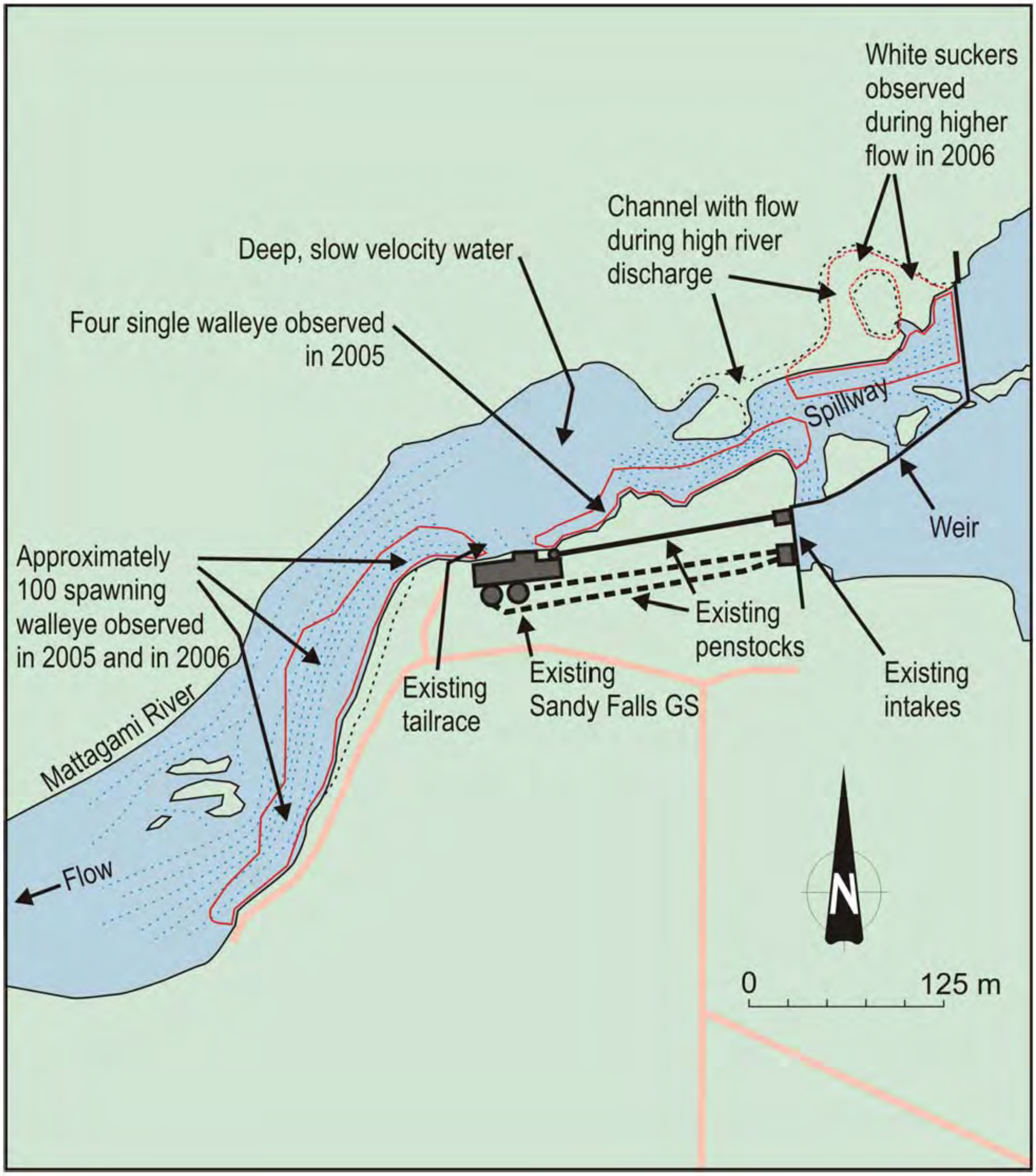
On 06 May 2005, approximately 100 spawning walleye were observed in the rapids downstream of the tailrace. (Coker and Portt, 2005a). Longnose sucker in similar numbers were also observed spawning among the walleye. Four single walleye were observed in deep slow-moving water upstream of the tailrace. None were observed in the steep rapids below the weir.

On 01 May 2006, Coker and Portt (2006h) observed approximately four walleye and a few longnose sucker in the rapids downstream of the tailrace. At the time, water temperature was 8.5°C, water was turbid and flow was high.

On the following day (02 May) with water temperature at 10.3°C and less turbid conditions, walleye were observed in the rapids downstream of the tailrace in similar numbers and distribution as in 2005 (see Figure 2.8). No walleye were observed upstream of the tailrace. Longnose sucker and four common sucker were also observed spawning in the same area among the walleye. Numerous white sucker were also observed in the shallow, temporary, high flow channels on the north side of the river below the weir. Some large yellow perch were observed in the flooded grasses along the shore.

In summary, although observations were conducted in all the sections of the rapids downstream of the Sandy Falls weir in 2005 and 2006, spawning walleye were only observed in the shallow cobble, gravel and sand riffles downstream of the Sandy Falls GS tailrace (Coker and Portt, 2005a, 2006h). Large numbers of longnose suckers were also observed spawning among the walleye.

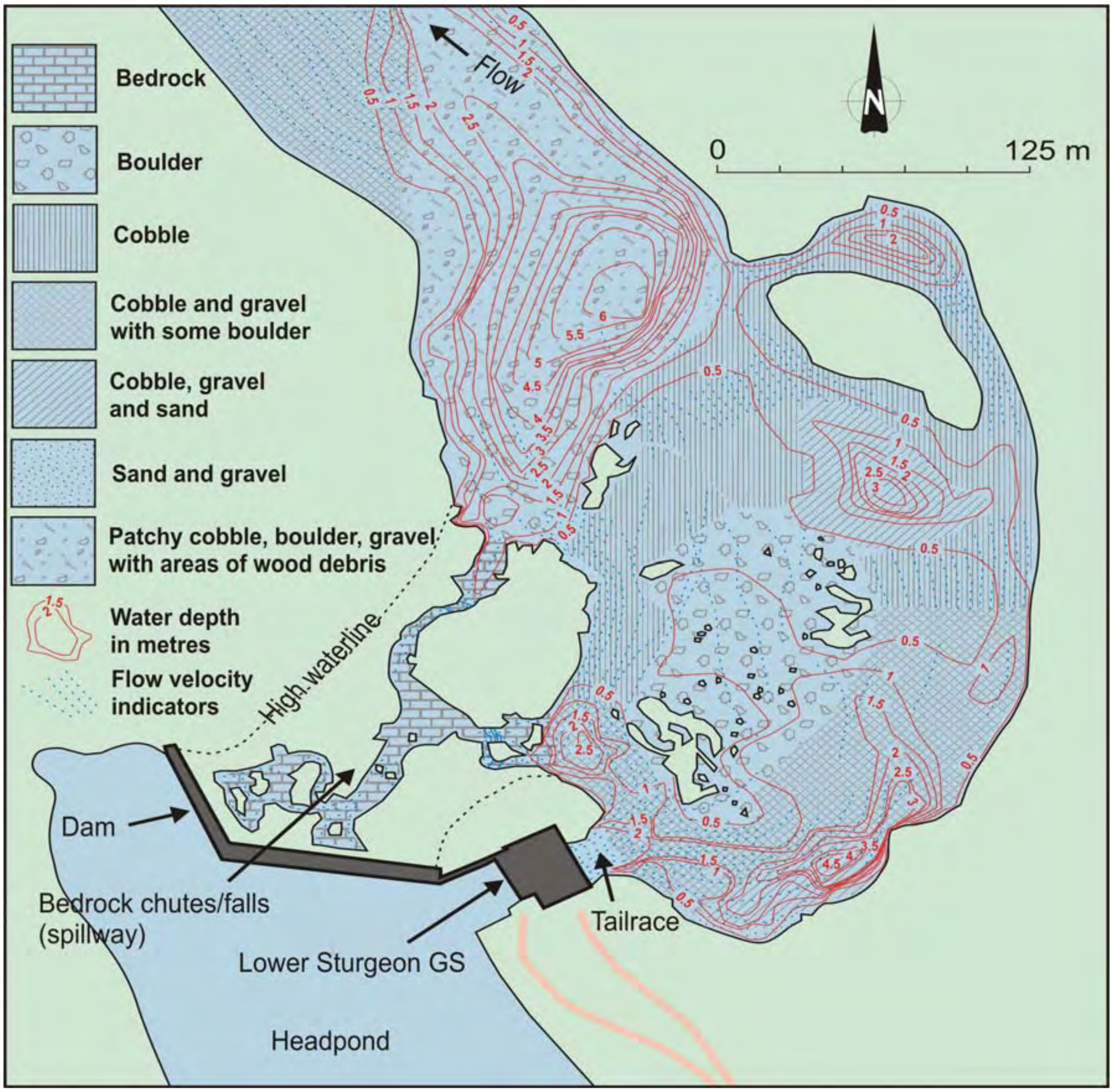
Figure 2.8: Walleye Spawning Survey Observations, Sandy Falls GS



Lower Sturgeon GS

Much of the aquatic habitat immediately downstream of the Lower Sturgeon GS is shallow, with flow velocities ranging from swift rapids to quiet nearshore and bar areas. A few isolated deep areas exist, with the most extensive of these located downstream and north of the bedrock chutes/falls (see Figure 2.9). Substrate outside of the chutes/falls section consists of various mixtures of cobble, gravel and/or boulder, together with sand in some lower gradient areas. Large woody debris occurs in the deep area located downstream and north of the bedrock chutes/falls.

Figure 2.9: Aquatic Habitat Downstream of the Lower Sturgeon GS



Lake chub, emerald shiner, mimic shiner, longnose dace, juvenile burbot, trout-perch, mottled sculpin, juvenile smallmouth bass, yellow perch, Iowa darter, johnny darter and logperch were present in the offshore riffle areas and/or in the quieter shallow habitats along the nearshore (Coker and Portt, 2006c,f). Walleye and longnose sucker were observed in the deeper portions of the area immediately downstream of the Lower Sturgeon GS (Coker and Portt, 2006c). During the MNR lake sturgeon intensive gill netting program in 1985, white sucker, northern pike, longnose sucker and walleye were captured within the deeper area downstream of the dam spillway.

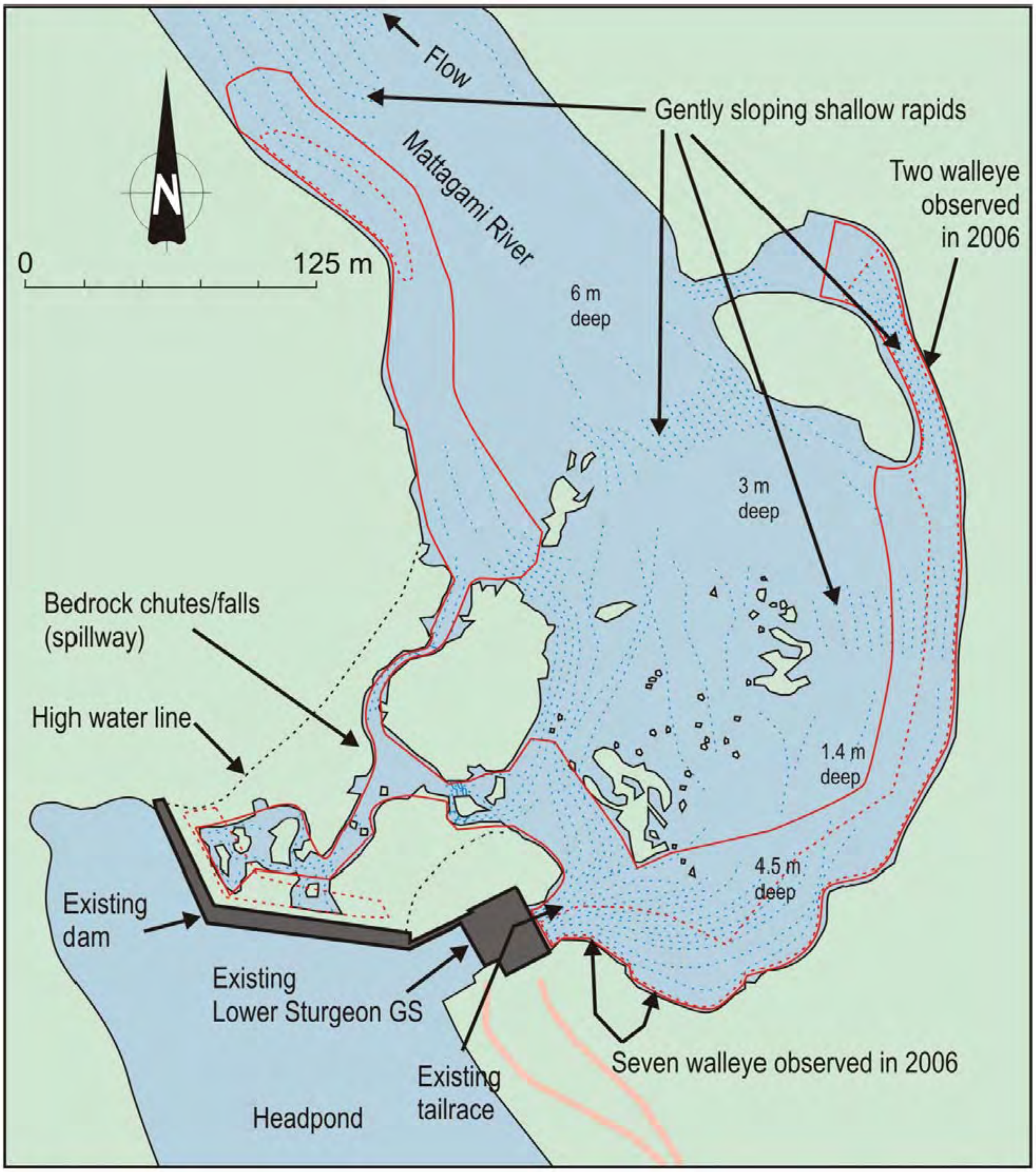
The gently sloped rapids downstream of the bedrock spillway and the tailrace appear to provide good spawning habitat (Cocker and Portt, 2005c) (see Figure 2.10). Extensive areas of these rapids have appropriate substrate, and a variety of flow velocities and water depths that included those preferred by spawning walleye. However, no walleye were observed during the May 2005 survey. This location has historically been known as an important walleye spawning area.

On 01 May 2006, Coker and Portt (2006i) again observed no walleye downstream of the bedrock spillway and the tailrace. At the time, water was significantly more turbid and deeper than during the May 2005 survey, reducing the area that could effectively be monitored for walleye.

The same area was examined on 03 May 2006 (Coker and Portt, 2006i). Although the water was still turbid, seven walleye were observed as a group along the shore just downstream of the tailrace and two other walleye were observed in the channel between a small island and the shore (see Figure 2.10). Flows through the spill channel during the 2006 surveys were significantly higher than in 2005, rendering observation within the spill channel and downstream impossible, except from the walkway on top of the dam. Such high flows would generally exclude walleye from the spillway.

In summary, Coker and Portt (2006c) concluded that the series of bedrock chutes/falls below the dam in the spillway does not provide good walleye, sucker or sturgeon spawning habitat due to the mostly bedrock substrate. Appropriate flow velocities may also be limiting in this area. At the time of the 05 May 2005 survey, it was deemed that this area was inaccessible to walleye due to waterfalls at the downstream end of the bedrock chutes/falls; however, it would be accessible during higher spill flow and elevated tailwater (Coker and Portt, 2006i). Walleye have been observed in large numbers within the bedrock spillway beneath the dam on some occasions (G. Deyne, MNR Timmins District, 2005, pers. comm.), likely during higher spill flow and elevated tailwater conditions. The habitat downstream of the Lower Sturgeon GS is deeper than is typically used by walleye for spawning along much of the accessible shoreline; however, this depth also makes observations more difficult, particularly under turbid conditions. A small number of walleye were observed during the second 2006 survey (Coker and Portt, 2006i); moreover, three larval walleye were captured in drift nets in June 2005, indicating that some walleye spawning had occurred (Coker and Portt, 2006c). The considerable extent of rapids downstream of the Lower Sturgeon GS probably provides many potential spawning locations.

Figure 2.10: Walleye Spawning Survey Observations, Lower Sturgeon GS



2.2.7 Aquatic Avifauna

The Mattagami River is considered be very productive for waterfowl nesting and brood rearing in the Sandy Falls and Timmins area, downstream of the Wawaitin GS (Sears, 1992). Mallard, black duck, wigeon, teal and goldeneye, as well as shorebird species, are common. A small marsh and wild rice stand at the mouth of Craft Creek, approximately 5 km upstream of the Sandy Falls GS, attract large numbers of waterfowl. The pattern of water level fluctuations, i.e., high levels in the spring followed by gradual reductions over the summer, are extremely beneficial for the nesting waterfowl and wild rice stands. Kenogamissi Lake upstream of the Wawaitin GS may also offer nesting, brood rearing and staging areas for local waterfowl.

Canada Land Inventory (CLI, 1973) mapping for waterfowl production indicates that the Mattagami River between Wawaitin GS and downstream of Lower Sturgeon GS is categorized as 80% Class 6, 10% Class 5 and 10% Class 4 with severe, moderately severe and moderate limitations, respectively, due to adverse topography and free-flowing water conditions. Kenogamissi Lake upstream of Wawaitin GS is classified as Class 6 with severe limitations to waterfowl production due to adverse topography and excessive water depth. The MNR (1981) has identified the entire length of the Mattagami River as a waterfowl staging area.

Table 2.17 lists the aquatic avifauna species recorded in the Timmins area. Of the 77 species listed, 23 breed or likely breed in the Timmins area. Of these, 11 are designated by the Natural Heritage Information Centre (NHIC, 2006) as S5, i.e., very common in Ontario and demonstrably secure, whereas 12 are S4, i.e., common in Ontario and apparently secure.

TABLE 2.17: AQUATIC AVIFAUNA SPECIES RECORDED IN THE TIMMINS AREA[1]

Common Name	*Scientific Name*	Breeding Status[2]	Provincial Status[3]
Loons	**Gavidae**		
Red-throated loon	*Gavia stellata*		S1S2
Common loon	*G. immer*	Confirmed	S4
Grebes	**Podicepididae**		
Pied-billed grebe	*Podilymbus podiceps*	Possible	S4
Horned grebe	*Podiceps auritus*		S1
Red-necked grebe	*P. grisegena*		S3
Cormorants	**Phalacrocoracidae**		
American white pelican[4]	*Pelecanus erythrorhyncos*		SAN
Double-crested cormorant	*Phalacrocorax auritus*		S4
Herons and Bitterns	**Ardeidae**		
American bittern	*Botaurus lentiginosus*	Possible	S4
Great blue heron	*Ardea herodias*	Possible	S5
Cattle egret	*Bubulcus ibis*		SZN
Black-crowned night heron	*Nycticorax nycticorax*		S3
Swans, Geese and Ducks	**Anatidae**		
Whistling (tundra) swan	*Cygnus columbianus*		S3
Mute swan	*C. olor*		SE
Snow goose	*Chen caerulescens*		S4
Greater white-fronted goose	*Anser albifrons*		SZN
Brant goose	*Branta bernicla*		SZN
Canada goose	*B. canadensis*	Possible	S5
Wood duck	*Aix sponsa*		S5
Green-winged teal	*Anas crecca*	Probable	S4
American black duck	*A. rubripes*	Confirmed	S5
Mallard	*A. platyrhynchos*	Confirmed	S5
Northern pintail	*A. acuta*		S5
Blue-winged teal	*A. discors*	Confirmed	S5
Northern shoveler	*A. clypeata*		S5
Gadwall	*A. strepera*		S5
American wigeon (Baldpate)	*A. americana*	Possible	S4
Eurasian wigeon	*A. penelope*		SZN
Canvasback	*Aythya valisineria*		S1
Redhead	*A. americana*		S2
Ring-necked duck	*A. collaris*	Confirmed	S5
Greater scaup	*A. marila*		S2
Lesser scaup	*A. affinis*	Probable	S4
Oldsquaw	*Clangula hyemalis*		S2S3
White-winged scoter	*Melanitta fusca*		S1S2
Black scoter	*M. nigra*		SZN
Surf scoter	*M. perspicillata*		S1
Common goldeneye	*Bucephala clangula*	Confirmed	S5
Bufflehead	*B. albeola*		S3
Hooded merganser	*Lophodytes culcullatus*	Confirmed	S5
Common merganser	*Mergus merganser*	Confirmed	S4
Ruddy duck	*Oxyura jamaicensis*		S2

Common Name	*Scientific Name*	Breeding Status[2]	Provincial Status[3]
Rails, Gallinales and Coots	**Rallidae**		
Yellow rail[5]	*Coturnicops noveboracensis*		S4
Virginia rail	*Rallus limicola*		S4
American coot	*Fulica americana*	Possible	S4
Sora	*Porzana carolina*		S4
Cranes	**Gruidae**		
Sandhill crane	*Grus canadensis*		S4
Plovers	**Charadriidae**		
Semipalmated plover	*Charadrius semipalmatus*		S4
Killdeer	*C. vociferous*	Confirmed	S4
Lesser golden plover	*Pluvialis dominica*		S1
Black-bellied plover	*P. squatarola*		SZN
Sandpipers and Phalaropes	**Scolopacidae**		
American avocet	*Recurvirostra americana*		SZN
Greater yellowlegs	*Tringa melanoleuca*		S4
Lesser yellowlegs	*T. flavipes*		S4
Solitary sandpiper	*T. solitaria*	Probable	S4
Spotted sandpiper	*Actitis macularia*	Confirmed	S5
Upland sandpiper	*Bartramia longicauda*		S4
Marbled godwit	*Limosa fedoa*		S2
Hudsonian godwit	*L. haemastica*		S2S3
Ruddy turnstone	*Arenaria interpres*		SZN
Least sandpiper	*Calidris minutilla*		S4
Semipalmated sandpiper	*C. pusilla*		S3S4
White-rumped sandpiper	*C. fuscicollis*		SZN
Pectoral sandpiper	*C. melanotus*		SZN
Dunlin (Sanderling)	*C. alpina*		SZN
Buff-breasted sandpiper	*Tryngites subraficallis*		SZN
Short-billed dowicher	*Limnodromus griseus*		SZN
Common snipe	*Gallinago gallinago*	Probable	S5
American woodcock	*Scolopax minor*		S5
Red-necked phalarope	*Phalaropus lobatus*		S3
Wilson's phalarope	*P. tricolor*		S3
Gulls and Terns	**Laridae**		
Bonaparte's gull	*Larus philadelphia*	Probable	S4
Ring-billed gull	*L. delawarensis*		S5
Herring gull	*L. argentatus*	Confirmed	S5
Glaucous gull	*L. hyperboreus*		SZN
Great black-backed gull	*L. marinus*	Probable	S2
Common tern	*Sterna hirundo*		S4
Black tern[6]	*Chlidonias niger*		S3

1 Source: http://mrca.vianet.on.ca/Whiskyjack/wjpage2.html.
2 Cadman *et al*. (1987).
3 Source: NHIC (2006); S5 = very common in Ontario, demonstrably secure; S4 = common in Ontario, apparently secure; S3S4 = rare to uncommon in Ontario; S3 = rare to uncommon in Ontario; S2S3 = very rare to uncommon in Ontario; S2 = very rare in Ontario; S1S2 = very rare to extremely rare in Ontario; S1 = extremely rare in Ontario; SAN = accidental; SZN = not of practical conservation concern as there are no clearly definable occurrences; and SE = exotic.
4 Designated as an endangered species by COSSARO (MNR, 2006) regulated under the *Endangered Species Act.*
5 Designated as a species of concern by COSEWIC (2006), as well as by COSSARO (MNR, 2006) but not listed in regulation under the *Endangered Species Act*.
6 Designated as a species of special concern by COSSARO (MNR, 2006) but not listed in regulation under the *Endangered Species Act*.

2.2.8 Significant Aquatic Wildlife Species

As indicated in Section 3.11, only lake sturgeon and goldeye are considered to be rare to uncommon by the MNR. Both species occur in the lower reaches of the Mattagami River downstream of the Lower Sturgeon GS. As indicated in Section 2.2.6, 50 lake sturgeon were recently transplanted to the river section between the Wawaitin GS and Sandy Falls GS. None of the aquatic species listed in Tables 2.11, 2.12 and 2.16 are considered at risk federally by COSEWIC (2006).

Of the aquatic avifauna species listed in Table 2.17, the American white pelican is designated as endangered provincially and is protected by regulation under the Ontario *Endangered Species Act* (MNR, 2006), whereas the black tern is designated as a species of concern by COSSARO (MNR, 2006) but not listed in regulation under the *Endangered Species Act*. COSEWIC (2006) lists the American white pelican and black tern in the not at risk category. In addition, the yellow rail and black tern have been designated as being species of special concern by COSSARO but not listed in regulation under the Ontario *Endangered Species Act* (MNR, 2006). These species are not afforded habitat protection under the Provincial Policy Statement (OMMAH, 2005) of the *Planning Act*. Federally, the yellow rail is also designated as a species of concern by COSEWIC (2006), whereas the black tern is considered to be not at risk.

Based on the SARA Schedule 1 Species at Risk Web Mapping Application (Environment Canada, CWS, 2004), no aquatic wildlife species at risk have documented occurrences overlapping the three proposed redevelopment sites. Similarly, examination of the NHIC (2006) database indicated that there were no records of aquatic wildlife species, including the American white pelican, yellow rail and black tern, within a 5-km radius of the proposed redevelopment sites.

2.2.9 River Uses

2.2.9.1 General Recreation

The CLI (1972a) has categorized the shorelands around Lake Kenogamissi as primarily Class 4 with moderate capability for outdoor recreation. These shorelands provide access to water affording opportunity for angling or viewing of sportfish; a vantage point or area which offers a superior view; and areas suited to family or other recreation lodging use. These shorelands also exhibit variety, in topography or land and water relationships, which enhances opportunities for general outdoor recreation such as hiking and nature study or for aesthetic appreciation of the area. In addition to the predominant Class 4 lands, some Class 5 and Class 6 lands are also present with moderately low and low capability for outdoor recreation, respectively. These Class 5 and Class 6 lands provide access to areas suited to family or other recreation lodging use and/or organized camping, as well as areas exhibiting major, permanent, non-urban, man-made structures of recreational interest.

Lands around the Mattagami Lake Dam and the Wawaitin GS are designated as Class 3 with moderately high capability for outdoor recreation providing access for sportfishing and sportfish viewing. The Mattagami Lake Dam lands also exhibit cultural landscape patterns of industrial and/or social interest, as well as major, permanent, non-urban man-made structures of recreational interest. The Wawaitin GS lands also provide areas suited for family or other recreational use.

The Mattagami River shorelands from Wawaitin GS to Timmins are predominantly categorized as Class 4 with moderate capability for outdoor recreation. These shorelands provide sportfishing opportunities; views of waterfalls and/or rapids; family or other recreation lodging use; general outdoor recreation opportunities; and/or access to water suitable for popular forms of family boating. The remaining shorelands are classified as Class 5 with moderately low outdoor recreation capability providing access to sportfishing and exhibiting man-made structures of recreational interest.

The shorelands from Timmins to Sandy Falls GS are designated as Class 5 with moderately low capability providing sportfishing and recreational boating opportunities, as well as exhibiting cultural landscape patterns of agricultural and/or social interest.

Between Sandy Falls GS and Lower Sturgeon GS, the shorelands are primarily Class 4 with some Class 5 with moderate and moderately low capabilities, respectively, for sportfishing, canoe tripping, and/or family or other recreation lodging use. The Class 4 lands also provide opportunities to view waterfalls or rapids and exhibit man-made structures of recreational interest.

Downstream of Lower Sturgeon GS to Loon Rapids (CLI, 1972a,b), the shorelands are designated primarily as Class 4 with some Class 5 with moderate and moderately low capabilities, respectively, with opportunities for sportfishing, canoe tripping, organized camping, and/or general outdoor recreation. The Class 4 shorelands also exhibit man-made structures of recreational interest, and provide opportunities for viewing rapids and/or waterfalls, family boating and family or other recreation lodging use. The Class 5 shorelands also provide opportunities for viewing wetland and upland wildlife.

Inland from the Mattagami River, the lands are primarily designated as Class 6 with some Class 5 with low and moderately low capabilities for outdoor recreation, respectively, with opportunities for access to sportfishing and general outdoor recreation such as hiking and nature study, as well as for viewing wetland and upland wildlife. The Class 6 lands also exhibit cultural landscape patterns of agricultural or social interest and interesting landform features other than rock formations. In addition, some inland areas are classified as Class 7 with very low capability for outdoor recreation affording opportunity for viewing of upland wildlife.

The Wawaitin Holiday Park (a tourist outfitter lodge), the Cache Campgrounds (a tent/trailer park) and Post 392 (a bed & breakfast cottage) on Kenogamissi Lake provide opportunities for fishing, boating, canoeing, camping, snowmobiling and/or hunting.

2.2.9.2 Recreational Boating

Boating and canoeing occur on the Mattagami River upstream and downstream of the three hydroelectric facilities (Sears, 1992). The shallow depth of the Mattagami River at some locations during certain times of the year, as well as the presence of dams and rapids, prevent larger craft from using the river for long distance navigation. Some recreational boating does take place upstream of the three generating stations, particularly on Kenogamissi Lake. The Mattagami River is a designated canoe route (MNR, 1991). Portage trails or roads are available to traverse canoes and gear around the generating stations.

The Timmins Chamber of Commerce has provided route-specific canoe trip information for the upper Mattagami River from Mallette Bridge to the Timmins Waterfront and from the Timmins Waterfront to Sandy Falls, as well as for the Grassy River from High Falls to Dalton Road Bridge and the Tatachikapika River from Highway No. 144 to Mallette Bridge (www.timminsoutdoors.ca).

Two boat launch sites are located on Kenogamissi Lake: one at Hydro Bay on Dalton Road and the other at the Cache Campgrounds on Highway No. 144. A boat launch is also present on both sides of the river downstream of the Sandy Falls GS.

Wild Exodus of Timmins (out of Wawaitin Holiday Park) provides guided excursions on the Mattagami River (extending as far north as James Bay) and its tributaries (e.g., Grassy River, Tatachikapika River).

2.2.9.3 Commercial Fishing

Historically, one commercial licence was issued to fish lake sturgeon with 300 baited hook lines from Sandy Falls to Poplar Rapids on the Mattagami River (Payne, 1987). The commercial harvest fluctuated widely from a record high of 5,518 kg in 1948 to a low of 190 kg in 1967 with low catches thereafter. This licence was revoked in the early 1980s due to the declining stocks from overexploitation and concern for the continued viability of lake sturgeon populations in this section of the river (Nowak and Hortiguelo, 1986; Payne, 1987; Brousseau and Goodchild, 1989).

A commercial gillnet fishery for lake whitefish operates at the south end of Kenogamissi Lake (Sears, 1992). In 1990-91, the operator harvested approximately 800 kg of lake whitefish, 5 kg of northern pike and 5 kg of walleye under the allowable quota of 1,000 kg of whitefish and 25 kg each of northern pike and walleye. The fish are sold locally.

Commercial baitfishing activities are common in the Timmins area. The MNR Timmins District office controls and issues baitfishing licences. Baitfish consists of shiners, chubs, suckers and dace and are usually caught during the summer months.

MNR (1990) indicated that there were 15 baitfish dealers in MNR Timmins District with a reported 1986 harvest of 63,000 dozen. It was anticipated that both participation in the baitfish industry and baitfish harvest will increase by the year 2000 with no harm to the resource.

2.2.9.4 Sportfishing

Sportfishing provides recreation, food and tourist dollars for the residents of northern Ontario and is mainly centred on the larger lakes and rivers. Fishing is conducted by local and other Ontario residents, as well as out-of-province visitors.

Walleye has been consistently the most sought after species by anglers on the Mattagami River. The Sandy Falls site and downstream Fish Sanctuary, as well as the entire upstream section of the Mattagami River which passes through Timmins, experience heavy fishing pressure (Sears, 1992). As indicated in Section 2.2.6, fishing in the Sandy Falls Fish Sanctuary occurs outside of the protected season of 01 April to 14 June. Based on a creel survey of 514 anglers in the summer of l983 between Sandy Falls GS and Lower Sturgeon GS, 94% of the anglers fished in the vicinity of the Sandy Falls GS. The sportfish catch consisted of northern pike (62%), walleye (34%) and yellow perch (4%). Catch-per-unit-effort (CPUE) for all species caught was 0.22 fish/h, which is considered below the MNR District level.

Sportfishing is less common at and downstream of the Lower Sturgeon GS and Wawaitin GS. Some angling for brook trout occurs at the mouths of tributaries downstream of the Wawaitin GS (Sears, 1992).

Kenogamissi Lake provides an important recreational fishery particularly to residents of Timmins and area. Creel data for 1989 indicate that an estimated 5,800 walleye and 4,370 northern pike were caught between 20 May and 31 August representing CPUEs of 0.218 walleye/h and 0.165 pike/h (Burkhardt, 1990b). Much smaller numbers of yellow perch and smallmouth bass were also taken in the sportfishery. In comparison, Deyne (1983) reported CPUEs of 0.307 and 0.299 walleye/h and 0.130 and 0.333 pike/h for creel surveys undertaken in 1971 and 1975, respectively. Burkhardt (1990c) reported that based on growth parameters, walleye and northern pike populations were improved in 1989 compared to 1971 and 1975. However, pressure, success and harvest data suggest that the 1989 populations were under stress due to past overharvesting. As indicated in Section 3.11, fishing in the Upper Dam Fish Sanctuary which is a prime fishing location for local anglers is only permitted outside the protected season of 01 April to 14 June. Ice fishing also occurs on Lake Kenogamissi.

Timmins occurs within the OMNR Division 19 fishing area, with specific fishing seasons (Table 2.18) and catch limits.

TABLE 2.18: FISHING SEASONS IN DIVISION 19 FISHERY AREA[1]

Species	Open Season
Lake sturgeon	01 January to 14 May and 15 June to 31 December
Northern pike	Open all year except 24 December
Lake whitefish	Open all year except 24 December
Brook trout	01 January to 15 September
Smallmouth Bass	Open all year except 24 December
Yellow perch	Open all year except 24 December
Walleye	01 January to 14 April and third Saturday in May to 31 December

[1] Source: MNR (2005); for sportfish species present in the Mattagami River (see Table 2.12).

2.2.9.5 Municipal Water Supply

Timmins relies on the Mattagami River for most of its municipal water supply with the water treatment plant located just south of Highway No. 101 in the city. In addition, approximately 90 households and cottages were identified downstream of the Wawaitin GS in areas located outside of municipal piped water service (Ager, 2001). The majority of these residences are likely surface water users.

2.2.9.6 Hydropower Facilities

There are ten hydroelectric generating stations and eight dams in the Mattagami River watershed. Table 2.19 provides a summary description of these hydroelectric facilities and dam structures.

2.2.9.7 Other Uses

Wild rice harvesting occurs at the mouth of Croft Creek, about 5 km upstream of Sandy Falls GS.

The three hydroelectric facilities are located on a section of the Mattagami River that had been designated as the Kenogamissi-Mattagami Recreation Corridor (MNR, 1983). This river section was under consideration for water-based recreation and cottage development. Along the Mattagami River between Wawaitin GS and Lower Sturgeon GS, there are over 280 cottages/residences, a youth camp and a tent/trailer park. Access limitations prevent more extensive use of the area downstream of the Lower Sturgeon GS. There are over 250 cottages around Kenogamissi Lake. One tourist outfitter lodge (Wawaitin Holiday Park) on the east shore, whereas a tent/trailer park (The Cache Campgrounds) and a bed & breakfast cottage (Post 392) on the west shore, operate on the lake.

TABLE 2.19: SUMMARY OF HYDROELECTRIC FACILITIES AND DAM STRUCTURES IN THE MATTAGAMI RIVER WATERSHED[1]

Facility/Dam	Owner/ Operator	Comments
Mesomikenda Lake Dam	OPG	This control dam is located at the outflow of Mesomikenda Lake. Water levels are maintained between 364.85 and 365.30 m during the period 15 May to 01 July to protect fish habitat. The levels are also maintained between 364.94 and 365.30 m from Victoria Day to Thanksgiving weekend in October for recreational and navigational needs. If required, the levels can be increased to reduce flooding downstream.
Minisinakwa Lake Dam	MNR	Located approximately 10 km downstream from the community of Gogama, this dam controls discharges from Minisinakwa Lake into the Minisinakwa River (main branch of the Mattagami River system). The target summer and winter water levels are 348.69 and 347.78 m, respectively. The facility is currently operated to remove all but one log in each bay of the south dam in preparation for the spring freshet. Log operations are carried out in conjunction with log operations at the upstream Mesomikenda Lake Dam.
Mattagami Lake Dam	OPG	Located at the outlet of Mattagami Lake, this dam controls lake flow into Kenogamissi Lake, which is the forebay for Wawaitin GS. This provides flood control for Timmins as it has the largest storage capacity on the upper Mattagami River system. The MNR and OPG collaborate to adjust flows to maximize the spring walleye spawn. The water level is maintained between 330.90 and 331.48 m from Victoria Day to Thanksgiving Day weekend for recreational and navigational purposes.
Wawaitin GS	OPG	The Wawaitin GS is located at the outlet of Kenogamissi Lake. The forebay at Wawaitin GS is drawn down to 309.10 m in the spring to help mitigate flooding downstream in Timmins. The water level is maintained between 310.38 and 310.68 m from Victoria Day weekend until Thanksgiving weekend for recreational and navigational purposes. During dry periods water is pulled from Wawaitin GS forebay to ensure that domestic water intakes for the City of Timmins remain submerged.
Sandy Falls GS	OPG	Sandy Falls GS, located approximately 11 km downstream of the Timmins urban centre, is fed by Wawaitin GS as well as the Peterlong Dam on the Grassy River. The upstream water level at Sandy Falls GS is maintained above 269.0 m to ensure that the City of Timmins domestic water intakes remain submerged.
Peterlong Lake Dam	OPG	This dam controls Peterlong Lake flow into the Grassy River, which flows into the Mattagami River upstream of Timmins, and also serves to mitigate flooding in Timmins, as it is the second largest reservoir on the Upper Mattagami River system. During dry periods, water from Peterlong Lake is used to supplement flows for the Timmins domestic water intakes.

Facility/Dam	Owner/ Operator	Comments
Lower Sturgeon GS	OPG	The Lower Sturgeon GS is located approximately 48 km southeast and downstream of the Timmins urban centre. An agreed upon minimum flow of 15 m^3/s is maintained at all times for the Tembec Industries Inc. (Tembec) Kraft Mill in the Town of Smooth Rock Falls to sustain the ecology downstream. The upstream water level is maintained between 257.70 and 258.30 during the summer months for recreational and navigational purposes.
Smooth Rock Falls GS	Tembec	The Smooth Rock Falls GS is operated on the Mattagami River as a run-of-the-river facility. The hydroelectricity generated is used in the production of kraft (sulphate) pulp. The forebay elevation is normally maintained between 228.77 and 228.89 m under normal conditions. The maximum operating elevation is 228.92 m.
Kapuskasing GS	Spruce Falls Inc. (SFI)	The Kapuskasing GS, operated as a run-of-the-river facility, is located on the Kapuskasing River approximately 60 km upstream of the confluence with the Mattagami River. The forebay level is maintained between 212.79 and 212.91 m from 01 November to 01 April and between 212.86 and 213.00 m from 01 June to 30 September for economic (mill water supply and wood delivery via ice bridge) and seasonal recreational and navigation purposes. The forebay may be drawn down to 212.73 m in the spring to help mitigate flooding downstream.
Remi Lake Dam	MNR	The Remi Lake Dam consists of two dams at the outlet of Remi Lake approximately 17 km north of the community of Moonbeam. Water from the dam discharges into the Kapuskasing River, which joins the Mattagami River further downstream. During the summer, the dam is set with all logs in place to regulate to elevation 227.17 m. When necessary, one log is manipulated to control the summer water level for recreational and navigational purposes. In the fall, one stop log is removed prior to freeze up to allow the water level to slowly drop over the winter months in preparation for the spring runoff. The target water elevation during the winter months is 226.26 m. Two more stop logs are removed in the latter part of March to allow for spring freshet.
Horwood Lake Dam	OPG	The Horwood Lake Dam, located at the outlet of Horwood Lake, controls Horwood Lake flow into Groundhog Lake and the Groundhog River. Maximum discharge has been established to mitigate flooding downstream on Groundhog Lake. MNR and OPG collaborate to adjust flows to maximize spring walleye spawn. Minimum flow is maintained on a reasonable-effort basis to sustain the ecology downstream. The water level upstream is maintained between 334.25 and 334.86 m from Victoria Day weekend to Thanksgiving Day weekend for recreational and navigational purposes. All changes in flow are communicated to Carmichael Falls GS downstream.
Ivanhoe Lake Dam	MNR	The Ivanhoe Lake Dam, located at the outflow of Ivanhoe Lake, controls the level of the lake for recreation. Water from the dam discharges into the Ivanhoe River which feeds into the Groundhog River upstream of the Carmichael Falls GS. The Ivanhoe Lake level is maintained between 341.25 and 341.40 m with a target elevation of 341.34 m from Victoria Day weekend to Thanksgiving for recreational and navigational purposes.

Facility/Dam	Owner/ Operator	Comments
Carmichael Falls GS	Brookfield Power (Sault Ste. Marie)	This run-of-the-river facility is located on the Groundhog River approximately 20 km of the community of Faquier. Flows are largely controlled by the upstream Horwood Lake Dam on the Groundhog River and the Ivanhoe Lake Dam on the Ivanhoe River. The flow release profile is managed according to a headpond level of between 226.0 and 226.4 m.
Zadi Lake Dam	OPG	The Zadi Lake Dam, located on the Opasatika River at the outlet of Zadi Lake, diverts water from the Opasatika River to Little Long GS via Hull Creek while maintaining adequate water levels in Allan and Zadi Lakes. When the water level at the Highway No. 11 Bridge reaches 219.76 m, logs are removed at Zadi Lake Dam to prevent flooding of the park and highway. Opasatika Lake discharge is diverted from Zadi Lake into the Hull River to provide additional water to the Mattagami River (Little Long headpond). If the Little Long GS is spilling water, Zadi Lake Dam can be opened to let the Opasatika flow down its original path.
Mattagami GS Complex	OPG	The Mattagami GS complex consists of four separate facilities: the Little Long GS, Smoky Falls GS and Harmon GS peaking facilities and the Kipling GS baseload facility. With a maximum output of 132.8 MW, the Little Long GS is fed from the Smooth Rock Falls GS in the Mattagami River, the Kapuskasing GS on the Kapuskasing River, the Lost River Diversion and the Carmichael Falls GS on the Groundhog River. The Adam Creek Diversion/ Spillway was built to bypass the lower Mattagami River plants during freshet periods (or other times) when the total inflow to Little Long GS exceeds plant capacity (583 m^3/s). Maximum outputs of the Smoky Falls GS, Harmon GS and Kipling GS are 56 MW, 140 MW and 142 MW, respectively.

[1] Source: OPG *et al.* (2006).

3.0 IMPACT ASSESSMENT AND MITIGATIVE MEASURES

The available environmental baseline information and site-specific aquatic vegetation, benthic macroinvertebrate and fisheries survey findings provided the basis for an assessment of potential construction and operational effects on the aquatic environment, e.g., due to cofferdam installation/ removal, dewatering, blasting/rock fragment excavation, soil erosion and turbidity generation, etc.

Recommended mitigative measures for project effects on the aquatic environment are based on standard environmental construction guidelines, relevant government guidelines for proposed hydroelectric power plant development, as well as government agency and other organization consultation.

The significance of potential impacts was based on their magnitude, duration and extent after the implementation of recommended mitigative measures.

3.1 Surface and Groundwater Hydrology

For the proposed Wawaitin GS redevelopment, the new powerhouse will be located adjacent to the north of the existing powerhouse (see Figures 1.4 and 1.5). A new steel penstock, about 850 m in length, will be buried parallel to the south of the existing twin penstocks. A new upper tailrace section, approximately 10 m wide, 7 m deep and 30 m long, will be excavated from the new powerhouse location to the existing tailrace. Upon completion of the new generating station, the existing powerhouse will be decommissioned. Existing surge tanks and aboveground penstock sections will be removed and backfilled. The buried penstock sections will either be excavated or filled in.

For the proposed Sandy Falls GS redevelopment, the new powerhouse will be located adjacent to the east of the existing powerhouse (see Figure 1.7). A water canal will connect the new powerhouse to the existing intake structures. Upon completion of the new generating station, the existing powerhouse will be decommissioned. The existing surge tanks and aboveground penstock will be removed and backfilled. The buried penstocks will either be excavated or filled in.

For the proposed Lower Sturgeon GS redevelopment, the new powerhouse is planned to be located on the same footprint as the existing powerhouse. The existing powerhouse will be demolished followed by the construction of the new facility. The concrete base of the existing powerhouse extends to depths of approximately 8 to 11 m. Although this concrete base is of good quality with few zones of poor or very poor quality, it will be removed prior to construction of the new powerhouse foundation.

As indicated in Section 2.1.1, drainage ditches are present on the Wawaitin GS and Lower Sturgeon GS properties. These drainage ditches may be affected by sediment loadings due to accelerated soil erosion during construction. Till and gully erosion caused by channelized overland flow can also be a major source of soil erosion. Sheet erosion can be an additional source of sediment.

Erosion and sediment control will be an integral component of the construction planning process. All personnel involved with the proposed works will be briefed on erosion and sediment control including engineers, contractors, inspectors and environmental staff. In general, the following guidelines will be applied in the development of the Erosion and Sediment Control Plan:

- fitting of proposed works to the terrain;
- timing of grading and construction activities to minimize soil exposure;
- retention of existing vegetation where feasible;
- restriction of the use of heavy construction equipment to within the approved work areas to minimize soil disturbance and vegetation destruction;
- storage of striped soil at upland locations;
- implementation of erosion control measures, e.g., rip rap berms underlain by filter geotextile, straw bales used as filters, silt fencing along the shoreline and/or mulching for interim stabilization;
- diversion of runoff away from exposed areas;
- minimization of the length and steepness of slopes;
- maintenance of low runoff velocities;
- design of drainage works, such as ditches and outfalls, to handle concentrated runoff;
- retention of sediment on site;
- routine inspection and maintenance of erosion and sediment control measures; and,
- revegetation of disturbed areas by seeding and/or planting following construction as soon as seasonal conditions permit;

As indicated in Supporting Document 2 – Terrestrial Environment, site-specific Erosion and Sediment Control Plans, addressing the areas around the existing and new powerhouses and their ancillary infrastructures, as well as the construction laydown and assembly areas, will be prepared and implemented during construction. The site-specific Erosion and Sediment Control Plan will be part of a broader Environmental Management Plan for each redevelopment project.

For any new temporary crossings of these drainage ditches, standard construction procedures will be followed including crossing design (culvert or ford), installation and maintenance. For new crossings, a permit must be obtained from the MRCA.

The implementation of these standard procedures during construction and rehabilitation will obviate or minimize potential effects on surface hydrology.

Blasting will likely be required to facilitate new powerhouse and/or ancillary infrastructure construction at the Wawaitin GS and Sandy Falls GS redevelopment sites. At the Lower

Sturgeon GS redevelopment site, blasting will be required to demolish the existing powerhouse and its foundation. Blasting may also be required at one or more of the redevelopment sites for grading of rock outcrops in the proposed material laydown and assembly areas.

Explosives used in construction will be closely controlled, with their use restricted to authorized personnel who have been trained in the use of explosives in a manner so as to minimize impacts on the environment. Appropriate government agencies and the local residents will be informed of the blasting schedule in advance of construction, as well as just prior to the detonation program. All necessary permits will be obtained by the Design-Build-Contractor (DBC), who will also comply with all legal requirements in connection with the use, storage and transportation of explosives, including, but not limited to, the *Canada Explosives Act* and the *Transportation of Dangerous Goods Act*. The DBC will be required to retain a consulting engineer with technical expertise in blasting to provide advice on maximum loading of explosives for all blasting, as well as an engineering report indicating recommended charges and blasting methods to be used at specific locations. All blasting will occur in such a way as to be in compliance with federal regulations and directions.

Blasting could have a potential effect on groundwater quality and flow in the immediate vicinity of the blasting operations (Fitchko *et al.*, 1998). It has been estimated that peak particle velocities produced from blasting operations in excess of 600 mm/s will cause cracks and discontinuities in sedimentary rock up to a 5-m radial distance from the blast using the sophisticated techniques and control measures employed in modern blasting practice. Damage (seam creation) will be less and more localized in Precambrian rocks. Minimization of the physical effects of blasting will be ensured by following the recommendations of the blasting engineer.

Wells providing potable or other service groundwater within 100 m of blasting activities should be identified and sampled for water quality and level prior to and after blasting to confirm no effects on groundwater resources.

No effects on surface hydrology and groundwater are anticipated as a result of the operation of the proposed Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS; therefore, no mitigation is required.

3.2 Upper Mattagami River

For the proposed Wawaitin GS redevelopment, the existing four-unit GS, with a maximum output of 10.4 MW will be replaced by a new two-unit GS with a maximum output of 15 MW. A single penstock will replace the two existing penstocks (Figure 1.4). Although the new penstock and GS will not occupy the same locations as the existing penstocks and GS, the intake will be located at the same position at the end of the intake canal (Figure 1.4). The new tailrace will be a 48-m long channel that will discharge to the existing tailrace channel (Figures 1.4 and 1.5). The existing GS will be decommissioned and demolished, and the existing penstocks will be removed and/or buried in-place. The unused section of existing tailrace will be retained to provide fish habitat.

A cofferdam will be required in the intake channel to dewater approximately 630 m^2 (0.06 ha) of the channel in the vicinity of the penstock intake (Photograph 1.3). A second cofferdam will be required to dewater approximately 2,950 m^2 (0.295 ha) of the upper section of the existing tailrace (Photograph 1.2) to allow construction of the new tailrace and the decommissioning of the existing Wawaitin GS. It is anticipated that the cofferdams will be in place for 12 to 14 months.

During the period when no flow is being diverted through the Wawaitin GS, all flow in the Upper Mattagami River will be passing through the spill channel (Figure 1.4).

For the proposed Sandy Falls GS redevelopment, the existing three-unit GS, with a maximum output of 3.0 MW, will be replaced by a new single unit GS with a maximum output of 5.5 MW. Instead of penstocks, which are currently used, the proposed GS will utilize an intake canal to deliver water from the existing dam to the powerhouse (Figure 1.7). Although the new canal and GS will not occupy the same location as the existing penstocks and GS, the intake structure will remain at the same location and will be enlarged. The new tailrace will discharge adjacent to the existing tailrace and will be orientated such that it discharges into the same area as the existing tailrace (Figure 1.7). The existing GS will be decommissioned and the existing penstocks will be removed and/or buried in-place. The unused section of the existing tailrace will be retained to provide fish habitat.

A cofferdam will be required at the intake structure and for weir dam refurbishment to dewater approximately 870 m^2 (0.09 ha) of the Mattagami River (Photograph 1.5). A second cofferdam will be required at the tailrace to dewater approximately 500 m^2 (0.05 ha) of river, part of which is presently existing tailrace (Photograph 1.6), to allow construction of the new tailrace configuration. It is anticipated that the upstream cofferdam will be in place for 6 months and the downstream cofferdam will be in place for 12 to 14 months.

During the period when no flow is being diverted through the GS, all flow in the Upper Mattagami River will be passing through the spill channel (Figure 1.7).

For the proposed Lower Sturgeon GS redevelopment, the existing two-unit GS, with a maximum output of 5.3 MW, will be replaced by a new two-unit GS with a maximum output of approximately 14 MW. The existing GS will be completely demolished and the proposed GS will be built upon the footprint of the existing GS. The configuration of the GS will remain the same, with water from the headpond directly entering short penstocks contained within the powerhouse, passing through the turbines and draft tubes, and then discharging via the tailrace (Figure 1.9). The intake and the tailrace of the proposed facility will occupy the same locations and have the same orientation as the existing facility; however, they will be deepened to accommodate the larger plant flows.

A cofferdam will be required at the intake structure to dewater approximately 520 m^2 (0.05 ha) of the Upper Mattagami River. A second cofferdam will be required at the tailrace to dewater approximately 1,080 m^2 (0.11 ha) of river, most of which is presently existing tailrace (Photograph 1.8), to allow the deepening of the new tailrace and decommissioning of the existing GS. It is anticipated that the cofferdams will be in place for 12 to 14 months.

During the period when no flow is being diverted through the GS, all flow in the Upper Mattagami River will be passing through the spillway (Figure 1.9).

The temporary cofferdams at each of the three GS locations will be composed of clean rock fill. Temporary cofferdam construction will require the use of heavy equipment along the shoreline and on the rockfill wall as it is built up around the site. The work will also involve dewatering to the area downstream of the cofferdam and as necessary the placement of erosion control structures.

Blasting of bedrock will be required within the dewatered zone at most locations with the rock fragments removed by backhoe. The DFO has developed a number of guidelines on methods and practices which are intended to prevent or avoid the destruction of fish, or any potentially harmful effects to fish habitat that could result from the use of explosives (Wright and Hopky, 1998). The use of temporary cofferdams to permit blasting within the dewatered areas and adherence to the DFO Guidelines and blasting engineer recommendations will avoid the destruction of fish and or harmful alteration, disruption or destruction (HADD) of fish habitat (see Section 3.2.7)

Once construction is completed after blasting, the shoreline plug providing a barrier for water intrusion into the on-land excavation areas will be removed followed by the removal of the temporary cofferdam.

3.2.1 Hydrology

As indicated in Section 3.2, during the periods when no flow is diverted through the three generating stations, all flow in the Mattagami River will be passed through the spill channel or spillway. As a result, the hydrology of the river will not be affected downstream of the generating stations during construction.

As indicated in Section 1.0, the three generating stations have operated as run-of-the-river plants and will continue to do so. The new facilities will continue to operate under the existing Water Management Plan Operating Regimes (OPG *et al.*, 2006). The river flows and levels will not be altered as a result of facility redevelopments, with the minor exceptions discussed in Section 3.2.8.

3.2.2 Water Quality

During the construction periods of the three generating station redevelopments, water quality of the Mattagami River may by affected by soil erosion and turbidity generation, in-water construction activities, accidental spills and waste material dispersion.

As indicated in Section 3.1, site-specific Erosion and Sediment Control Plans will be prepared and implemented during construction.

With the implementation of site-specific Erosion and Sediment Control Plans, the potential effects of soil erosion and turbidity generation in the Upper Mattagami River will be minimized or obviated.

The potential effects of in-water construction activities, such as cofferdam construction on water quality in the Upper Mattagami River, will be minimized by using clean rock fill, the placement of rock fill over similar coarse substrate and judicious selection of the discharge location and water pressure during dewatering.

Incidental spills of oil, gas, diesel fuel and other liquids to the environment could occur during construction. Fuelling and lubrication of construction equipment should be carried out in a manner that minimizes the possibility of releases to the environment. Measures for containment and cleanup of contaminant releases should be followed to minimize contamination of the natural environment, e.g., placement of fuel tanks and generators on plastic sheets bermed around the edges, and use of suitable hydrocarbon absorbent material for cleanup and approved landfill or other disposal. Any spills with the potential to create an impact to the environment should be reported to the MOE as required by provincial spills legislation. Interim sanitary waste collection and availability of treatment facilities should be arranged for the duration of the construction period. All construction waste, washwater and wastewater should be disposed of in accordance with regulatory requirements.

A Hazardous Materials Management Plan, Waste Management Plan and a Spills Emergency Preparedness and Response Plan will be developed for each redevelopment project as part of the broader Environmental Management Plan.

The implementation of these pollution prevention plans will obviate or minimize the environmental effects of accidental releases to the natural environment that have the potential to affect water quality in the Upper Mattagami River.

During dam and outlet structure refurbishment, there is a potential for accidental loss of cement during surface application. Any dripped cement should be recovered from the river bottom for suitable disposal prior to temporary cofferdam removal. All trash and other solid debris should also be collected for appropriate disposal.

Overall, the effects of the construction of the three generating stations on Upper Mattagami River water quality are expected to be localized, temporary and negligible.

3.2.3 Sediments

As indicated in Section 2.2.2, bottom substrate in the Upper Mattagami River in the vicinity of the three generating stations consists predominantly of coarse material, e.g., sand, gravel, cobble, boulder and/or bedrock. After construction, substrate type and quality will be similar to that currently in place. The potential use of fragmented rock generated by blasting activities for fish habitat enhancement and/or use for nearshore/shoreline erosion protection will be discussed with DFO. Otherwise, the excess rock will be removed form the dewatered areas behind the temporary cofferdams for suitable upland disposal.

As the new facilities will continue to operate under the existing Water Management Plan Operating Regimes (OPG *et al.*, 2006), no alternation of sediment type or quality is anticipated.

3.2.4 Aquatic Vegetation

As indicated in Section 2.2.3, no aquatic vegetation was observed by Coker and Portt (2006a,b) downstream of the Wawaitin GS and Sandy Falls GS. At the Lower Sturgeon GS, wild celery and pondweed are sparsely scattered in small patches or individual plants along the east shore opposite the station (Coker and Portt, 2006c). These plants will not be affected by construction activities or future operation of the generating station.

3.2.5 Plankton

Plankton populations will not be affected by construction or operation of the three hydroelectric facilities. Any plankton confined behind the cofferdams will be returned to the river during dewatering.

3.2.6 Benthic Macroinvertebrates

The placement of rock fill may have a localized adverse effect on benthic macroinvertebrate communities on the surface and within the substrate. The extent of disruption depends on the type of bottom substrate, the extent of the disturbed area, any resultant turbidity and sedimentation, and the timing of construction. As indicated in Section 2.2, the substrate in the areas to be excavated consists primarily of boulder, cobble, gravel and/or sand over bedrock, or bedrock. The placement of rock fill over this type of similar substrate will minimize any detrimental effect on the benthic macroinvertebrate communities.

With the use of the larger-size rockfill, sufficient interstitial spaces will be available for the survival and migration of mobile benthic fauna. Recovery after cofferdam removal is expected to be rapid. Recovery is defined as the return of aquatic biotypes after disturbance to an abundance and diversity comparable to that in an adjacent undisturbed control area (Rosenberg and Snow, 1977). The principal mechanism of recolonization by invertebrates is drift (Luedtke and Brusven, 1976; Williams and Hynes, 1977), but other mechanisms, such as lateral migration, vertical migration from within the hyporheic zone (i.e., after burial) and larval recruitment from aerial sources are also important (Luedtke and Brusven, 1976; Williams and Hynes, 1977; Griffiths and Walton, 1978; Hirsch *et al.*, 1978). The rate of recovery is dependent on ambient environmental conditions, the type of organisms present and the size of the disturbed area. In general, there will be less impact upon benthic communities associated with a naturally variable, high energy environment. The benthic organisms are adapted to the high-energy, unstable conditions, and have life cycles that allow them to better withstand these stresses (Hirsch *et al.*, 1978).

In the case of dam refurbishment, the placement of rockfill may also occur on top of finer sediments with benthic communities adapted to a low energy environment. In this case, recovery may be somewhat longer. Although no specific data are available on negative effects of finer substrate coverage by rockfill or other material, recovery rates from dredging activities range from six days (McCabe *et al.*, 1998), 14 days (Rosenberg and Snow, 1977), three weeks (Diaz, 1994), 38 days (Griffith and Andrews, 1981) and up to one year (Griffiths and Walton, 1978).

Blasting of the three redevelopment nearshore areas will result in localized destruction of the benthic communities. Benthic mortality will be a function of distance from and intensity of the blast (Schwartz, 1961). However, recovery from blasting is expected to be rapid (see above).

As the proposed hydroelectric facilities will continue to operate under the existing Water Management Plan Operating Regimes (OPG *et al.,* 2006), no effect on benthic macroinvertebrate communities is anticipated.

3.2.7 Fish Populations

As indicated in subsection 2.1.5 of the Provincial Policy Statement (OMMAH, 2005), development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements. Sections 3.2.7 and 3.2.8 present the recommended mitigation measures to be implemented for the three proposed redevelopments to meet regulatory requirements.

<u>During Construction</u>

The area within the temporary cofferdam will be dewatered to facilitate intake reconstruction, tailrace excavation and/or dam refurbishment. An impervious geotextile will be placed on the cofferdam face to preclude water ingress. Fish within the area to be dewatered will be collected by electrofishing during drawdown and released to the river. The temporary unavailability of this habitat during the excavation period will have negligible effect on the local fish populations.

Blasting of bedrock will be required in the nearshore areas to be excavated. Numerous studies have been undertaken to assess fish mortality due to in-water blasting (e.g., Hubbs and Rechnitzer, 1952; Fry and Cox, 1953; Ferguson, 1962; Foye and Scott, 1965; Chamberlain, 1976, 1979; Teleki and Chamberlain, 1978; McAnuff and Booren, 1989; Keevin *et al.*, 1997). The degree of blasting impact on fish will depend on the type of explosive, type of substrate blasted, blasting technique, fish physiology and timing. Injury to fish from in-water blasting will result from physical abrasion from ejected debris and from pressure changes associated with the blast shock waves.

Common blast-induced injuries to fish include haemorrhage in the coelomic or pericardial cavity and rupture of the swim bladder. Differences in species-specific susceptibility to blast injuries are a function of the fish's shape and swim bladder formation (Teleki and Chamberlain, 1978). Physoclistic (with swim bladder isolated from oesophagus) and laterally compressed fish such as the centrarchids, e.g., smallmouth bass, are the most sensitive to pressure changes. Mortality within this group varies with orientation of the laterally-compressed body to the pressure front at the time of a blast. Physostomic (with swim bladder connected to the oesophagus by an open duct, which provides pressure release) fish with fusiform shape, such as the white sucker, are most resistant to pressure changes.

To obviate injury to fish, blasting will be undertaken in the “dry”, i.e., after dewatering and removal of fish. The shockwaves (peak particle velocities) produced from blasting using the sophisticated techniques and control measures employed in modern blasting practice will be attenuated rapidly within the bedrock. With the width of the cofferdam and its sufficient distance from the limit of blasting, no injury to fish from pressure changes associated with the blast shockwaves is expected. Moreover, blasting mats will be used to minimize the occurrence of fly-rock.

As indicated in Section 3.2, during the period when no flow is being diverted through the Wawaitin GS and Sandy Falls GS, all flow in the Upper Mattagami will be passing through the spill channel. For Lower Sturgeon GS, all flow will be passing through the spillway.

For the proposed Wawaitin GS redevelopment, the relatively small areas that will be temporarily dewatered are portions of constructed channels with granular substrate in a range of sizes (Coker and Portt, 2006d). Because these channels were designed to convey water efficiently, the bottom is relatively smooth with few protruding features that would provide structural habitat for fish. The areas impacted by the proposed cofferdams and dewatering are manmade habitats that are not thought to be critical for any life stages of any of the species present. The fact that they are temporarily unavailable is not expected to have any significant impact on the overall fish production of the system.

Diverting all flow through the Wawaitin GS spill channel will not result in increased erosion since the spill channel is the original channel of the Mattagami River, and has historically accommodated the total river flow. Flows in the important walleye and sucker spawning habitat that occurs downstream of the tailrace will not be altered during this construction period, as they are downstream of the confluence of the tailrace and the bypass channel, and flow in the Mattagami River will continue to be managed as it was prior to the redevelopment. Walleye spawning observations in 2005 and 2006 did not identify the spill channel as a significant spawning area for walleye or suckers (Coker and Portt, 2005b, 2006g). No other critical or important habitats are thought to occur here that may be impacted by this temporary change in spill channel flow (Coker and Portt, 2006a,j). The temporary change in spill channel flow is not expected to have a negative effect upon the resident fish community within the spill channel (Coker and Portt, 2006d).

For the proposed Sandy Falls GS and Lower Sturgeon GS redevelopments, the relatively small areas that will be temporarily dewatered have historically been impacted by the construction and operation of the existing generating stations, and are likely exposed bedrock or exposed bedrock overlain with a relatively thin layer of coarse granular material (Coker and Portt, 2006e,f). Because these areas were designed to convey water efficiently, the bottom has few protruding features that would provide structural habitat for fish. These areas are not thought to be critical for any life stages of any of the species present, and the fact that they are temporarily unavailable is not expected to have any significant impact on the overall fish production of the system.

Diverting all flow through the Sandy Falls GS spill channel and Lower Sturgeon GS spillway will not result in increased erosion since the spill channel and spillway are the original channels of the Mattagami River, and have historically accommodated the total river flow. Flows in the important walleye and sucker spawning habitat that occurs downstream of the Sandy Falls GS tailrace will not be altered during this construction period, as they are downstream of the confluence of the tailrace and the spill channel, and flow in the Mattagami River will continue to be managed as it was prior to the redevelopment. Similarly, flows in the walleye and sucker spawning habitat that may be, and probably are, present in the several kilometres of rapids downstream of the confluence of the Lower Sturgeon GS tailrace and the spillway will not be altered during this construction period, as flow in the Mattagami River will continue to be managed as it was prior to the redevelopment. Walleye spawning observations in 2005 and 2006 did not identify the Sandy Falls GS spill channel or Lower Sturgeon GS spillway as significant spawning areas for walleye or sucker (Coker and Portt, 2005a,c, 2006h,i). No other critical or important habitats are thought to occur here that may be impacted by the temporary changes in spill channel and spillway flow (Coker and Portt, 2006b,c). The temporary changes in spill channel and spillway flows are not expected to have a negative effect upon the resident fish community within the spill channel and spillway (Coker and Portt, 2006e,f).

To minimize or obviate effects on fish populations at the three GS redevelopment sites, Coker and Portt (2006d,e,f) recommended the followed mitigative measures:

- In-water construction activities should be timed to avoid the spawning and incubation period of spring spawning fishes, such as walleye and suckers, which typically excludes in-water work from 01 April to 15 June for the proposed Wawaitin GS and Sandy Falls GS redevelopments and from 01 April to 01 July for the Lower Sturgeon GS redevelopment due to the presence of lake sturgeon;

- If all water is being diverted through the spill channel at the time of the walleye, lake sturgeon and sucker spawning periods, all water should continue to be diverted through the spill channel until the end of the hatch (15 June or 01 July);

- Sediment and erosion control measures should be implemented as required prior to work and maintained during the work phase, to prevent entry of sediment into the water, including sediment removal from water pumped from within cofferdam enclosures;

- All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substances (e.g., petroleum products, debris, etc.) from entering the water;

- Blasting, if required, should adhere to the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998); and

- Dredged material should be disposed on land above the high water level and suitably contained/ stabilized to prevent the dredged material from re-entering the water.

Upon review of the timing restrictions recommended by Coker and Portt (2006d,e,f), the MNR indicated that the presence of smallmouth bass in the reaches of the Upper Mattagami River encompassing the three proposed redevelopment sites would necessitate a timing restriction of 15 May to 15 July (J. Mucha, MNR, 2007, pers. comm.). As indicated in Section 2.2.6, smallmouth bass is a non-native species introduced to the Moose River Basin headwater lakes. This species generally occurs upstream of the Kenogamissi Falls Dam; however, juveniles were captured at Lower Sturgeon GS in 2006 (see Table 2.13). Furthermore, due to the presence of lake sturgeon transferred upstream of Sandy Falls in 2002, the timing restriction of 01 May to 30 June should apply to all Mattagami River reaches from Wawaitin GS to downstream of Lower Sturgeon GS. With the incorporation of these in-water timing restrictions for the three fish species, the overall timing restriction would extend from 01 April to 15 July.

The MNR also indicated that the presence of lake whitefish, which is a fall spawner with eggs overwintering in the substrate, would necessitate a standard timing restriction of 15 September to 30 May. Lake whitefish spawning has been observed from late October to early December downstream of Mattagami Dam (G. Coker, C. Portt & Associates, 2007, pers. comm.). Spawning usually occurs in shallow water (less than 7.6 m) often over a hard or stoney bottom, but sometimes over sand (Scott and Crossman, 1973). The eggs are deposited more or less randomly above the spawning grounds, drifting downstream to settle in areas of lesser flows. With the hydroelectric plants in operation during cofferdam installation, it is highly unlikely that whitefish eggs will settle in the areas of higher turbulent flow proximate to the tailrace. The potential for increased turbidity generation and siltation is the main concern in protecting lake whitefish eggs. As indicated in Section 3.2.2, implementation of site-specific Erosion and Sediment Control Plans and use of clean rock fill over similar coarse substrate will minimize or obviate turbidity generation. The MNR has indicated that OPG should meet with Timmins District staff once construction details relating to the cofferdams and schedules have been finalized in order to discuss the potential impacts of the timing restrictions and possible mitigative measures.

During Operation

The three proposed redeveloped generating stations will remain as run-of-the-river hydroelectric plants, and therefore, continue to operate in accordance with the approved Water Management Plan (OPG et. al., 2006).

Wawaitin Generating Station

In the case of the proposed Wawaitin GS, the only difference will be in the distribution of water between the GS and the spill channel. Presently, water is spilled through the original river channel when flows exceed the 40 m^3/s capacity of the existing GS, which occurs approximately 23% of the time. The Wawaitin GS is capable of taking all river flow when flows are less than 40 m^3/s. The redeveloped Wawaitin GS will have a rated flow of 45 m^3/s which will decrease the frequency of water spilled through the spill channel from approximately 23% to approximately 10% of the time. Maximum mean flow velocities in the intake channel and in the tailrace are expected to increase from 0.8 to 0.9 m/s. Downstream of where the tailrace joins with the spill channel, flow velocity and volume will not differ between pre- and post-redevelopment.

Since there are no known critical or important habitats within the intake channel and the tailrace, Coker and Portt (2006d) do not anticipate that the approximately 0.1 m/s increase in the maximum mean water velocity that will occur periodically from March to early July will have a significant or measurable effect on the productivity of local fish communities. As a result, no mitigation is proposed.

Water is typically only spilled through the spill channel during the spring melt (March to June), and only when total river flow exceeds the capacity of the existing Wawaitin GS. Outside of that period the flow within the 2.6-km long spillway is approximately 1 m^3/s due to natural inflows. Coker and Portt (2006a) have surmised that this local watershed contribution is the limiting factor for fish productive capacity of the resident fish community in the lower reaches of the spill channel. Therefore, a further decrease in the frequency or duration of spill due to excessive river flow is not expected to have significant negative effects upon the productivity of the spill channel fish community (Coker and Portt, 2006d).

Sandy Falls Generating Station

In the case of Sandy Falls GS after redevelopment, the proposed GS will have a greater flow capacity, and therefore, will alter the distribution of flow volume between the GS and the 200 m-long overflow weir (see Figure 1.7). Presently, water is spilled over the overflow weir when flows exceed the 44 m^3/s capacity of the GS, which occurs approximately 48% of the time. The redeveloped Sandy Falls GS will have a rated flow of 65.4 m^3/s which will decrease the frequency of water spilled over the overflow weir from approximately 48% to 30% of the time. This further decrease in the frequency or duration of flows over the weir is not expected to decrease the productivity of the spill channel fish community (Coker and Portt, 2006e). No critical habitats have been identified within the spill channel that could influence productive capacity.

Downstream of where the tailrace joins with the spill channel, flow velocity and volume will not differ between pre- and post-redevelopment. However, the adjusted location and discharge direction will result in some changes in flow velocity pattern in the immediate vicinity of the new tailrace area. Changes in flow direction will likely cause some shifts in habitat utilization in the immediate vicinity of the tailrace; however, neither the types or quantities of habitat will change significantly, and no significant change in productivity is expected. There are no known critical habitats within the tailrace. The fact that the existing tailrace and the proposed tailrace will continue to discharge into the deep pool adjacent to the GS, ensures that any shifts in habitat utilization caused by flow direction or velocity changes will be local and will dissipate well upstream of the critical habitats located downstream of the existing Sandy Falls GS. As a result, no mitigation is recommended (Coker and Portt, 2006e).

Lower Sturgeon Generating Station

After redevelopment, the proposed Lower Sturgeon GS will also have a greater flow capacity and therefore, will alter the distribution of flow volume between the GS and the spillway. Presently, water is spilled through the spillway when flows exceed the 56 m^3/s capacity of the GS, which occurs approximately 65% of the time. The redeveloped Lower Sturgeon GS will have a rated flow of 123 m^3/s which will decrease the frequency of water spilled through the spillway from approximately 65% to 26% of the time.

Downstream of the confluence of the tailrace and spillway, flow velocity and volume will not differ between pre- and post-redevelopment. However, the increased capacity of the proposed Lower Sturgeon GS will result in more water, on average, being passed through the GS and less through the spillway, resulting in some changes in flow velocity within discrete areas immediately downstream of the tailrace and spillway.

Habitat within the spillway is poor, being almost exclusively a series of bedrock chutes that are subjected to extremes in flow (Coker and Portt, 2006c, f). The extremes of flow and bedrock substrate limit the amount of habitat available and its productivity. As a result, no mitigation is proposed (Coker and Portt, 2006f).

Overall, as the three new facilities will continue to operate under the existing Water Management Plan Operating Regime (OPG *et al.*, 2006), there will be no effect on fish populations. Moreover, impingement of fish on the intake bar racks of the three generation stations in the Upper Mattagami River has not been observed (Sears, 1992).

3.2.8 Fish Habitat

At the proposed Wawaitin GS redevelopment, direct physical impacts to small areas of previously constructed channel will occur where the existing intake structure will be replaced by a new intake structure at the same location, and where the tailrace of the new GS will connect to the existing tailrace (Coker and Portt, 2006d). The existing intake channel and the tailrace have been constructed to facilitate the efficient conveyance of flow, and are therefore relatively flat and provide little habitat structure. In the case of the intake a few metres (< 5 m) of the channel bed and sides, outside of the existing intake structure, will likely require re-contouring to smooth the transition between the existing channel and the new intake structure. The substrate in the intake channel near the penstocks is unknown, but it likely consists of granular material with the concrete walls (see Photograph 1.3).

In the case of the proposed Wawaitin GS tailrace connection, a small section of the vertical channel side will be removed and the bed of the channel may require re-contouring to smooth the transition between the new tailrace channel and the existing tailrace channel. The area that will be altered is relatively small and not critical habitat, consisting of the bedrock side wall of the tailrace and the relatively flat cobble and gravel tailrace floor. It is thought that the cobble and gravel is a thin layer over excavated bedrock. The addition of an approximately 20-m wide and 48-m long section of new tailrace will create additional habitat of the kind found within the existing tailrace. Provided that the following recommended mitigation measure, in addition to those listed in Section 3.2.7, is implemented, the net effect to fisheries production from direct habitat alterations will be negligible (Coker and Portt, 2006d):

- The floor of the proposed tailrace connection with the existing tailrace, as well as any area of the existing tailrace that is re-contoured, should be covered by a layer of cobble-sized material to provide better habitat.

Based on the fisheries impact assessment for the proposed Wawaitin GS, Coker and Portt (2006d) concluded that:

- No critical fish habitats, such as walleye spawning habitats, will be directly altered;
- There will be no changes in the volume of water passing over the critical walleye spawning habitat downstream from the proposed GS tailrace, and thus no change in velocities;
- The areas that will be directly altered are manmade habitats (the intake channel and the tailrace) and, although they do contain fish, the fact that they will be temporarily

unavailable is not expected to have a significant impact on the productive capacity of the system; and

- Following completion of construction, the total amount of habitat in the intake will be essentially unchanged, and the total amount of habitat in the tailrace area will be slightly increased due to the construction of the new tailrace.

Overall, the proposed redevelopment and subsequent operation of the new and enlarged Wawaitin GS will not have a significant or measured effect on the composition or production, respectively, of the Upper Mattagami River fish community.

At the proposed Sandy Falls GS redevelopment, refurbishment and increasing the capacity of the intake structure will not result in any permanent alterations to fish habitat (Coker and Portt, 2006e). A section of the existing riverbank will be removed to accommodate the width of the proposed tailrace, and the riverbed will require re-contouring to smooth the transition between the new tailrace and the existing riverbed. Some of the riverbed re-contouring will likely occur within the existing tailrace. Although the extent of any re-contouring is presently unknown, it will extend, at a maximum, approximately 20 m offshore and will be approximately 14 m wide. The tailrace area and adjacent riverbed that will be altered are not thought to be critical habitat. Most of this area has a substrate of exposed bedrock or exposed bedrock overlain with a relatively thin layer of coarse granular material. However, the cobble shoals that have developed along the lip of the existing tailrace likely provide good general habitat for smaller fish and invertebrates, and for larger foraging fish. The cobble shoal material is expected to re-sort into similar deposits relative to the new tailrace configuration, resulting in an alteration of habitat, but not a habitat loss or a reduction in habitat productivity. Provided that the recommended mitigation measures are implemented, the net impact to fisheries production from direct habitat alterations will be negligible.

Proposed reconstruction of the Sandy Falls GS and maintaining the same intake and tailrace locations, will result in permanent alterations to the floors of the short intake channel and the short tailrace, as both of these will need to be deepened close to the GS to accommodate the flows of the proposed larger GS (Coker and Portt, 2006f). The areas being altered are not thought to be critical habitats, and likely have substrates of exposed bedrock or exposed bedrock overlain with a relatively thin layer of coarse granular material. These works will result in a minor alteration of habitat, but not a habitat loss or a reduction in habitat productivity.

Provided that the following recommended mitigation measure, in addition to those listed in Section 3.2.7, is implemented, the net impact to fisheries production will be negligible (Coker and Portt, 2006e):

- The floor of the new tailrace and any area of the existing riverbed that is re-contoured to expose bedrock, should be covered by a layer of cobble-sized material to provide better habitat.

Based on the fisheries impact assessment for the proposed Sandy Falls GS, Coker and Portt (2006e) concluded that:

- No critical fish habitats, such as walleye or sucker spawning habitats, will be directly altered;
- There will be no changes in the volume of water passing over the critical walleye and sucker spawning habitat downstream, and thus no change in velocities;
- The areas that will be directly altered are mostly manmade habitats (the intake structure, the tailrace, and immediate tailrace vicinity) and, although they do contain fish, the fact that they will be temporarily unavailable is not expected to have a significant impact on the productive capacity of the system; and
- Following the completion of construction the total amount of habitat will be unchanged.

Overall, the proposed redevelopment and subsequent operation of the new and enlarged Sandy Falls GS will not have a significant or measurable impact upon the composition or production, respectively, of the Upper Mattagami River fish community.

Reconstruction of the proposed Lower Sturgeon GS upon the same footprint and maintaining the same intake and tailrace locations, will result in permanent alterations to the floor of the short intake channel and the floor of the short tailrace, as both of these will need to be deepened close to the GS to accommodate the flows of the proposed larger GS. The areas being altered are not thought to be critical habitats, and likely have substrates of exposed bedrock or exposed bedrock overlain with a relatively thin layer of coarse granular material. These works will result in a minor alteration of habitat, but not a habitat loss or a reduction in habitat productivity. Provided that the following recommended mitigation measure, in addition to those listed in Section 3.2.7, is implemented, the net impact to fisheries production will be negligible (Coker and Portt, 2006f):

- The floor of the tailrace and any area of the existing riverbed that is deepened and re-contoured to expose bedrock, should be covered by a layer of cobble-sized material to provide better habitat.

Since the orientation of the intake and the tailrace will not change post-development, habitat shifts in the vicinity of the intake and the tailrace that may occur due to changes in water flow over particular substrates are expected to be minimal. The primary change in habitat due to the operation of the expanded Lower Sturgeon GS will be subtle changes in flow velocity and water depth within the broader area below the GS and the spillway (see Figure 1.8). This area is generally shallow, with a few discrete deep locations, and the anticipated changes in the distribution of flow between the GS and the spillway will likely have some effect upon flow velocities over the riffles immediately below the GS and the spillway. It is anticipated that some portions of these riffles will be slightly faster, on average, under the post-development flow than what they would be under existing conditions and, conversely, some portions will be slower. Because of the complexity of the riffle habitats in this area, these changes will result in subtle, probably balanced, shifts in habitat utilization in close proximity to the tailrace and the spillway. These minor changes in flow velocity and depth will occur mainly near the tailrace and spillway outflows, and decrease in magnitude at greater distances downstream. No habitat will be lost. A deep habitat area downstream will buffer any residual flow changes caused by the post-development operating conditions, so that flows in the balance of the 4 km of riffles that provide potential spawning habitat downstream in this section of the Upper Mattagami River, will not change post-development.

Based on the fisheries impact assessment for the proposed Lower Sturgeon GS, Coker and Portt (2006f) concluded that:

- Following the completion of construction, the total amount of habitat will be unchanged;

- No critical fish habitats, such as walleye, sucker, or lake sturgeon spawning habitats, will be directly altered;

- Small changes in water depths and flow velocities are expected in the riffle areas that are in close proximity to the tailrace and spillway. However, because of the broad range of riffle habitats and the complex flow pattern in this area, the likely result of these flow changes will be a limited redistribution of subtle habitat conditions. These expected changes will occur in only a small portion of the total amount of riffle habitat found downstream of the Lower Sturgeon GS site; and

- The areas that will be directly altered are mostly manmade habitats (the intake structure, the tailrace, and small areas in the immediate vicinity of both) and, although they do contain fish, the fact that they will be temporarily unavailable during construction is not expected to have a significant impact on the productive capacity of the system.

Overall, the proposed redevelopment and subsequent operation of the new and enlarged Lower Sturgeon GS will not have a significant or measurable impact upon the composition or production, respectively, of the Upper Mattagami River fish community.

3.2.9 Aquatic Avifauna

As indicated in Section 2.2.7, a number of aquatic avian species likely use the Upper Mattagami River from Lake Kenogamissi to downstream of the Lower Sturgeon GS as breeding, staging, stopover and/or feeding habitat.

CLI (1973) mapping for waterfowl production indicates that the Mattagami River between Wawaitin GS and downstream of Lower Sturgeon GS is categorized as 80% Class 6, 10% Class 5 and 10% Class 4 with severe, moderately severe and moderate limitations, respectively, due to adverse topography and free-flowing water conditions. Kenogamissi Lake upstream of Wawaitin GS is classified as Class 6 with severe limitations to waterfowl production due to adverse topography and excessive water depth. The MNR (1981) has identified the entire length of the Mattagami River as a waterfowl staging area.

Although three aquatic avian species at risk have been recorded in the Timmins area, i.e., American white pelican, yellow rail and black tern, there are no records of these species within a 5-km radius of the proposed redevelopment sites (Environment Canada, CWS, 2004; NHIC, 2006).

The construction disturbance will be sufficiently local that little displacement of aquatic avifauna will occur. Any resident birds can relocate temporarily to avoid human activity associated with construction activities. Most bird species habituate rapidly to noise and vehicular traffic.

Noise from blasting could have an initial effect on avian startle flight; however, it is anticipated that over time birds will become habituated to the impulse noise. During the St. Lawrence River crossing by a natural gas pipeline, blasting had no effect on waterfowl in the area (Silver and Fitchko, 1992). Noise effects due to other construction activities can be acceptably mitigated by conventional construction practices and are predicted to be localized, minor and transient.

During operation, noise will be generated from the proposed generating stations. This steady noise from the proposed plants will be similar to that of the existing facilities and not elicit an adverse reaction from nearby habituated wildlife.

3.2.10 Water Uses

During construction and operation of the proposed generating facilities, there will be no impact on recreational activities on the Upper Mattagami River. The water levels of the lakes and river upstream will be maintained as per the approved operating regimes identified in the Water Management Plan (OPG et al., 2006). Therefore, there will be no negative impact on recreational boating or use of docks. While the Mattagami River is an identified canoe route by the MNR and the Lower Mattagami River is a well known wilderness trip culminating at Moose Factory, the level of use on this section of the river is not significant.

4.0 SUMMARY AND CONCLUSIONS

This technical supporting document provides an aquatic environmental baseline, as well as the potential environmental effects of the proposed Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS on the aquatic environment and the recommended mitigative measures to minimize these effects.

During proposed generating stations construction, potential impacts on the aquatic environment may occur due to in-water construction activities, blasting, soil erosion and turbidity generation, and accidental spills. Based on an assessment of the available baseline information and potential effects, as well as the implementation of the recommended mitigative measures, SENES concludes that effects during construction will be minimal, localized and short-term.

During proposed generating stations operations, potential impacts on the aquatic environment may occur due to accident spills. Based on assessment of the baseline information and potential effects, SENES concludes that the operation of the proposed Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS will have negligible effects on the aquatic environment.

Environmental protection during proposed generating stations construction and operation will be ensured by adherence to the site-specific Environmental Management Plans, as well as compliance with regulatory standards and guidelines.

The Environmental Management Plan for each redevelopment project ensures that environmental protection will be achieved by describing government agency requirements, OPG policy, project commitments and recommended mitigation measures to be undertaken. The Environmental Management Plan will include the Erosion and Sediment Control Plan, Spills Emergency Preparedness and Response Plan, Hazardous Materials Management Plan and Waste Management Plan.

Table 4.1 summarizes potential construction and operation effects, the recommended mitigative/remedial measures to minimize or obviate these impacts and the net effects.

TABLE 4.1: SUMMARY OF POTENTIAL EFFECTS AND RECOMMENDED MITIGATIVE/ REMEDIAL MEASURES

Effect/Activity	Recommended Mitigative/Remedial Measure	Net Effect
Construction		
Soil erosion	• Adherence to Erosion and Sediment Control Plan.	Negligible effect
Incidental spills of oil, gasoline and other liquids during construction	• Adherence to Spills Emergency Preparedness and Response Plan.	Negligible effect
Hazardous Materials/ Waste	• Adherence to Hazardous Materials Management Plan and Waste Management Plan. • Waste disposal in accordance with regulatory requirements.	Negligible effect
Blasting	• Adherence to DFO guidelines (Wright and Hopky, 1998) and blasting engineer recommendations.	Negligible effect
In-water construction activities	• Use of clean rock fill for cofferdam. • Placement of rock fill over similar coarse substrate. • Judicious selection of discharge location and water pressure during dewatering. • Adherence to in-water construction timing restrictions. • Confined upland disposal of dredged material. • Provision of cobble-sized material on the floor of the new tailrace areas of the proposed Wawaitin GS and Sandy Falls GS.	Negligible effect
Operation		
Incidental spills of oil, gasoline and other liquids during operation	• Adherence to Spills Emergency Preparedness and Response Plan.	Negligible effect

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APPENDIX 1

Fisheries Survey and Impact Assessment Reports

APPENDIX 2

Benthic Macroinvertebrate Taxa Recorded in the Mattagami River

APPENDIX 2: BENTHIC MACROINVERTEBRATE TAXA RECORDED IN THE MATTAGAMI RIVER[1]

Taxon
P. COELENTERATA
P. NEMATODA
P. ANNELIDA
Cl. Oligochaeta
F. Naididae
Arcteonais lomondi
Nais
N. communis
Pristina
Slavina appendiculata
Stylaria
S. lacustris
Uncinais uncinata
F. Tubificidae
Aulodrilus americanus
Limnodrilus claparedianus
L. hoffmeisteri
L. profundicola
Quistadrilus multisetosus
Tubifex tubifex
F. Lumbriculidae
Lumbriculus
Stylodrilus herringianus
Cl. Hirudinae
F. Hirudinidae
Haemopsis grandis
H. lateromaculatus
F. Erpobdellidae
F. Glossiphoniidae
Glossiphonia complanata
Placobdella
P. ornata
P. ARTHROPODA
Cl. Arachnida
O. Acarina
F. Eylaidae
Eylais
Cl. Ostracoda
O. Podcopida
F. Cypridopsidae
Potamocypris pallida
Cl. Malacostraca
O. Amphipoda

Taxon
F. Gammaridae
Gammarus
F. Pontoporeidae
Pontoporeia affinis
F. Hyallelidae
Hyallela azteca
O. Decapoda
F. Cambaridae
Cambarus
Orconectes
O. propinquus
O. virilis
Cl. Insecta
O. Coleoptera
F. Dytiscidae
Agabus
Deronectes depressus
Hydroporus
Illybius biguttulus
F. Elmidae
Dubiraphia
D. quadrinotata
F. Gyrinidae
Dineutus
Gyrinus
G. impressicollis
F. Haliplidae
Haliplus
F. Hydrophilidae
Helophorus
O. Ephemeroptera
F. Baetidae
Baetis
B. flavistriga
B. pygmaeus
Centroptilum
Cloeon
F. Baetiscidae
Baetisca
F. Caenidae
Caenis
F. Ephemerellidae
Attenella
Dannella simplex
Ephemerella invaria
Eurylophella bicolor

Taxon
F. Ephemeridae
Ephemera
E. simulans
Hexagenia
H. limbata
F. Heptageniidae
Heptagenia
Stenacron
S. interpunctatum
Stenonema
S. pulchellum
S. vicarium
F. Leptophlebiidae
Paraleptophlebia
F. Metretopodidae
Metretopus borealis
F. Siphlonuridae
Isonychia
Siphlonurus
F. Tricorythidae
Tricorythodes
O. Hemiptera
F. Belostomatidae
Lethrocerus americanus
F. Corixidae
Hesperocorixa
Palmacorixa gillettei
Sigara
S. bicoloripennis
S. decoratella
S. lineata
S. trilineata
Trichocorixa borealis
F. Gerridae
Gerris
G. remigus
F. Notonectidae
Notonecta
F. Veliidae
Rhagovelia obesa
O. Megaloptera
F. Sialidae
Sialis
O. Odonata
S.O. Anispotera
F. Aeshnidae
Aeshna interrupta
Basiaeschna janata

Taxon
Boyeria
B. vinosa
F. Gomphidae
Gomphus brevis
Ophiogomphus
O. carolus
O. columbrinus
F. Libelluiidae
F. Macromiidae
Didymops transversa
Didymops/Macromia
Macromia illinoiensis
S.O. Zygoptera
F. Calopterygidae
Calopteryx
C. aequabilis
F. Coenagrionidae
Enallagma
O. Plecoptera
F. Chloroperlidae
Alloperla
F. Leuctridae
Leuctra
L. ferruginea
F. Perlidae
Acroneuria
A. carolinensis
Paragnetina
P. media
F. Pteronarcidae
Pteronarcys
O. Trichoptera
F. Glossosomatidae
Glossosoma
F. Hydropsychidae
Cheumatopsyche
Hydropsyche
H. alternans
H. morosa
H. retrocurva/walkeri
H. slossonae
F. Hydroptilidae
Agraylea
Leucotrichia
Mayatrichia

Taxon
F. Lepidostomatidae
Lepidostoma
F. Leptoceridae
Mystacides
M. sepulchralis
Oecetis
(?) O. inconspicua
F. Limnephilidae
Anabolia
Hydatophylax
Limnephilus
Neophylax
F. Molannidae
Molanna
F. Phryganeidae
Phryganea cinerea
F. Polycentropodidae
Cyrnellus fraternus
Neureclipsis
Nyctiophylax
Phylocentropus
Polycentropus
(?) P. cinereus
F. Psychomyiidae
Psychomyia
F. Rhyacophilidae
(?) Rhyacophila glaberrima
O. Diptera
F. Athericidae
Atherix sp.
A. lanthus
A. variegata
F. Ceratopogonidae
Bezzia
(?) B. setulosa
F. Chaoboridae
F. Chironomidae
S.F. Chironominae
Chironomini
Chironomus
Cladotanytarsus
Cryptochironomus
Cryptotendipes
Microtendipes
(?) M. tarsalis
Parachironomus
Paracladopelma
Polypedilum

Taxon
P. fallax
P. illinoiense
P. ophiodes
Pseudochironomus
Tanytarsus
T. subletta
Tribelos
S.F. Diamesinae
Prodiamesa
S.F. Orthocladiinae
Cardiocladius
Cricotopus
Cricotopus/Orthocladius
Eukiefferiella
Heterotrissocladius marcidus
Nanocladius
Orthocladius
Psectrocladius
Rheocricotopus
Tvetenia discoloripes
S.F. Tanypodinae
Ablabesmyia
Coelotanypus
Conchapelopia
Conchapaelopia/Arcto
Rheopelopia
Procladius
F. Dolichopodidae
(?) Hydrophorus
F. Empididae
Hemerodromia
Roederiodes
F. Simuliidae
Simulium
F. Tipulidae
Antocha
Tipula
P. MOLLUSCA
Cl. Gastropoda
F. Ancylidae
Ferrissia rivularis
F. Hydrobiidae
Amnicola limosa
F. Physidae
Physa
P. jennessi
Physella integra

Taxon
F. Planorbidae
Gyraulus parvus
Promenetus exacuous
F. Valvatidae
Valvata sincera
V. tricarinata
Cl. Bivalva (Pelecypoda)
F. Sphaeriidae
Musculium partumeium
M. transversum
Pisidium
P. casertanum
Sphaerium
S. partumeium
S. simile

[1] Source: Fiset (1995).