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Executive Summary

Introduction

The Government of Guyana (GoG) is committed to developing its hydrologic resources to create a dependable supply of electric power, as a catalyst for economic development, and to provide value for its citizens through cheaper electricity in the long term. For decades, the people of Guyana have endured an electricity supply that is expensive, inefficient, and unreliable. Without dependable and affordable electricity, growth and economic development are slowed. The Amaila Hydropower Project (“Project”) will change this reality by providing Guyana with a dependable and steady source of clean energy for today and the future. The Project is an essential part of the GoG’s independent and low-carbon energy strategy.

The Project involves the construction of a hydropower plant in the area of west-central Guyana where the Amaila and Kuribrong Rivers meet (“Hydropower Facility”). Electricity produced at the hydropower plant will be delivered to Guyana’s capitol, Georgetown, and its second largest town, Linden, by an electric transmission line and two new substations (“Electrical Interconnection”). To provide access to the Hydropower Facility, new roads will be constructed, and some existing roads will be upgraded (“Access Road”).

The Hydropower Facility and Electrical Interconnection are being developed, and will be constructed and operated, by Amaila Falls Hydro Inc. (“Company”), a wholly-owned member of the Sithe Global Power group that is incorporated in Guyana. Sithe Global Power is a leading U.S.-based international energy company, with a proven track record of developing energy projects around the world. Guyana Power and Light (GPL) will purchase the power based on a power purchase agreement (PPA) with an expected term of 20 years. The Company will operate the Hydropower Facility and Electrical Interconnection for 20 years following completion of construction, after which those facilities will revert to the GoG, at no cost, through a Build Own Operate Transfer (BOOT) arrangement. The Company will contract for the construction of the Hydropower Facility and the Electrical Interconnection, under an Engineering Procurement Construction (EPC) arrangement with an engineering and construction contractor (EPC Contractor). It is anticipated that China Railway First Group Co., Ltd., one of the world’s largest infrastructure construction companies, will be the EPC Contractor for the Project. The Company will arrange financing for the Hydropower Facility and Electrical Interconnection. The GoG will have the right to invest equity into the Project.

After conducting an open international tender process, the GoG contracted Synergy Holdings (“Road Contractor”), a Guyanese and U.S.-based company, to design, build, and improve the main access road to the Hydropower Facility and to clear vegetation for the portion of the transmission-line right of way (ROW) between the Bartica-Potaro Road and the hydropower site. The GoG will be responsible for the financing, construction, operation, and maintenance of the Access Road, although the Company may lease the last section of the road.

The Project will provide significant benefits to Guyana, including reducing long-term average wholesale energy costs in Guyana, helping advance Guyana's low-carbon development strategy, providing energy to meet Guyana's future needs, providing an economic stimulus to Guyana's economy, providing improved power reliability, and benefiting local communities by providing opportunities for employment and sale of goods and services to the Project.

The Company is committed to ensuring that local communities and cultures are not adversely affected, to actively engaging with the local communities throughout the life of the Project, and to protecting biodiversity. The Project has been approved by the Guyana Environmental Protection Agency based on the Amaila Hydropower Project Environmental Impact Assessment (EIA) completed in 2002, and subsequently, a Project EIA Addendum in 2008.

As part of the Project development process, the Company has been performing additional environmental and social studies to assist in the final pre-construction planning process and to provide updated information to Project stakeholders and potential international lenders. This Environmental and Social Impact Assessment (ESIA) was developed to provide:

- Stakeholders with detailed information on the Project's environmental and social aspects, which will allow them to be better informed and increase their understanding of the Project
- Potential lenders to the Project with an updated ESIA or Social and Environmental Assessment (SEA), in accordance with the lenders' internal environmental and social policies.

The Company contracted an experienced international environmental and social consulting firm, Exponent, Inc., with the support of a Brazilian firm, JGP Consultoria e Participacoes Ltda., and a Guyanese firm, Ground Structures Engineering Consultants Ltd., to prepare this ESIA. Because the Access Road may be considered an associated facility to the Hydropower Facility and the Electrical Interconnection, it is included in this ESIA.

Project Description

The Project consists of the following three components (see Figure EX.1):

1. **Hydropower Facility**—Consisting of a dam at the confluence of the Amaila and Kuribrong Rivers, a reservoir, a water tunnel, a powerhouse, turbine generators, an onsite electric substation and switchyard, local access roads, and other ancillary systems required to collect, control, and efficiently use water to generate electricity, all located approximately 200 km southwest of Georgetown.
2. **Electrical Interconnection**—Consisting of about 270 km of high-voltage, 230-kV transmission line and two remote substations, one at Linden and one

at Georgetown, that will deliver power from the Project to the GPL electric grid.

3. **Access Road**—Consisting of the construction of approximately 85 km of new roads, and upgrading approximately 122 km of existing roads, to provide sufficient access to the transmission line and the Hydropower Facility.

The Company is responsible for construction and operation of the Hydropower Facility and the Electrical Interconnection, and the GoG is responsible for the construction and operation of the Access Road, which includes clearing a portion of the transmission-line alignment, from where it crosses the Kuribrong River to the hydropower site.

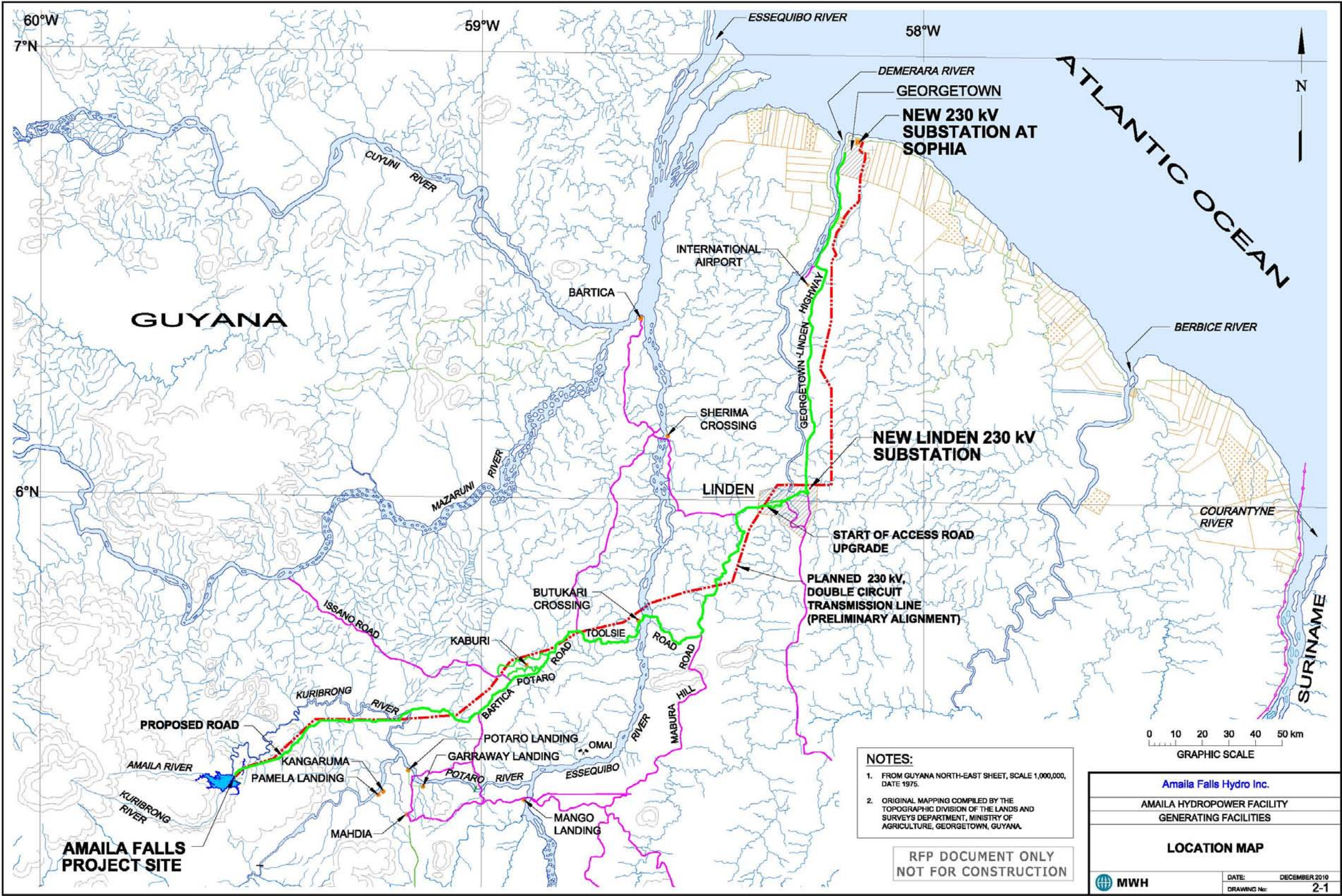


Figure EX.1. Location map.

Hydropower Facility

Components and Design

The primary components of the Hydropower Facility are an earth- and rock-filled dam, which creates a water reservoir (or lake), and a powerhouse, which uses the water to create electricity. Water flowing from the Amaila and Kuribrong Rivers will fill and continuously replenish the reservoir, while the hydropower plant will draw water from the reservoir to generate electricity for delivery to the GPL grid. Water for power generation will be drawn from the reservoir through an intake structure and conveyed through a tunnel and penstock to the powerhouse, located at the bottom of the escarpment approximately 350 m below the reservoir.

The design and construction of the Hydropower Facility will be in accordance with internationally recognized standards of practice. These standards are specified in the construction work scope and are intended to ensure (among other things) the safety of the Hydropower Facility, including the dam. A rigorous engineering review process will be conducted by the EPC Contractor and the Company to ensure dam safety. In addition, the Company will establish a Dam Safety Panel to review the design and safety standards of the dam.

The main features of the Hydropower Facility will consist of (see Figures EX.2 and EX.3):

- Dam about 2.5 km long, crossing the Kuribrong River and Amaila River, with a ridge dam between them
- Reservoir of approximately 23.3 km² in area
- Controlled water intake structure
- Headrace tunnel, power shaft, surge shaft, and power tunnel
- Ungated overflow spillway located in the Amaila section of the dam
- Gated water outlet for minimum environmental flows
- Powerhouse and turbine generators
- Electrical switchyard and substation located adjacent to the powerhouse
- Emergency diesel generators (about 1 MW) to provide emergency power
- One backup Pelton hydroelectric turbine generator (less than about 1 MW)
- Onsite access roads required for operation and maintenance
- Security and surveillance systems, fencing of selected areas, and site communications
- Ancillary systems and equipment as needed to operate and maintain the hydropower facility
- Offices, maintenance shop, warehouse, staff living quarters, and other onsite facilities.

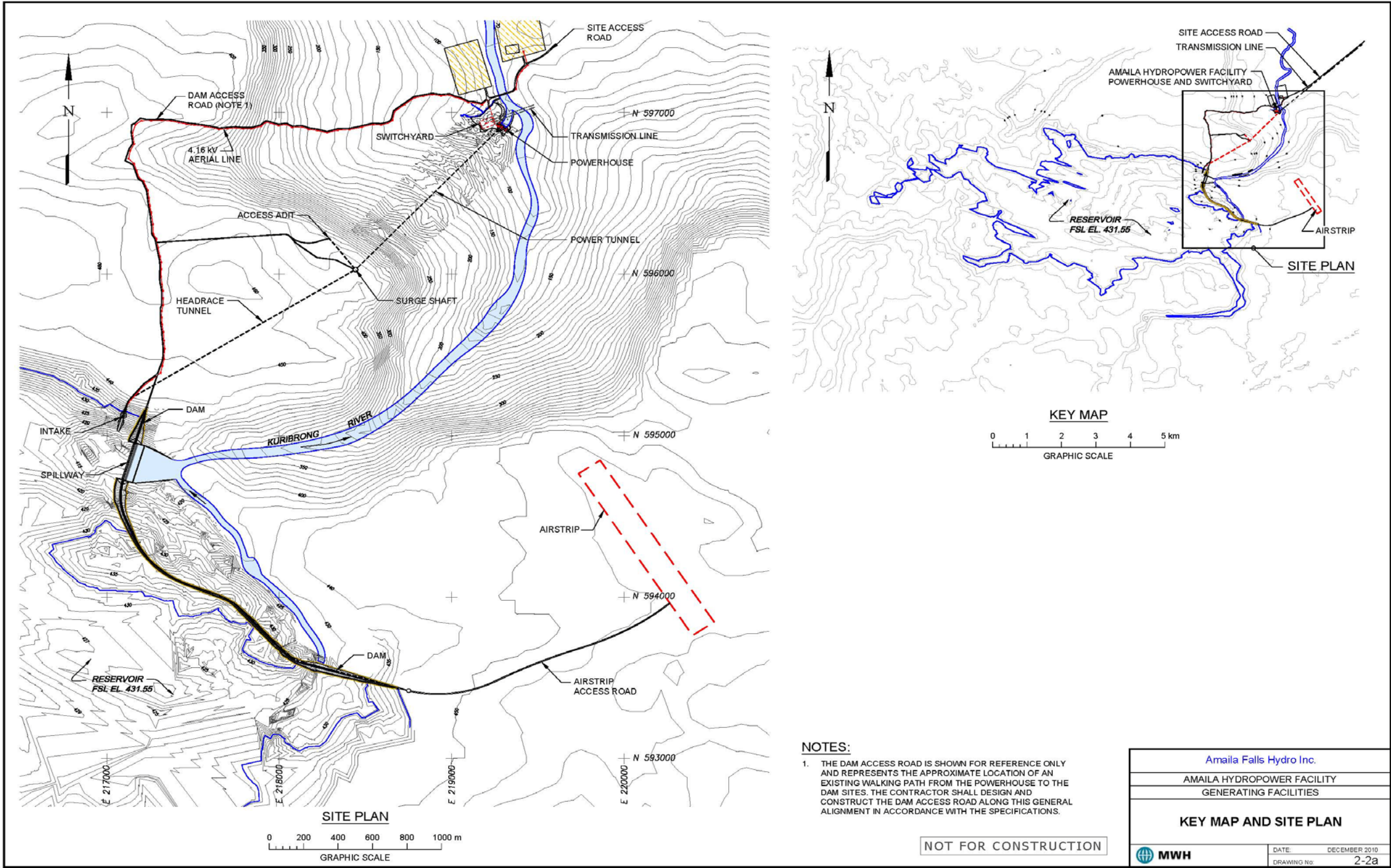


Figure EX.2. Key map and site plan

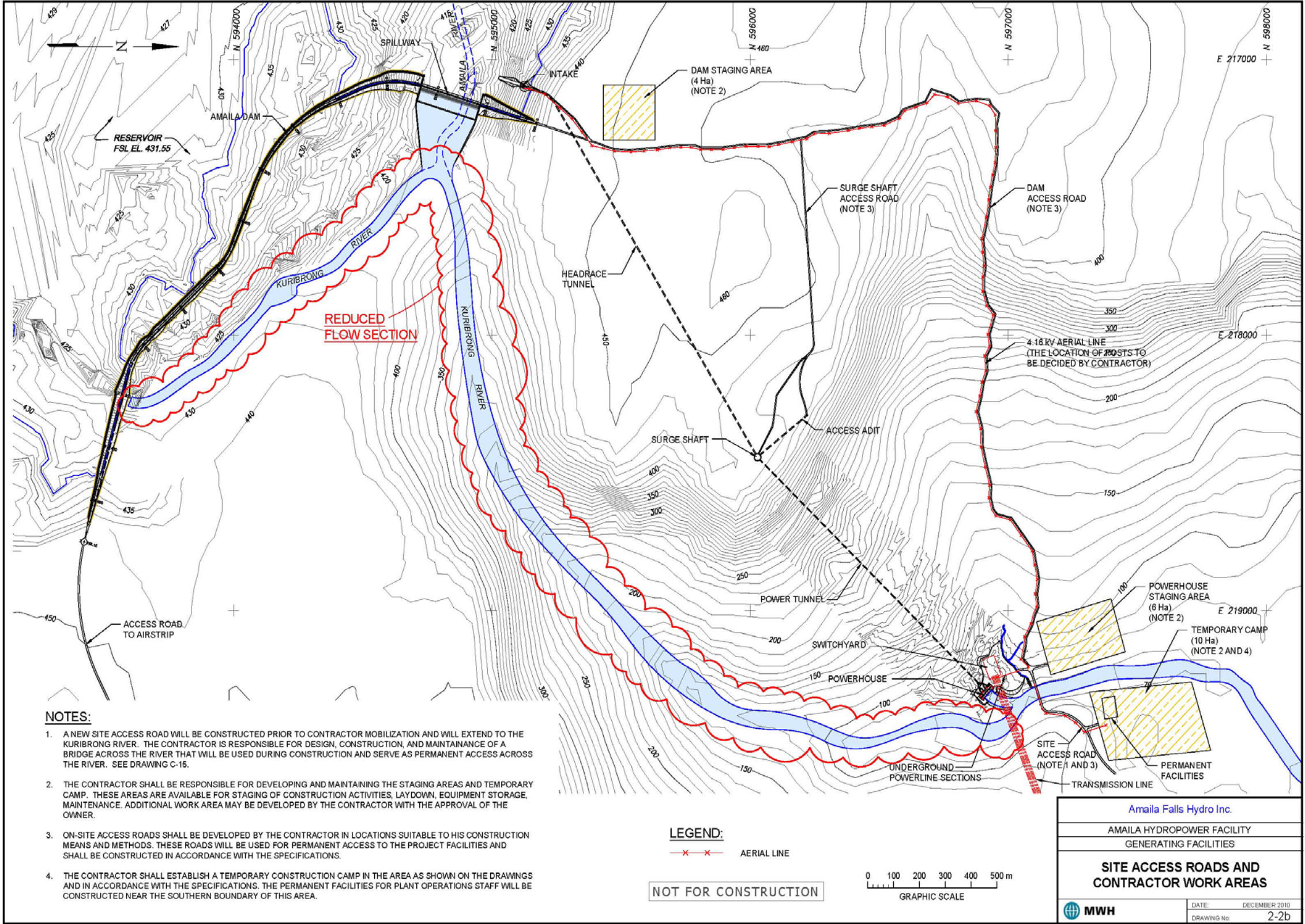


Figure EX.3. Site access roads and contractor work areas

The Hydropower Facility includes a main dam to be constructed upstream of the confluence of the Amaila and Kuribrong Rivers. The dam will be a concrete-faced rockfill structure, with grout curtains to ensure water containment in the reservoir. The crest of the dam will be about 8 m wide. Modern, low-maintenance instrumentation systems will be installed to monitor foundation and embankment-fill pore pressures, seepage system outflows, embankment fill and crest deformations, and joint movements.

The inundated area will be primarily a contiguous reservoir, with the exception of a few small islands, which may be eliminated depending on the final selection of the onsite quarry areas. The reservoir surface area at full supply level (FSL) will be approximately 23 km², and when the reservoir is at minimum operating level (MOL), the surface area would be approximately 8.4 km². Based on the full 165-MW output from the powerhouse, the active volume will provide about an average of 23 days storage, assuming zero inflow. This storage will be critical during the dry seasons when river flow into the reservoir is lowest.

The spillway will be located on the Amaila section of the dam and will safely discharge overflow water when the reservoir level reaches the spillway elevation of 431.55 m above mean sea level (masl). Water flowing over the spillway will continue over the Amaila Falls and down the reduced-flow segment of the river to join with water flowing from the powerhouse tailrace and into the Kuribrong River. The spillway will also incorporate a low-level outlet feature to pass water to the reduced-flow section and down the falls during periods when there is no water otherwise flowing over the spillway. The low-level outlet will be designed to pass a minimum environmental flow (MEF) of approximately 1 m/s³. The MEF was established, in part, after the analysis of alternatives, which contemplated the historical hydrological series, the potential impacts on biodiversity downstream of the dam (including both the plant species in the mist zone and the fish species in the reduced-flow segment, according to preliminary identifications during the field campaign), and analysis of costs to be borne by rate payers and/or GOG for maintaining a MEF. The reduced-flow segment will consist of about 1.6 km of the Kuribrong River downstream of the dam but upstream of the falls, about 0.5 km of the Amaila River before its confluence with the Kuribrong River, and about 3.6 km between the falls and the powerhouse. The flows in these components of the reduced-flow segment will vary throughout the year depending on the reservoir operating regime, natural inflows, and powerhouse operations. During the wet season after the reservoir fills to the FSL, water from the reservoir will flow over the spillway and down the reduced-flow segment of the Amaila River, over the falls, and down the Kuribrong River to the powerhouse. During other times of the year, the MEF will flow in these segments of the river. The MEF will be augmented by normal leakage under and around the dam.

Water from the reservoir will be delivered to the turbine generators via a water intake structure and conduit system, consisting of a headrace tunnel, vertical shaft, and power tunnel. The water intake will be located near the left side (facing downstream) of the Amaila dam section and spillway. The water intake will be a single, submerged, open-faced intake about 11 m wide by 8 m high.

The underground headrace tunnel will be concrete lined and will slope gently toward the edge of the escarpment to connect to the vertical surge/power shaft. The power shaft will drop about 240°m vertically within the escarpment to deliver water to the power tunnel located under the

escarpment. The surge shaft will extend to above ground. The power tunnel will be a concrete tunnel with a steel lining, extending approximately 1,200 m to the powerhouse. The power tunnel will split its flow into one penstock for each turbine.

The powerhouse will house four Francis-type hydro-turbine generators, one Pelton-type hydro-turbine generator for auxiliary power, and other ancillary systems required to operate and maintain the facility. The powerhouse will be located at the bottom of the Amaila Falls escarpment, approximately 3 km from the water intake (edge of the reservoir). The main electrical substation and switchyard will be located adjacent to the powerhouse, and the Access Road and the transmission line will terminate at the powerhouse. The main access to the site will be from the Access Road. A site access/service road will be constructed as part of the EPC Contract, including a bridge across the Kuribrong River to the powerhouse. The powerhouse will include a control room with a digital control system, administration offices, washroom facilities, kitchen and dining areas, and electrical rooms housing communications equipment, switchgear, motor controls, batteries, protections and relays, etc.

Various permanent site services will be established for use during the operational phase of the Hydropower Facility, some of which will be built to support the construction phase. These include workshops and stores facilities, hazardous material storage, work camp and lodging, kitchen and eating area, water treatment plant, wastewater treatment disposal system, maintenance areas, auxiliary power supply, communications systems, and quarry and waste-soil disposal area.

Construction

The design and construction process consists of a number of phases, as follows:

- Detailed design
- Site surveys for design
- Planning, subcontracting, and labor recruitment
- Onsite service/access road construction
- Mobilization and site preparation
- Ongoing engineering, procurement, and transportation
- Works to set up the diversions
- Powerhouse, substation, and tailrace construction
- Dam and spillway construction
- Tunnel and penstock construction
- Transmission-line clearing and construction
- Remote substation construction

- Reservoir clearing and preparation
- Reservoir inundation
- Project testing and commissioning.

During the mobilization phase, areas of the site to be occupied by temporary works will be cleared and leveled (approximately 115 ha). An area will be developed for housing, feeding, and supporting the construction workers. It is estimated that there will be about 700 workers on average at the Hydropower Facility, with a maximum of about 1200, and the corresponding numbers for the Electrical Interconnection will be 450 and 650 workers, respectively.

Permanent housing for Hydropower Facility personnel (approximately 40) will also be established at this location. Only persons working on the site will be allowed access to the lodging areas. The complex will include support facilities, including kitchen, eating area, bathrooms, showers, and recreation areas. Communication systems (e.g., telephone, etc.) will be provided at the site for workers. Potable water will be provided by treating water from the Kuribrong or Amaila Rivers, or from underground wells. Additional personnel (approximately 30) will be needed to operate the Electrical Interconnection; these people are anticipated to reside in Georgetown and Linden.

Quarries and borrow pits will be identified and developed to provide aggregate, rockfill, and sand for construction of the dam embankments, spillway foundation, coffer dams, onsite roads, foundations, and other facilities. An estimated total of about 1,000,000 m³ of rock fill is needed to construct the dams and for purposes such as concrete production, cofferdams, and onsite access roads. The total area of quarry needed, based on 1 million m³, plus 50% contingency and assuming 5 m depth, is about 550 m by 550 m. Rock will be loosened by drilling and blasting and will then be loaded by front-end loaders into haul trucks for transport to the processing plant. Processing operations will include crushing, screening, and size classification. Batching plants will also be required for concrete production and for production of filter material for the dam. Material that has to be excavated but is unsuitable for construction purposes will be disposed of by spreading the material in layers in designated spoil areas, such as the exhausted quarry areas or other areas that may be identified during construction planning. The total spoils area is estimated to be about 500×500 m. Permanent spoil areas visible after completion of construction will be shaped to blend with the local topography. Surfaces will be finished and graded to the extent necessary to provide surface drainage, and re-vegetated to prevent future erosion of the materials.

The EPC Contractor will install temporary diesel-powered reciprocating-type generation and site electrical distribution to provide the electricity required during construction. A peak of up to 3 MW of electrical power will be needed during construction.

Construction water use (average about 4,500 m³/day, peak 6,000 m³/day) will include dust suppression; truck and equipment cleaning; certain equipment cooling; mixing of soil, rock, cement; and other uses. Construction water will likely be drawn from the Kuribrong and/or Amaila Rivers, and potable water (200 m³/day, peak 400 m³/day) will likely be taken from

drilled groundwater wells. Potable water will be treated by a water treatment system at the site and will be distributed by pipe and pump systems and/or water delivery truck, as appropriate.

The construction wastewater discharge totals are expected to be about 80% of the daily water use, or 3,600 m³ per day on average. Construction wastewater will be treated to meet Project environmental standards before being discharged to the environment. Monitoring will be conducted to ensure proper operation and compliance with required standards.

Sanitary wastewater from toilets, kitchen and household sinks, showers, and other sources will be treated through a temporary sanitary wastewater treatment system. Treated wastewater will be discharged via a septic system and leach field, or a treatment lagoon/basin, to the river, in compliance with Guyana regulations and Project environmental standards. Sludge generated in the treatment system will be disposed in a landfill.

Fuel for the site generators and site vehicles will be stored in bulk storage tanks (estimated maximum storage quantity of approximately 300 m³). All fuel-tank areas will be enclosed by secondary containment capable of storing at least 110% of the capacity of the largest tank for all tanks that are bermed together. Handling of fuels off the hydro site will be managed separately and will include appropriate containment handling and spill response measures.

Other hazardous chemicals such as lube oils, paints, sealants, cleaning agents, and others (typically stored in small, 55-gallon drums or 2- to 4-m³ tanks) will be stored in appropriate secured covered areas, with secondary containment and proper handling and spill control features.

The use of explosives will be required to excavate the quarry area, dam foundations, the powerhouse foundation, and the water tunnel.

Solid waste generated during construction may include packaging materials (e.g., wood, paper, plastic), scrap metal, household and office trash, and oily waste. Other waste material may also include material classified as hazardous waste, such as medical waste, paints, and certain cleaning solutions. The EPC Contractor will implement a Waste Management Plan (WMP) that describes procedures for handling, recycling (as feasible), and disposing of solid waste generated during construction. The WMP may also include a combination of burial and incineration.

The diversion of the Amaila and Kuribrong Rivers will be accomplished by constructing cofferdams at the confluence of the Amaila and Kuribrong Rivers on top of the plateau upstream of the Amaila Falls. The present diversion scheme assumes that the Amaila River will act as the main water channel during the construction period and will be diverted into two phases. The first phase is to build a diversion dam on the right bank of the Amaila River, in order to build a portion of the Amaila Dam and spillway. The second-stage diversion phase is the interception of all water from both the Amaila and Kuribrong Rivers and diversion through the under ports of the spillway built during the first stage. During this second-stage diversion, the Kuribrong River will also be diverted to the Amaila River via a newly constructed 40- to 50-m-wide channel between the two rivers.

The construction of the dam will be undertaken in several distinct phases, including foundation excavation and preparation, foundation grouting, embankment fill placement, and placement of impervious concrete face.

Prior to reservoir filling, the reservoir will need to be cleared of vegetation, which will be done according a clearing plan to be developed further by the EPC Contractor. Based on an average annual inflow of approximately $64 \text{ m}^3/\text{s}$ and a gross reservoir storage volume of about 136 million m^3 , it will take approximately 25 days to completely fill the reservoir to the FSL.

It is estimated that 50 to 100 vehicle trips will be made each day, both ways, on the Project Access Road, to support the Hydropower Facility construction during peak activity periods. The EPC Contractor anticipates using access to the Demerara River in Linden for loading and unloading material and equipment.

All temporary areas disturbed by construction activities and not intended for permanent use during operation of the Hydropower Facility will be restored by landscaping, topsoil spreading for natural revegetation, or seeding with native plants and trees if needed. Measures will be incorporated to minimize erosion or sediment disturbance, and consequential impacts on reservoir and downstream river-water quality.

Operation and Maintenance

The Hydropower Facility will be operated and maintained by the Company, and will provide capacity and energy to the GPL grid in accordance with dispatch instructions from GPL. The water flow discharged from the powerhouse will roughly follow the energy output of the facility, which can vary from 10% to 100%. It is anticipated that the energy output will be generally baseloaded but will follow the GPL system load. The reservoir is sized to provide storage of water to facilitate baseload operation during both the wet and dry seasons. During the wet season, the reservoir will be replenished with incoming water. When the reservoir FSL is reached, water will begin to flow over the spillway and down the falls section.

Under normal hydrologic conditions, the reservoir will operate at FSL from May into August. During these months, on average, the contribution of water to the reservoir will be greater than the volume released, and thus, water will be released from the dam spillway. During the remaining months, the reservoir will operate below FSL most of the time, and the reduced-flow segment of the river will have a MEF of $1 \text{ m}^3/\text{s}$. The estimated flow in the reduced-flow segment would be approximately $26 \text{ m}^3/\text{s}$ in May, $90 \text{ m}^3/\text{s}$ in June, $57 \text{ m}^3/\text{s}$ in July, and $25 \text{ m}^3/\text{s}$ in August. With regard to the reservoir water level, the reservoir water level will gradually decrease from August into December, going from the FSL to at or near the MOL. The highest amplitude change is expected during September and October (the driest month of the year). The Hydropower Facility will not generate electricity if the water level falls below the MOL.

The Company and EPC Contractor will develop an operation and maintenance plan that will include a regimented routine of monitoring and inspections of all appropriate equipment and facilities at the hydropower station, transmission lines, and substations. The maintenance procedures for each component will incorporate routine planned maintenance work and other

work of a less routine nature that may or may not require unit outage. The maintenance program will consist of routine and scheduled maintenance.

The Hydropower Facility will include a network of instrumentation of the type and quantity required to monitor the performance and safety of the facility during construction and operation, verify the design assumptions for structures, and monitor deformations, pore pressures, seepage, and leakage.

Only minor amounts of water will be used for the operation-and-maintenance phase, and will likely be drawn from groundwater. Some water for non-contact equipment cooling (e.g., about 700 m³/hr) may be drawn from the power conduit or the Kuribrong River and discharged back to the river. The facility will use service water (e.g., for routine equipment and area cleaning activities) and for potable use (staff household and office), totaling up to about 150 m³/day. The wastewater generated during these periods will be about 80% of the water use, or about 120 m³/day. Service water may be drawn from groundwater, the reservoir, or the river, while the potable water will be drawn primarily from groundwater. Wastewater will be discharged through a treatment system designed to comply with applicable regulations. All permanent water supply, sewage, and waste disposal works will conform to the requirements of applicable laws, regulations, and permits. Solid waste generated during normal operation periods will be minor, consisting generally of household and office waste, along with small amounts of packaging waste from routine maintenance. Additional solid waste will be generated during the increased level of activity associated with outage maintenance.

Electrical Interconnection

The Electrical Interconnection consists of two main components: about 270 km of high-voltage, 230-kV transmission line, and two substations—one at Linden and one at Georgetown. The transmission line consists of two segments: approximately 170 km from the Hydropower Facility to a new substation to be constructed north of the town of Linden (the Linden Substation); and second segment that runs approximately 100 km from the Linden Substation to the existing Sophia Substation in Georgetown. The Amaila-Linden-Sophia transmission line will deliver electrical energy generated by the Hydropower Facility to the GPL grid.

Components and Line Design

The transmission line will be a double-circuit configuration supported by double-circuit towers with conductors on either side in either an in-line or delta configuration. The double-circuit design provides redundancy in service in case one of the circuits experiences an outage.

The transmission line and substations will be designed and constructed according to applicable electrical design standards. The accessories, connections, and components that conduct current will be specified with a conduction capacity corresponding to the thermal limits of the conductor in accordance with the climatic conditions of the Project region and maximum capacity. The tower foundations will be designed to ensure that all structural forces resulting from each tower will be suitable to the conditions of the soil. Appropriate safety factors will be used to satisfy the failure criteria and will be considered in developing the structural design.

The physical and mechanical soil properties at each location will be determined through soil analysis to understand the precise geomechanical characteristics. Based on the resulting data, the parameters used for the tower foundations will be defined.

The transmission-line corridor must provide adequate space to accommodate construction, operation, and maintenance of the transmission towers and circuits. The routing was selected to avoid wetland areas and follows relatively straight path segments, minimizing the number of sharp angles or bends in the alignment.

The width of the corridor was selected to ensure the reliable, uninterrupted operation of the transmission circuits, minimizing the risk of trees falling on the transmission conductors. The remote location creates challenges in repairing the transmission line in case of outages. Given the remote location and the critical importance of maintaining high reliability of the system, the corridor width was selected to minimize the risk of damage or interruption to the circuits. The 100-m-wide corridor (plus a 25-m side buffer) will be maintained from the hydropower site to the substations in Linden and to the outlying areas of Georgetown. Where the corridor enters residential areas of Georgetown, the corridor will be minimized to reduce impacts to homes and businesses along the route. Between Linden and Georgetown, the vegetation is not as tall, and therefore, the clearing width within the easement may be less.

All land required for the corridor from Linden to the hydropower site is GoG-owned land and will be transferred to the Company for purposes of constructing, operating, and maintaining the transmission line. Except for some forest concessions, the corridor between Linden and the site is entirely vacant and unpopulated and has no agricultural use; therefore, no resettlement will be required along this corridor. A majority of the corridor between Linden and Georgetown is also State owned, but some persons have leased land from the State for mainly agricultural use.

The towers and cables are designed to provide adequate safety clearances from the ground, in accordance with electrical safety standards. The minimum conductor sag height between towers is typically about 8 m or more above the ground. The towers will incorporate anti-climbing measures and signs as appropriate, to prohibit climbing and/or theft of tower components. The transmission towers will be the steel lattice type commonly used in the United States, Europe, and Brazil. The towers will be about 35 to 40 m high, although the specific height of each tower will be determined individually. The distance between towers will vary 300 to 400 m, and up to approximately 900 steel tower structures will be erected. Depending on the structure type, the total area occupied by each tower will be approximately 15×15 m. Barriers to climbing will be installed on many towers to reduce interference by animals, prevent vandalism, and reduce risk to public safety. Concrete pad, chimney-type, and/or pile-supported foundations are planned for most towers. Foundations for the self-supporting towers will likely use large-diameter bored piles, shallow foundations, or rock-anchored blocks. The choice of foundation type will be based on soil characteristics and access conditions for each individual foundation site. The conductors will be connected to the towers using electrical insulators specifically selected for the design of the transmission line. The grounding system will be designed in accordance with applicable electrical safety standards.

The Electric Interconnection will include construction of two substations, one to be built north of Linden (“Linden S/S”) and one east of Georgetown on land adjoining the existing GPL Sophia substation (“Sophia S/S”).

The Linden S/S will be built with a 230/13.8-kV (the low voltage rating is yet to be finalized) transformer to be consistent with the distribution system. It will be located within 1 km east of the Georgetown-Linden Highway in an open, undisturbed area, and will have an area of approximately 2 ha. The location may shift slightly to the south to better align with the transmission-line corridor. GPL plans to build short-distance 13.8-kV lines to connect the new high-voltage substation to the existing Linden Power & Light system (which GPL will operate). The new Linden S/S area will be re-graded, leveled, and filled with suitable engineered fill to support the heavy substation equipment. The site is owned at present by GoG.

Sophia S/S modifications will be an expansion of an existing GPL substation, which will be enlarged to accommodate the Project’s transmission line and include a 230-kV/69-kV transformer, consistent with the distribution system in the area. The Sophia S/S is planned to be located east of the existing Sophia S/S, in an area of approximately 5 ha, and will be located along with other 69-kV substations planned in the future by GPL (unrelated to the Amaila Project). The 230-kV high-voltage line will arrive from the south and connect to the high-voltage bus. Connections for the 230/69-kV transformers will draw off the high-voltage bus for delivering power to the GPL system. Each of the 69-kV connections will deliver power to GPL’s existing 69-kV substation via two new short-distance 69-kV lines from the new 230-kV substation. The Sophia S/S is located within a flood zone, and therefore, 1–2 m of engineered fill will be added.

Small control and auxiliary buildings and appropriate security measures will be installed at both 230kV substations. Equipment in all substations will be grounded to protect both the equipment and personnel working in the substations. All equipment will be fenced to protect the public from contact with the high-voltage equipment. Oil used in transformers will not contain any polychlorinated biphenyls (PCBs), and all equipment containing significant amounts of oil will have secondary containment areas, as well as an integrated means of ensuring that rainfall runoff from the areas passes through an oil/water separator before being discharged to the environment.

Construction/Implementation

The construction of the transmission line work will likely consist of the following stages:

- Mobilization, surveying, planning, and design
- Tower spotting and geotechnical survey
- Vegetation clearing
- Tower foundation installation
- Tower assembly

- Cable installation
- System checks, testing, and commissioning.

Clearing of the transmission-line corridor will be required to provide access to the tower locations, and to conduct tower spotting and the geotechnical survey of the spotted locations. The transmission-line corridor for the portion of the alignment between the Kuribrong River and the Hydropower Facility will be cleared in conjunction with clearing and building of the Access Road. The remaining transmission-line corridor will be cleared by the EPC Contractor (or other contractor retained by GoG or the Company). The transmission-line corridor is required to be cleared to 100 m width, with an additional 25-m buffer zone on either side. A cleared pathway of about 10 m will be maintained in the corridor to facilitate construction of the transmission towers and stringing of the lines. In the 25-m outside buffer area, only trees taller than 35 m will be cut selectively using chain saws to direct the fallen tree to land in the transmission-line corridor. Vegetation cleared from the alignment will be used for beneficial construction purposes to the maximum extent practicable, or burned or used as erosion control material. Vegetation clearing and overburden removal activities will be limited to the strictly necessary areas and will be conducted to avoid disturbing vegetation adjacent to the cleared perimeters. Vegetation clearing will be conducted and monitored per the Project Environmental and Social Management Plan (ESMP). In applicable areas, vegetation clearing will be done in a manner to mitigate potential fragmentation impacts.

The substation construction will begin with surveying and demarcating the construction area. After the site ground base is prepared, work will begin on excavating trenches and installing required conduits, cabling, grounding grid, stormwater control measures, and other piping. Work will also include excavation and installation of foundations. After the civil work is completed, the substation construction will continue with installation of above-ground structures, equipment, and cabling. After installing required structures, equipment, and cabling, a substantial effort will include making final terminations of cabling, and conducting final checks and testing to ensure that proper equipment protection and controls are in place.

The substations, transmission line, and hydropower facility will be built using relatively independent construction processes. Two primary construction management locations for the transmission line will likely be maintained at Linden and Amaila. A smaller team will likely be located in Georgetown. Substation construction will require smaller field offices at the Linden and Sophia substation locations. As the transmission-line teams move to more remote areas between Linden and Amaila, smaller intermediate logistical support facilities and temporary work camps may be set up along the alignment to support work as it progresses along the route. Different activities (i.e., surveying, geotech studies, tower foundations, erection, and cable stringing) will require different levels of logistical support and, therefore, adjustments in logistical management.

Operation and Maintenance

The 230-kV transmission line and substations at Linden and Sophia will be owned, operated, and maintained by the Company. The substations will be connected via a high-bandwidth communication system to facilitate system controls, monitoring, and protection. There will also

be a dedicated voice communication link between the control rooms at the powerhouse and the GPL Control Center.

Operation and maintenance of the transmission lines will include regular visual inspections of the lines by ground access via the Project Access Road, and occasional use of airplanes and/or helicopters. The inspection staff will be a combination of specially trained security and inspection staff for routine inspections, in addition to more specialized electrical technicians, and in some cases, third-party engineers as needed. In addition, local personnel may be used for more frequent inspections of vegetation growth, erosion control measures, condition of the access roads, and general condition of the towers and foundations. Inspections of the corridor will also include monitoring of encroachment by buildings, crops, or other structures within the right of way. Periodic and selective forest cutting (about every two years) of overgrown trees (typically taller than 4 m) will take place during operation, to ensure that trees do not present a risk to the power lines. The Company will engage a forest expert to assist in developing a forest management/clearing plan during operation and maintenance. Vegetation in the transmission-line ROW will be maintained and disposed of according to the Project ESMP. No significant use of pesticides or herbicides is contemplated. The operation and maintenance will not generate significant solid or liquid wastes.

Access Roads

To provide access to the Hydropower Facility site, the GoG has contracted a construction firm (“Access Road Contractor”) to upgrade some existing public roads and construct new roads from a location west of Linden to the hydropower site. Maintenance of the Access Road is the responsibility of the GoG. The Access Road contract includes an option for the Access Road Contractor to maintain the roads for a number of months during construction of the hydropower project.

The Access Road consists of the following:

Section	Description	Distance (km, approximate)	
		New	Upgrade
1	Upgrade of existing road from west of Linden along Mabura Hill Road (MHR) to 41 Mile turnoff to Essequibo River.		50
2	New road from MHR to Essequibo River East Landing (most of this uses existing logging trails)	18	
3	Upgrade of existing roads from Essequibo River West Landing (Butakari) along existing Toolsie Road and Bartica-Potaro Road (BPR) to just north of the Kaburi community.		36
4	Upgrade of an existing logging road north of Kaburi to Issano Road junction (near Kaburi).		20
5	Upgrade of existing BPR from Issano Road Junction to the Amaila Hydro Road (AHR) Junction (at 82-Mile mark).		16
6	New road from AHR/BPR Junction to west of Kuribrong River bridge until it connects to the transmission line corridor.	24	
7	New road (AHR) from west of Kuribrong River Bridge to just east of the hydropower site.	43	
Total		85	122

The Access Road work includes upgrading existing roads, building new roads, building new river-ferry launching facilities at the Essequibo River, building a new bridge over the Kuribrong River, and building or installing small bridges, culverts, railings, drainage facilities, and other features as needed for the access road. The Access Road work also includes building smaller feeder roads to provide access to selected areas of the transmission line where the Access Road Contractor will be responsible for clearing.

The Access Road generally parallels the transmission line corridor. Portions of the access road are within the transmission-line corridor in the new road section between the Kuribrong River and the hydropower site (approximately 33 km out of 43 km). Where the road and the transmission corridors coincide, the roadway will be offset (e.g., 20 to 30 m) from the centerline of the transmission-line clearing, to allow the transmission line to be in the center of the clearing and the road immediately to one side of it. The Access Road contract includes clearing a portion of the transmission line corridor between the hydropower site and a location near Portage Falls, approximately 43 km east of the hydropower site. The Access Road will require a corridor (ROW) of approximately 20 m. The road width generally consists of the main road bed, about 5–7 m wide; another 6–7 m on each side may be required for additional shoulder, drainage ditches, and cleared area beside the road. Where the transmission corridor and Access Road are separate, feeder roads will be placed at regular intervals from the Access Road to the transmission corridor. The width of the transmission-line corridor feeder roads will be narrower, normally a maximum of 10 m.

The Access Road will be capable of handling equipment weighing at least 100 tons. The design and installation of the Access Road will conform to Guyana national safety standards, as well as international specifications defined in the construction specifications.

The Access Road will require two major river crossings: one at the Essequibo River, and one at the Kuribrong River. The Essequibo River will be crossed using a ferry (or pontoon) landing at the existing site of Butakari, on the west bank of the Essequibo. The Kuribrong River bridge will be located approximately 43 km east of the hydropower site. The Kuribrong River bridge will adhere to conservative design criteria. A security station that will monitor road access will be located at this bridge. Other smaller rivers and streams will be crossed using bridges, culverts, and similar structures. Based on preliminary engineering, about 12 timber bridges are anticipated, half of which will replace older existing bridges. The Access Road drainage system is designed to redirect surface stormwater flow to maintain the natural drainage of the terrain without interfering with traffic safety or increasing road maintenance.

Construction

The general steps in Access Road construction are:

- Vegetation clearing; biomass handling, including harvesting commercial-grade wood; and burning (note: to the extent required—for example, in some areas where the road is upgraded—no vegetation clearing is needed)
- Ground grubbing and bedding for road base
- Installing bridges, culverts, and other facilities
- Road capping and stormwater drainage.

Vegetation will be cleared in areas of the new Access Road and a portion of the transmission-line corridor from the Kuribrong River to the hydropower site. In applicable areas, vegetation will be cleared for crossings in a manner that will mitigate potential fragmentation impacts. Earthwork activities will begin after the road corridor is cleared. Organic debris will be removed and proper road base established. To the extent necessary and reasonable, fill will be added to the road and shoulder to create adequate drainage of rainfall. Any unusable soil will be removed and replaced with suitable fill acquired from borrow pits. If needed, unsuitable excavated material may be removed to spoil areas or piled outside of the roadbed. The earthwork activities will include excavation of materials in the borrow areas, development of spoil areas, and transport of materials within the corridor. The borrow and spoil areas will be closed and re-graded to natural contours on completion of road construction. Use of explosives is not anticipated. Various small, temporary work camps will be used. The camps will be supplied with food rations, portable generators, tools, accommodations, and appropriate waste-handling facilities.

Operation and Maintenance

GoG will be responsible for maintaining and managing the Access Road. The Access Road construction contract has an option for the Access Road Contractor to provide maintenance services for three years after construction of the roads, to ensure adequacy of the roads to support heavy traffic during construction of the Hydropower Facility and Electrical Interconnection.

The key operation and maintenance activities for the Access Road will include surface evaluation and maintenance; evaluation and maintenance of drainage works; maintenance of bridges, signs, and signals; and evaluation, monitoring, and maintenance of road safety. The GoG will be responsible for access control, as well as other environmental management aspects of Access Road operation and maintenance.

Workforce

For the Hydropower Facility, the EPC Contractor estimates an average workforce of about 700 workers and a peak of approximately 1200 workers. The EPC Contractor workforce to construct the Electrical Interconnection is expected to average about 450 workers, reaching a maximum of about 650. The general labor types required for construction include equipment operators, plant operators, mechanics, surveyors, truck drivers, foremen, electricians, carpenters, concrete masons, ironworkers, skilled laborers, and common laborers. The estimated workforce for operation and maintenance of the Hydropower Facility and the Electrical Interconnection may be up to approximately 70.

The estimated peak workforce for the Access Road construction is approximately 70, including personnel to support logistics, transport, engineering, and project management. The estimated Access Road workforce during operation and maintenance will be relatively small and intermittent in nature (i.e., many not working full time exclusively on the Access Road). GoG will perform the operation and maintenance either with Ministry of Public Work staff or by subcontracting for such services.

The EPC Contractor, Access Road Contractor, and their subcontractors will be responsible for retaining the required workers for the Project. Some workers will be from outside of Guyana, while many workers will be hired from within Guyana. A significant portion of the workforce will be technical and professional staff required for design and management of the construction operations, while many semi-skilled and unskilled laborers will also be required. Approximately 40% or more of the workforce may be semi-skilled and unskilled laborers who may be hired from within Guyana. The worker recruitment process will be managed by the EPC Contractor and its subcontractors, and the Access Road Contractor (as applicable).

Schedule

Construction of the Access Road began in September 2010, with the commencement of the road upgrades and is anticipated to be completed prior to the start of onsite construction of the Hydropower Facility and Electrical Interconnection. Construction of the Hydropower Facility

and Electrical Interconnection is expected to begin in 2011, dependent on obtaining necessary financing, and is expected to take approximately 3½ years to complete.

Policy, Legal, and Administrative Framework

The ESIA was performed and the Project will be developed within a framework that consists of four main components:

- Guyana policy, legal and administrative framework
- International agreements and conventions
- International financing institution requirements
- Good industry practices.

Guyana Policy, Legal and Regulatory Framework

The Project is being developed to be consistent with Guyana's national environmental framework and policy, including the National Environmental Action Plan, National Biodiversity Action Plan, National Energy Policy, and Low Carbon Development Strategy.

The Project is also being developed to be compliant with all applicable Guyana legislation, including the Constitution of the Co-operative Republic of Guyana Act, Environmental Protection Act, Environmental Protection Authorizations Regulations, Environmental Protection Air Quality Regulations, Environmental Protection Water Quality Regulations, Environmental Protection Noise Management Regulations, Environmental Protection Hazardous Wastes Management Regulations, Amerindian Act, Public Health Ordinance, Occupational Safety and Health Act of 1997, Pesticides and Toxic Chemicals Control Act, Wild Birds Protection Act, Species Protection Regulations, Kaieteur National Park Act, National Parks Commission Act, State Lands Act, Town and Country Planning Act Chapter, Hydroelectric Power Act, Guyana Energy Agency Act, Electricity Sector Reform Act, Public Utilities Commission Act, Forest Act, and Mining Act.

International Agreements and Conventions

The international agreements and conventions for which Guyana is a signatory that may be relevant to the Project include the following: Rio Declaration on Environment and Development, Agenda 21, United Nations Framework Convention on Climate Change, Convention on Biological Diversity, Protocol Concerning Specially Protected Areas and Wildlife, Treaty on Cooperation for the Development of the Amazon Basin, Convention on International Trade of Endangered Species, Basel Convention on Hazardous Waste, Convention Concerning the Protection of the World Cultural and Natural Heritage, Montreal Protocol on Substances that Deplete the Ozone Layer, International Labor Organization Core Labor Standards, and United Nations Declaration on the Rights of Indigenous Peoples.

International Financing Institutions

The Project is being developed to meet the environmental, social, health and safety, and labor policies and requirements of the lenders that may provide financing or insurance to the Project. These include the following: Inter-American Development Bank (IDB) Environmental and Safeguards Compliance Policy, IDB Involuntary Resettlement Policy, IDB Indigenous Peoples Policy, International Finance Corporation (IFC) Social and Environmental Sustainability Performance Standards, and the Equator Principles.

Good Industry Practice

The Project is also being developed to be consistent with relevant environmental and social good industry practice for new hydropower projects, including the World Commission on Dams, which provides a framework for decision making related to dams and development; the Business and Biodiversity Offsets Programme, which has established principles on biodiversity offsets; and the International Hydropower Association Sustainability Guidelines, which provide guidance to promote greater consideration of environmental, social, and economic aspects in the sustainability assessment of new energy and hydroelectric power projects.

Project Environmental Standards

Based on Guyana legislation and potential financial institution environmental and social requirements, the Project-specific environmental standards are established for ambient air quality criteria, air emission standards for combustion facilities, noise standards, potable water, wastewater discharge limits, and electric and magnetic field criteria.

Project Regulatory Status

An application was submitted to the Guyana EPA for an environmental authorization, and EPA indicated that an Environmental Impact Assessment (EIA) was required for the issuance of an environmental authorization for the project. In accordance with EPA policy, an EIA was developed and included a hydropower facility (including reservoir), transmission line, and access road. A draft Terms of Reference (TOR) was prepared and submitted to EPA in 2001. EPA published a notice of the Project in at least one daily newspaper, and a summary of the project was made available to members of the public for a period of 28 days. Three public consultation meetings were held after this 28-day period, one in Georgetown on January 24, 2001, and two in Mahdia on January 25, 2001, and February 11, 2001. A final TOR was issued by EPA, and the EIA was prepared. The EIA was submitted to EPA for evaluation and recommendations. EPA published a notice in at least one daily newspaper notifying the public of the submission of the EIA. The public had 60 days from the publication date of the notice to make submissions to the EPA and/or the EAB related to the EIA. EPA, along with relevant sector agencies, reviewed the EIA during this 60-day period, to ensure that the EIA was consistent with plans, guidelines, and regulations or codes of practice developed by the EPA and sector agencies. Copies of the EIA and the findings of the review by EPA and sector agencies were passed to the EAB for review and recommendation. Two public meetings, chaired by the

EAB, were held at the end of the 60-day period, one in Georgetown and one in Mahdia, on March 13 and 20, 2002, respectively. Additional comments were provided by members of the public at these meetings. A final EIA was then prepared to address the comments from EPA, the sector agencies, the public, and the EAB. The EAB then recommended to EPA whether the EIA was acceptable and the conditions to be attached to the Environmental Permit, upon it being granted on July 29, 2002.

A Project ESIA Addendum was prepared to address a design change in a portion of the transmission line and access roads alignment. Meetings with government officials were held on April 25, 2008, and on May 2, 2008, including with the Ministry of Amerindian Affairs. During the meetings, the discussion included the scope and potential of the impending changes to the Project, the likely social impacts that could be derived from the Project, specifically related to the Kaburi community, and the likely assistance in the form of history/culture of the community. A community consultation meeting was held on May 10, 2008, at the Kaburi Amerindian community, and the issues discussed included the scope and potential of the project and the likely impacts on the community.

An ESIA Addendum was submitted to EPA on June 24, 2008, and was accepted without EPA requiring any additional public disclosure. After review by the EPA, relevant sector agencies and the EAB, a revised EIA Addendum was submitted on October 20, 2008. The EAB, by letter dated June 1, 2009, indicated to the EPA that the revised Addendum was acceptable and identified terms and conditions that should be included in the Renewed Environmental Permit. EPA decided that the Renewed Environmental Permit issued on July 27, 2007, required modification, because the Permit did not include conditions with regard to the installation of the transmission lines, and further did not include conditions identified by the EAB. EPA re-issued the Project Environment Permit dated October 2, 2009, for the Construction and Operation of the Amaila Falls Hydroelectric Project. The Permit was issued to cover all activities fully described in the ESIA dated April 2002, including the construction of all roads related to Project development and operation and in accordance with the ESIA Addendum for the Transmission Line Alignment, dated 2008.

On May 21, 2010, the Ministry of Public Works and Communication (MoPW&C) submitted the Application for Environmental Authorization, along with the necessary maps and the proposed alignment, in order to permit the construction of the Access Road and transmission line clearance separately or as a subset of the overall Amaila Falls Hydroelectric Project, because construction of the access road and transmission line clearance would be undertaken by GoG through the MoPW&C. In permitting this aspect of the overall project, EPA requested that the Company submit, for review and approval, a detailed Environmental Management Plan (EMP) to cover all phases of the development (construction and operation) of the Access Road. The EMP identified and provided a detailed description of potentially significant environmental impacts and relevant feasible and cost-effective measures that may reduce or mitigate these potentially significant adverse environmental impacts to acceptable levels.

Environmental and Social Conditions

Environment

The primary information sources used to establish the environmental baseline conditions were: 1) detailed site reconnaissance of the Project area; 2) collection and analysis of environmental baseline data; and 3) review of existing data, documents, and reports. The environmental conditions are summarized with the perspective of providing the necessary detail for an assessment of how they may be affected by the Project. Baseline conditions are described for the following three areas: indirect area of influence (IAI), direct area of influence (DAI), and directly affected area (DAA).

The Project IAI for the physical and biological environments includes the watersheds of the Amaila and Kuribrong Rivers upstream of the confluence of the Kuribrong and Potaro Rivers. All of the hydropower project and part of the transmission line and access road are contained within this portion of the IAI. The remainder of the IAI for the physical and biological environment consists of a 10-km-wide strip centered on the transmission line and access road segments downstream of the confluence of the Kuribrong and Potaro Rivers.

The Project DAI limits for the physical environment and terrestrial biological environment include the DAA of the hydropower components (including the reduced-flow river segment) plus a 100-m buffer. In the case of the transmission line and access road, a 500-m buffer on each side was adopted. The DAI also includes the area to be occupied by construction camps, service roads, borrow pits, surplus material deposits, and other construction support infrastructure, plus a 100-m buffer surrounding these areas. In the case of aquatic ecosystems, the DAI includes the Amaila and Kuribrong river reaches upstream of Amaila Falls, along the full segment to be flooded by the reservoir, plus 1 km upstream, the reduced flow reaches between the dam and the tailrace channel discharge, and the Kuribrong River downstream of the discharge, along the reach terminating at the confluence with the Potaro River.

Regional Setting

The Project area is located in the Guiana Shield, which is a biologically rich area that encompasses much of northeastern South America, including all of Guyana, Suriname, French Guiana, the Venezuelan states of Bolivar and Amazonas, and parts of northern Brazil. The Guiana Shield consists of two somewhat distinct areas of highlands (300 to over 1,500 m elevation) and coastal plains (0–300 m) that are separated from the highlands by an escarpment. The Guiana Shield has many attributes that generally lead to high levels of biodiversity: geological diversity, a topographically variable landscape, and transition between ecosystems.

Climate and Meteorology

Guyana is located in the Equatorial Trough Zone (ETZ), and its weather and climate are influenced primarily by the seasonal shifts of the ETZ and its associated rain bands. It is characterized by a standard temperature cycle with small thermal variations throughout the year and high temperatures year-round (24–30°C), thus exhibiting seasonal homogeneity. August–

October is the quarter with the highest temperatures, and the months from December to February have the lowest temperatures. According to the Guyana Hydrometeorological Service (HMS), the regional climate consists of two distinct wet seasons and two relatively dry seasons. However, because Guyana is located within the influence zone of the El Niño Southern Oscillation (ENSO) these patterns are disrupted by this periodic event. The periods of February–April and September–November are dry, while the remaining months are characterized by rainy periods. The May–June quarter has the highest rainfall amounts, and June is the rainiest month. At Kaieteur National Park, the closest meteorological station to the study area, mean annual rainfall was 4,234 mm for the period of record (1953–1978). The maximum monthly rainfall was 893 mm, in June 1956. The maximum daily rainfall was 193 mm, in June 1966. Winds blow primarily from the northeast and east, and wind speeds are highest in March and lowest in July. The average of the higher wind speeds is 14.63 m/s. The average of the lower wind speeds is 9.12 m/s.

Air Quality and Noise

Air quality in the Project area is generally considered to be good. There are no major industries in the Project area, with the exception of bauxite mining in Linden (with associated thermal power generation units) and some industries around Georgetown. The most significant emissions to the atmosphere on the proposed alignment result from the passage of motor vehicles on the roads near the Electrical Interconnection and Access Road. Because the Project area is almost entirely in rural or undeveloped areas, ambient noise is low, with the exception of areas in Linden and Georgetown.

Geology

Geologically, the Guiana Shield is an ancient Precambrian land mass made up of varied formations that include folded metavolcanic and metasedimentary rocks, as well as variable grained sedimentary rocks with intercalations of volcanic rocks and intrusive bodies within the folded strata, and Cenozoic sediments. The Guiana Shield can be considered as a group of three highland islands separated by a series of troughs. These troughs correspond to areas where the crust has subsided due to a number of structural warps, faults, and shear zones, and contain sediment deposits eroded from highland areas (Hammond 2005).

The following types of lithostratigraphic units are found in the IA):

Barama-Mazaruni Supergroup—Barama-Mazaruni outcrops are rare, except along the Essequibo River and some of the larger creeks.

Badidku Suite—This suite is composed of small intrusions of ultramafic and gabbros rock and occurs southwest of Rockstone and Linden and between the Mazaruni and Essequibo Rivers.

Migmatites (Bartica Assemblage) and Granites (Younger Granites)—These granite-gneisses and migmatites have been named the Bartica Assemblage. Most exposures of these rocks can be observed on the banks of the Essequibo River.

Roraima Group—The Roraima sediments occur primarily in the Hydroelectric Facility IAI, especially in the reservoir area.

Avanavero Suite—Rocks of this suite are common and are exposed in the area of the dam and in a N-S strip, creating a ridge that includes the headwaters of the Amaila River and delimits the western edge of the reservoir.

Apatoe Suite—The Apatoe Suite is particularly common in the region of the Project between the Berbice and Essequibo Rivers.

Detritic-Lateritic Cover—Also known as the “Bauxite Hiatus” are crossed by the Project Transmission Line IAI between Linden and the Essequibo River.

Berbice Formation–White Sand Series—The White Sand Series consists predominantly of white uncompacted pure quartz sand and represents coastal or estuarine deposits. This formation typically supports open savannahs with grasses and sedges

Demerara and Coropina Formations—Along the Coastal Plain, the Cenozoic deposits are called the Demerara Formation (Young Coastal Plain) and the Coropina Formation (Old Coastal Plain)

Colluvial-Alluvial Deposits—This formation occurs along the coast of Guyana and consists of mangroves, mudflats, chemiers, and sandy beaches fronting a swampy coastal plain. The marine sediments include fine quartz sands with white and/or beige coloring in flat-parallel layers, deposited in old beaches and coastal sand bars. The sediments of mixed origin are clayey-silty and sandy-silty, rich in vegetal fragments and shells, deposited in lagoon and tidal plain environments that have river contributions.

Soils

In the Project IAI, 17 soil units were identified, some of which are soil associations with various components. The predominant soil types in the reservoir area and its immediate vicinity include five map units:

- Source of Amaila River and NW Portion of Reservoir—Soil Li, which is an association of shallow, excessively drained, grayish brown and brown sandy loam and sandy clay loam derived from deeply weathered acidic rocks such as granite, siliceous sandstone, and acid volcanic, and occur in steep, mountainous degraded uplands
- Around the Rim of the Reservoir—Soil unit Ap, which is an association of moderately deep and deep, dominantly poorly drained sterile white sandy soil, and deep, poorly drained medium-textured soils on level and gently sloping recent alluvials and terraces.
- Upstream of Amaila Falls—Soil unit Al is an association of deep, dominantly poorly drained, gray, white, and brown, silty clay and sandy soils occurring on nearly level or recent level alluvium.

- Immediately Downstream of Amaila Falls—Soil unit Rs is a dominantly deep, well-drained, friable brown or red clay loam to clay soil that may be gravelly.

The following predominant soil types were identified along the transmission-line alignment:

- Extreme Western Section—Soil La is an association of generally deep well- and somewhat excessively drained brown, very gravelly sandy loam and gravelly silt loam occurring on sloping, hilly, and dissected pediments.
- Coastal Plain—Soil unit Ag is an association of deep, gray, poorly drained clayey and silty soils.
- Gently Sloping White Sand Plateau and Terraces—Soil unit Qr is a deep excessively and poorly drained white sand soil.
- Rolling to Steep Dissected White Sand Plateau—Soil unit As is an association of deep, dominantly well-drained, yellow and brown clay loam and clay soils occurring with crystalline exposures and resulting from stratified, unconsolidated deposits and residual acidic materials.
- Nearly Level to Level Alluvium—Soil unit Al is a deep, gray and brown, generally poorly drained clayey silty and sandy soil that resulted from stratified, unconsolidated recent alluvial deposits of silt, clays, and sand.
- Level Coastal Plain and Riverine Organic Deposits—Soil unit Bo is a deep, very poorly drained, reddish brown, organic soil with inclusions of deep, poorly drained mineral soils and toxic salts.
- Level to Nearly Level Recent Coastal Plain—Soil unit Ao is an association of deep, gray, poorly drained clayey and silty soils.

Landforms

Landforms are the result of the combined influences of topographic, geologic, soil, and hydrologic features. Five large landform categories are recognized for the Guiana Shield: Recent Coastal Plains, Tertiary Sandy Plains, Precambrian Rolling Hills, Guiana Uplands, and Guyana Highlands. A recent Coastal Plains landform occurs along the Atlantic Coast in a narrow plain area with low-lying sediments. This landform rarely rises higher than 10 masl. The Tertiary Sandy Plains landform covers a large belt running parallel and rising above the Recent Coastal Plains. This landform rises between 10 and 50 masl and can reach several meters thick in regions of significant crustal down-warping—for example, along the lower Berbice/Courentyne Rivers. The Precambrian Rolling Hills landform comprises a series of flat-topped hills, ridges, and valleys, with an elevation between approximately 50 and 300 masl. The Guiana Uplands landform includes areas ranging from 800 to 1,600 masl composed of the Roraima Supergroup sediments and intrusive and ancient metamorphosed rocks, and includes areas of the Pakaraima Mountains Region and peaks rising above 300 masl.

Seismic Activity

Seismicity in the northern part of the South American continent is controlled largely by plate boundary events occurring along the southern rim of the Caribbean Basin. Most earthquake activity occurs along the plate boundary between the South American and Caribbean Plates. A search of the National Oceanic and Atmospheric Administration's earthquake database revealed that five events have occurred within recorded history within 300 km of the Project area. The magnitude of only two events was recorded, and the greater of the two was 4.9.

Surface Hydrology and Water Quality

The headwaters of the Kuribrong River are at an elevation of approximately 700 masl in the Pakaraima Mountains; the headwaters encompass a drainage area of approximately 2,144 km², and the river flows 183 km from the headwaters to its confluence with the Potaro River. The Kuribrong River has an elevation change of approximately 660 m and an average slope of 3.6 m/km. The Amaila River is the main contributor to the Kuribrong River on the plateau course and has a drainage area of about 113.5 km² and a total length of 22 km. Its elevation is approximately 230 masl and it has an average slope of 10.45 m/km. The valley below Amaila Falls is at first narrow and filled with talus consisting of immense sedimentary and igneous boulders. The river then enters a basin 10 miles wide, bounded on the western and southern sides by an irregular sandstone escarpment and on the northern and eastern sides by high ridges of intrusive rock. At Mona Falls, the river enters the dissected peneplain characteristic of most of the area between the Pakaraima Mountains and the Atlantic Ocean. Primary characteristics of the Kuribrong River are:

- Upper Reach (headwaters to confluence with the Amaila River)—In the higher altitude areas, the first- and second-order contributors have erosive channels on granite, with torrential flows associated with steep slopes and the presence of extensive rock outcroppings, which make the river waters flow rapidly and directly to the main channel, causing rapid and local high flows. The intensive headward erosion causes expansion of the drainage basin, which is further advanced by the steep slopes. Waterfalls and rapids are common features in this area.
- Middle Reach (confluence of Amaila/Kuribrong with Kuribrong/Apanachi)—Along this segment, the river is oriented primarily toward the northeast, where it intersects granite rock near Amaila Falls. However, along the remainder of the course, the channel is on greenstone-belt-type sedimentary volcanic rock, also covered with sandy and conglomerated deposits, in the segment that is primarily meandering. Downstream of the confluence with Wailang Creek, there is a segment with an inset erosive channel with steep slopes, supported on gabbro intrusions and with no fluvial plain.
- Lower Reach (Kuribrong/Apanachi to Kuribrong/Potaro)—Deposition processes and alluvial channels with floodplains were observed, similar to those in the middle reach. Due to the structural characteristics of this segment, rapids are observed frequently, and in erosive channels on rock,

islands and rock outcrops are observed. Portage Falls is an example of these formations.

At the Project dam site, the Kuribrong River has a mean width of 35 m, and the Amaila River has a mean width of 26 m. The average annual flow of the Kuribrong River at the Project powerhouse is estimated to be approximately $64.1 \text{ m}^3/\text{s}$, with peaks of high flow during the months of May ($109.6 \text{ m}^3/\text{s}$), June ($141.6 \text{ m}^3/\text{s}$), and July ($108.1 \text{ m}^3/\text{s}$). During October and November, smaller average flows of 20.1 and $24.3 \text{ m}^3/\text{s}$ occur. A flood event of $1,646 \text{ m}^3/\text{s}$ is estimated to have a recurrence of 100 years. Similarly, the 7-day minimum mean stream flow with a recurrence of 10 years (7Q10) was estimated at $5.48 \text{ m}^3/\text{s}$. The Kuribrong River receives considerable contributions from its tributaries, increasing its mean outflow by about 75% at a distance of 48 km downstream of the powerhouse.

In terms of general water quality, the chemical composition of rivers draining the Guyana Shield reflects the intense weathering of the soils by the wet tropical environment. Calcium-rich minerals are preferentially dissolved (Gaillardet et al. 1999) and unlike temperate forests, most of the organic carbon is stored in the vegetation rather than in the soil (Blais et al. 2005). As a result, rivers such as the Amaila and upper Kuribrong are relatively low in dissolved solids, high in organic carbon, low in nutrients, and acidic, with a pH of 4–5. During the environmental baseline survey in April–May 2010, eight stations were sampled and various water quality parameters were analyzed.

Laboratory analyses of water samples collected during the rainy season indicated good water quality in the studied reaches of the Kuribrong and Amaila Rivers, with no parameters exceeding standards established by international agencies. Turbidity values were all less than 2 NTU, except downstream in the Kuribrong River (82.9 NTU). This elevated turbidity is possibly associated with some limited gold mining activities in the river downstream of the Hydropower Facility. The higher turbidity, ammonia-nitrogen, total Kjeldahl nitrogen, and total phosphorus may also be attributable to this activity. Measured dissolved oxygen levels varied between 4.6 and 5.6 mg/L, with the exception of immediately below Amaila Falls, which had DO of 8.3 mg/L. Levels of pH varied between 4.34 and 5.38. In general, the limnologic characteristics of the Amaila River are different from those in the Kuribrong River, principally with relation to the total phosphorus and total nitrogen. Nutrients appear to be higher in the Amaila River, possibly due to the large proportion of permanently flooded forest in that watershed. With the exception of zinc, metals were found within ranges typically reported for rivers in the Amazon Basin. Sediment loads were calculated for the rivers based on measured suspended solids.

Hydrogeology

In the reservoir area, it is likely that any groundwater originates from recharge from the Amaila and Kuribrong Rivers, and that groundwater flow is along the shear planes present at the site. The major portion of the transmission-line alignment is covered by white sands and brownish red silty sandy clays of the White Sand Series. The aquifers used as sources of groundwater on the coast of Guyana outcrop in the White Sand Series. Both perched and normal groundwater conditions are likely to be encountered in the White Sand Series along the alignment.

Vegetation

There are three basic types of forest formations in the Hydropower Facility DAI. The forest formations mapped as “Periodically flooded riparian tropical forest (alluvial)” are restricted to the floodplains of the Amaila River and are subject to frequent flooding due to the intense and relatively rapid variation of the levels of this river. “Periodically flooded riparian tropical forest” areas are characterized by a significant presence of palm trees, and these areas are located upstream in the Kuribrong River. This vegetation community type is only found outside the Project DAI.

Outside these floodplains and, therefore, not subject to the normal flooding of the Kuribrong and Amaila Rivers, the predominant forest formations are known as the “Lower montane rainforests on rock outcrops (wet soil)” and “Lower montane rainforests on excessively drained sands (dry evergreen forest)”. The first is always associated with waterlogged soils, because they are situated over rock outcrops and a high water table, with a lot of organic material and matted roots. These forests cover the greatest part of the Hydropower Facility area of direct influence (DAI) and are characterized by an extremely damp appearance, which is favorable to a great growth of bryophytes on the tree trunks and by trees with low wood production capacity. The second forest formation occurs over well-drained sandy soils and is characterized by taller trees and greater wood production potential as compared to the formations mentioned previously, with a dryer appearance and open understory.

The vegetation cover of the transmission-line DAI is made up of a large continuum of rain forests through the base of the Pakaraima Mountains and the right bank of the Essequibo River, consisting of “Lowland mixed rainforests” and “Lowland rainforests on excessively drained sands.” The variations among these rainforests are caused by the different types of soil and terrain, which result in the differences between them and in the intensity of anthropogenic alterations to which these forests are subject. Between the Essequibo River and the beginning of the coastal plain, the anthropogenic alterations are more pronounced, and there are frequent occurrences of fire, which cause profound alterations in vegetation physiognomy. The coastal plain contains the area most affected by human influence within the DAI, where intensive agriculture and secondary vegetation are predominate.

The forest formations that are best preserved within the transmission-line DAI, practically without any significant anthropogenic alterations, occur between the surrounding areas of the powerhouse and the crossing of the Kuribrong River. This is probably due to the lack of land access and navigable rivers, thereby precluding or complicating commercial extraction of trees and transportation of timber to consumer centers.

The forests located at the base of the Pakaraima Mountains, where the powerhouse will be built, were mapped as “Lowland mixed rainforests on rock outcrops.” These forests grow predominantly on soil made up of lateritic gravel and rocky outcrops, and do not have just a few dominant species. In the greater part of the remainder of this segment, there are mixed rainforests without dominance by a few species, which were mapped as “Lowland mixed rainforests,” and dry evergreen forests dominated by few species, mapped as “Lowland rainforests on excessively drained sands,” which occur in areas where there are extremely sandy, well-drained soils, whose physiognomy changes with the sand/clay ratio in the soil.

According to the Vegetation Map of Guyana (Guyana Forestry Commission 2001), these dry evergreen forests on excessively drained white sands receive a regional denomination of “Clump Wallaba forest” and “Wallaba forest.” An alluvial forest formation mapped as “Periodically flooded lowland riparian tropical forest (alluvial)” occurs along most of the floodplain of the Kuribrong River and its tributaries, and its width varies greatly. This alluvial forest is subject to frequent flooding due to the variation in the level of the Kuribrong River and shows anthropogenic alterations only in the areas of small gold and diamond mine workings. At specific points, usually restricted to the mouths of small Kuribrong River tributaries, there are forest formations that are permanently flooded or that are flooded for long periods of the year. These were mapped, when possible at the scale of this study, as “Permanently flooded riparian tropical forest.”

In the segment of the transmission line between the left bank of the Kuribrong River and the Essequibo River, there are also “Lowland mixed rainforests” and “Lowland rainforests on excessively drained sands.” However, this forest is under concession and supports human populations such as the Kaburi Reservation, so these forests may show anthropogenic alterations resulting from commercial or subsistence extraction of timber, small areas of deforestation, and signs of fire. In this segment of the transmission line, a few areas are characterized by sandy soil with greater clay content than the surrounding areas, where the forest has a more dense physiognomy, with greater wood production capacity and dense understory. In the Essequibo floodplain, especially on the right bank, there is a wide strip of alluvial forest mapped as “Permanently flooded riparian tropical Forest,” due to widespread and long-lasting flooding to which it is subject during the greater part of the year.

In the segment between the end of the Essequibo River alluvial plain and the beginning of the coastal plain, anthropogenic alterations of vegetation cover are more intense, and these areas are very prone to fire. On the higher parts of water divides with extremely sandy soils, there are dry, low evergreen forests and shrub and grassy formations, which are influenced by fire and have the appearance of a savannah, mapped respectively as “Secondary lowland rainforests on excessively drained sands” and “Lowland grass/scrub savannah on white sand.” According to the Vegetation Map of Guyana (Guyana Forestry Commission 2001), these fire-influenced formations on excessively drained white sands are called “Dakama Forest” and “Muri scrub/white sand savannah.” In this segment of the transmission line, there are also human settlements and anthropogenic areas mapped as “Mosaic of anthropogenic areas,” “Urban areas or urban influence,” and “Large mines,” such as those existing at Linden and its surrounding areas.

In the transmission-line DAI on the coastal plain on which Georgetown is situated, there is a predominance of “Intensive agriculture” and some areas with “Secondary vegetation.” There are also areas designated as “Urban areas or urban influence” associated with Georgetown and its environs.

Terrestrial and Semi-Aquatic Fauna

Information regarding terrestrial fauna was developed during an extensive field campaign in April/May 2010. The surveys of medium- and large-sized mammalian fauna within the DAI of the Hydropower Facility identified 22 species belonging to 7 orders and 13 families. Including

the medium- and large-sized mammal surveys in both the project's DAI and IAI, a total of 29 species were observed, belonging to 8 orders and 16 families. Among medium- and large-sized mammals, no registered species are endemic to Guyana or the Guyana shield. In fact, a large part of the fauna recorded for this group is composed of species widely distributed throughout the neotropical region, as is the case for registered Carnivora, Pilosa, and Cingulata. Others, like the registered Primates, are typical of the northern Amazonian region but are also not restricted to the Guyana shield. One of the registered species is considered vulnerable by IUCN (*Priodontes maximus*), and another, the giant otter *Pteronura brasiliensis*, is considered endangered. *Panthera onca* is listed as near-threatened, and the red brocket *Mazama Americana* is listed as data deficient. Additionally, five species are listed in CITES Appendix 1 (*Leopardus pardalis*, *Panthera onca*, *Pteronura brasiliensis*, *Puma yagouaroundi* and *Priodontes maximus*), seven in Appendix 2 (*Puma concolor*, *Tapirus terrestris*, *Tayassu pecari*, *Pecari tajacu*, *Alouatta macconnelli*, *Saguinus midas* and *Cebus olivaceus*), and one in Appendix 3 (*Nasua nasua*).

Twelve non-volant small mammal species were registered during the field campaign, two of which are awaiting identification to the species level (*Marmosops* sp. and *Echimyis* sp.). One of the recorded small mammal species is endemic to the Guiana Shield—*Oecomys* cf. *auyantepui*. This species is widely distributed, however, and is believed to occur in a number of protected areas. No registered non-volant small mammal species are present in CITES appendixes, but one (*Neusticomys venezuelae*) is listed as vulnerable according to IUCN. *Neusticomys venezuelae* is a semi-aquatic habit specialist that has a patchy geographic distribution through Guyana and Venezuela, and prior to this work was known from only five different locations. Major threats to this species are habitat destruction and aquatic contamination.

Twenty-seven bat species were identified, of which *Rhinophylla pumilio* was the most frequent species with 20 (17.1%) captures, followed by *P. parnelli* with 18 (15.4%), *C. perspicillata* with 14 (12.8%), and *L. thomasi* and *T. cirrhosus* with 10 (8.5%) captures each. Guild proportion is similar with regard to abundance and richness in each area, but differences were found among areas. In the reservoir area, there was dominance of gleaning and aerial insectivorous and nectarivorous specimens and species; in lowland areas, on the other hand, there were additional records of carnivorous and omnivorous bats represented by *Trachops*, *Chrotopterus*, and *Phyllostomus*. Only one species is listed in IUCN, *Tonatia bidens*, which was classified as having deficient data (DD), and no species appears in CITES appendixes.

With respect to herpetofauna, the survey registered the presence of 36 species of amphibians (33 anurans and 3 caecilians), 39 species of squamate reptiles (18 lizards and 21 snakes), one species of crocodilian and three species of chelonians, totaling 79 species. From these, 14 are considered endemic, with eight species endemic to the Guyana shield, while six are exclusive to Guyana, representing a degree of endemism of 17.7%. One species of amphibian (*Hypsiboas* spp.) is awaiting identification to species level. The crocodilian species (*Paleosuchus trigonatus*), the three chelonians (*Platemys platycephala*, *Rhinoclemmys punctularia*, *Chelonoidis denticulata*), and both Boid snakes sampled (*Corallus hortulanus* and *Epicrates cenchria*) were listed in Appendix II of CITES (2010) as species that can be potentially disturbed by human development and commerce. However, most of these species are known for being tolerant to disturbed environments, having been recorded in altered forests.

Of the 412 birds recorded in the Project area, 27 (6.5%) are endemic to the Guyana shield, 11 (2.6%) are rare and patchily distributed, 2 are near-threatened, 1 is included in CITES Appendix I, 75 (18.2%) are included in CITES Appendix II, 7 are migratory, 5 are hunted or potentially persecuted by local populations, and 2 were recorded in Guyana for the first time. Furthermore, 7 species are specialized to micro-habitats such as waterfalls, rapids, boulders, caves, open grassy natural fields, open white-sand scrub, and riverine scrub. Therefore, nearly a third (129 species) of the birds recorded in the Amaila Falls Hydropower Project area can be regarded as of some conservation interest.

Aquatic Flora and Fauna

Existing data on the aquatic communities of rivers in Guyana are limited, and no data are available in the literature for the Kuribrong or Amaila River. The review of secondary data included data for the Amazon basin, the Orinoco basin, and rivers in Guyana that drain Suriname and French Guyana. Based on this literature review, 18 species were common to the four areas, and another 12 are species registered only in Guyana (endemic to the country). The environmental baseline field survey carried out during the rainy season recorded 53 fish species distributed into 6 orders and 19 families, none of which are listed as threatened or vulnerable according to the IUCN Red List of Threatened Species. The survey registered 12 species classified as migratory. None of these migratory fishes are commercially important in the DAI and the IAI. Although sampling is not yet conclusive for the fish community, the results obtained do not indicate that the project will result in significant degradation of critical natural habitat for fish, because various rapids and small tributaries will remain unaffected upstream of the reservoir, and these habitats are common in nearby rivers such as the Potaro River, which appears to have a fish community very similar to that found in the Kuribrong/Amaila Rivers. In relation to the remaining components of aquatic fauna (Phytoplankton, Zooplankton, Benthos, and Periphyton), no organism was indicated as endemic to the region.

Medically Important Fauna

Due to the tropical climate and similarity to other forests found in the Amazon Basin, similarities can be observed between local invertebrates of medical interest and those found elsewhere within the Basin. Therefore, it is anticipated that the general disease profile and presence of vectors will be similar to the general Amazonian conditions. Results from fieldwork and literature review indicate the presence of some important species, suggesting a risk of different infections such as arboviruses (among them yellow fever), malaria, and leishmaniasis. The presence of a high density of a leishmaniasis vector in the region increases the risk of leishmaniasis infections among workers exposed to forest areas, and the presence of *Anopheles neivai* indicates risk of plasmodia transmission. It was also found that the region close to Georgetown shows an epidemiologic condition that is conducive to the transmission of pathogens by vectors, due to the lack of basic sanitation in surrounding areas and high population density.

Forestry Resources

The Guyana Forestry Commission (GFC) reported that there are seven forestry concessions in the Project alignment, consisting of six State Forest Permits (SFPs) and one Timber Sales Agreement (TSA). All SFPs are located on the east bank of the Essequibo River and are between the Mabura Hill road and the Essequibo River. While no specific records were available on the status of these SFPs, it is believed that significant removal of commercial-grade timber has already occurred. The single TSA extends from the west bank of the Essequibo River to Kaburi Village. The TSA is operated by Interior Forest Industries, a subsidiary of Toolsie Persaud Limited. Toolsie Persaud personnel reported that the northern portions of the TSA (i.e., the location of the Project Access Road improvements and transmission line) have already been harvested, and they were now working in the southern portions. The remaining section of the proposed Access Road and transmission-line clearing from Kaburi Village to the hydropower powerhouse site is in unallocated forests. There are no forestry concessions in the Hydropower Facility area.

Mineral Resources

The Guyana Geology and Mines Commission (GGMC) has determined that there are 4 large-scale and 44 medium-scale mining properties in the road and transmission-line alignment between the reservoir and Linden. There are no small-scale land-based operations on the Access Road and/or Electrical Interconnection alignment. GGMC confirmed that there were no mining concessions/properties in the Hydropower Facility area. However, over sections of the Kuribrong River from Amaila Falls to the confluence of the Kuribrong and Potaro rivers, 62 river-based claims were identified, and two river-based claims were allocated in the Amaila River. In the Kuribrong River, a large number of small-scale claims were identified on both banks. A total of 150 of these claims are located on and immediately adjacent to the left and right banks of the river, and 121 claims are located farther away from the banks. Some limited small-scale mining activities were reported by members of the Kopinang community in the area of the future reservoir. In 2009, it is reported that six persons operated river dredges on the Kuribrong River. The operations were focused primarily between Amaila Gorge and Mona Falls.

Protected Areas

The location of the Hydropower Facility and the planned route of the transmission line and Access Roads do not coincide with any protected areas or conservation units. The national park closest to the Project is the Kaieteur National Park, the main protected area of Guyana, located about 20 km from the dam location and approximately 3 km from the Hydropower Facility DAI. The park has an area of approximately 62,700 ha.

Cultural and Archaeological Heritage

There are no known cultural or archaeological sites that are of historic interest in the study area for the Project.

Social

Information on the key socio-economic issues and activities relevant to the Project was developed to assist in evaluating potential Project direct and indirect socio-economic impacts and, as necessary, in designing mitigation and monitoring programs. The socio-economic baseline conditions were developed based on a review of various information sources and a social baseline assessment performed as part of this ESIA, which included Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA). The RRA/PRA consisted of formal consultation meetings and/or interviews in 14 communities in May 2010, including meetings in Amerindian communities and other mixed communities and interviews with individual community members. The consulted communities included Kaburi, Butakari, 14 Mile, Rockstone, Muritaro, Malali, Micobie, Campelltown, Princeville, Kopinang, Chenapou, Menzies Landing, and St. Cuthbert's Mission. The communities were informed prior to the meeting (written and/or verbal communication), and a brief written summary of the Project was prepared and distributed several days prior to the meeting. A questionnaire was developed and used during individual interviews. A walk/drive through each community was also performed to identify basic housing, infrastructure, services, water sources, commerce, and general local characteristics. A photographic register of the relevant areas was established. Meetings and site reconnaissance visits were also conducted in Mahdia, Linden and Georgetown, and the properties to be affected along the transmission line from Georgetown to Linden. Some informal field visits were conducted near the Sophia.

The summary of socio-economic baseline conditions is divided into regional and local conditions (selected cities and Amerindian communities).

Regional

For the purposes of this ESIA, a regional area was established and includes Guyana's Regions:

- Region 3 Demerara-Mahaica
- Region 4 East Berbice-Corentyne
- Region 5 Essequibo Islands-West Demerara
- Region 7 Pomeroon-Supenaam
- Region 8 Potaro-Siparuni
- Region 10 Upper Takutu-Upper Essequibo

The Hydropower Facility is located in Region 8, and the Access Roads and transmission line will cross portions of Regions 4, 7, 8, and 10. Although Regions 3 and 5 do not have any Project facilities or activities, they were included for completeness due to their proximity to the Project.

The population in Guyana is projected to be 787,083 people in 2010. Within the six regions, there is a high proportion of children and a low proportion of older people, indicating a

population in which there is a high birth rate, a high death rate, and a short life expectancy—a common pattern for less economically developed countries. One of the most significant characteristics of the Guyanese population is ethnic diversity. Almost 45% of Guyana's total population is composed of East Indian descendants (Indo-Guyanese), most of them living in Regions 3, 4, and 5. African descendants correspond to just over 30% percent of the population, most of them concentrated in Region 4. Those classified as Mixed are around 16% of the population. Amerindians correspond to less than 10% of the total population, and the remaining population, less than 1.5%, is composed of other or unknown ethnicity. While Regions 3, 4, and 5 are composed mostly of people of East Indian or African descent, Regions 7 and 8 have a large and important participation of Amerindians in their population composition, followed by a population of mixed ethnic origin. African descendants and mixed populations have the greatest representation in Region 10 where together they are more than 85% of the total.

The Guyanese economy is based largely on agriculture and extractive industries; the sugar industry is the largest employer in the country. The economy is heavily dependent on the export of sugar, gold, bauxite, shrimp, timber, and rice. In addition to these exports, the country also exports alumina, molasses, and rum. Major imports include manufacturing equipment, machinery, petroleum, and food.

According to *The World Fact Book* (CIA 2010), the labor force in Guyana was 333,900 people in 2007 and the unemployment rate in the same year was around 11%. According to data available at the Caribbean Community Secretariat website, most jobs are concentrated in the services sector (58.1%), followed by agriculture (23.1%) and industry (18.8%).

According to the Ministry of Health, the most frequent diseases reported in 2007 were malaria, especially in Regions 4, 5, 7, and 8, and gastroenteritis, in Regions 3, 4, 5, and 10. The high level of gastroenteritis is an important indicator of a lack of sanitation. Although the levels of HIV and AIDS among all reported cases are low, according to the Ministry of Health Statistical Bulletin (2007), HIV ranks fifth in leading causes of death.

In 2007, Guyana had a total of 379 health-care institutions. Almost one third of these institutions were located in Regions 3 and 4. According to the Ministry of Health's Statistical Bulletin, the number of doctors and hospital beds is low, reported as 3.8 doctors and 18.8 hospital beds per 10,000 inhabitants.

Education in Guyana is compulsory for children from 5 to 15 years of age. The education system includes non-compulsory pre-school, six years of primary school, four to seven years of secondary school, and two to four years of higher academic or practical education.

According to the Population & Housing Census 2002 (Guyana National Report), the main supply of drinking water is public, and reaches about 80% of the total Guyanese population. In Regions 3, 4, 5, and 10, the majority of households received their drinking water through pipes into dwellings, yards, or plots, while in Regions 7 and 8, the majority of households received their drinking water through a combination of water collected at ponds, rivers, and streams and through rainwater collection. The use of pit latrines is still predominant, except for Region 4, in which the predominant facility is the septic tank. Georgetown has a sewer-line system. The

most common method of household waste (garbage) disposal is reported as burning, although all regions except 8 have some kind of garbage collection system.

Guyana's road network is approximately 4,000 km long, consisting mostly of non-paved roads, and is composed of primary roads in the coastal and riverine areas serving the general population and the agricultural sector, a primary road to Linden that serves the general population and the mining and forestry sectors, feeder roads that link the agricultural areas along the coast to the primary road network, and interior roads and trails. The coastal main road system is not continuous, and there are gaps where the roads intersect the Essequibo, Demerara, and Berbice Rivers. In these gaps, people and goods cross by ferry systems, as well as by the Demerara Harbour Bridge and the Berbice River Bridge. It is estimated that about 1,000 km of waterways in Guyana are utilized for commerce.

The country produced 821 million kWh of electricity (2007), and its consumption in this same year was 667 million kWh. No electricity is exported or imported. Guyana's oil imports were 10,550 bbl/day (2007) and the country has no known oil reserves (CIA 2010).

In 2008, Guyana had around 125,000 fixed telephone lines in use, and many areas still lacked fixed-line telephone services; cell phone density is more than double the density of fixed-line telephones (281,400 mobiles). The country has AM and FM radio stations and three television stations, one public and two private, which relay U.S. satellite services (1997). Internet users reached 250,000 in 2008.

There are nine Amerindian tribes, which are spread over all ten administrative regions in Guyana. In relation to the Project, the relevant Regions are 4, 7, 8, and 10. The most common ethnic groups represented in the Project regions are the Arawak, the Akawaio, and the Patamuna, with a smaller number of Makushi as well as mixed ethnicity and a Carib group. The Amerindian villages currently occupy two land categories, titled and untitled, both of which are communal lands. Under the New Amerindian Act of 2006, titled Amerindian communities are governed by a Village Council, which is headed by a Toshao (Village Leader). Untitled Amerindian communities are governed by a Community Development Council (CDC).

Village layout is similar in most Amerindian Lands. Dwellings are scattered throughout sections of the titled land. Most Amerindian villages have a primary school, a health center, the village government office used by the Toshao and the Village Council, teachers' living quarters and a shop; a meeting place is also very common, and some Amerindian villages also have additional schools (nursery and/or secondary), a sports field, a guest house, and one or more churches. Christianity is common in most Amerindian Lands, and several denominations are represented. Emigration in search for work and/or education is relatively common. Most houses have pit latrines (outhouses), while garbage and other waste is either burned or buried. Water is collected from creeks and rivers; less widespread but also relatively common is the collection of rainwater. Some Amerindian villages have electricity generated by solar panels, while others rely on generators. Cooking is done with gas or kerosene stoves. Those that cannot afford gas or kerosene cook on an outdoor wood fire. A high-frequency two-way radio is available in the majority of Amerindian Lands. Amerindian Lands closest to Georgetown, Linden, and Mahdia have community phone booths and/or cell phone service.

Many of the Amerindian villages have only a primary school, and some of the primary schools have nursery and/or secondary school departments. Most children regularly attend and graduate from primary school, but early school leave tends to be relatively common when students reach secondary-school age, especially if they have to travel long distances and board in order to attend secondary school. The “Primary Top Ups” system is in place in some Amerindian communities and enables students who cannot afford to travel outside their communities to attend accredited secondary schools to begin their secondary education (grades 7 to 9) at a secondary school department within the primary school in their own community.

The economies in Amerindian Lands have certain common characteristics. Access to cash income is usually very limited. In some Amerindian communities, the only paid positions available are governmental employment as teachers, Toshao, and health workers. People over 65 receive a government pension. The economy is a varying combination of cash income-generating activities (mining and logging) and subsistence activities. A proportion of these Amerindian populations, however, has no or little access to cash income. Even for those engaged in some income-generating activity, subsistence farming and hunting/fishing play an important role. The usual diet in Amerindian Lands has cassava as an important component; it is processed into bread, beer, flour, and other foods. Protein obtained from fish and game is another component of the diet but to varying degrees of importance in different Amerindian Lands.

Inter-cultural contact is a common experience in the Amerindian villages in the Project’s area of influence. English is widely spoken in the villages, and its use in comparison to Amerindian languages varies. Some Amerindian communities are considered “mixed communities” due to a significant proportion of non-Amerindians. Another factor is that a considerable proportion of available paid work relates to employment in mining, which puts individuals from Amerindian communities in close contact with non-Amerindian populations. The secondary education scholarships available to a few students from Amerindian communities whose grades reach a certain level increase inter-cultural contact on an individual level.

Local

This Project ESIA describes local socio-economic baseline conditions for:

- Principal urban areas consisting of Georgetown and Linden
- Rural areas
- Three isolated rural communities linked to mineral exploitation (Mahdia, 14 Mile, and Menzies) and one community linked to forestry activities (Butakari)
- Amerindian communities (Kopinang, Chenapou, Campbelltown, Micobie, Kaburi, Malali, Muritaro, St. Cuthbert’s, and Rockstone).

In terms of relationships to the Project, the following areas are noteworthy:

- Area and people living or working within the transmission-line corridor, mainly between Linden and Georgetown (including those with squatting rights)
- Amerindian communities of Kaburi and St. Cuthbert's, both of which are within the direct area of influence of the Access Road or transmission line
- Forest operations work camp at Butakari, which is within the direct area of influence of the Access Road
- Some members of the communities of Kopinang, Chenapou, Campbelltown/ Princeville, and Menzies Landing that may occasionally use or travel through the area of the Hydropower Facility or Kuribrong River downstream of the powerhouse
- Persons living or working along the Kuribrong River downstream of the powerhouse, including a small settlement located at Wailang and several small-scale mining operations.

The Hydropower Facility area consists of natural forests with no human occupation, mining or forestry concessions, or Amerindian designated lands. There are no permanent existing economic uses or activities in the Hydropower Facility area. During the social baseline survey interviews performed for this study, it was determined that some members of the communities of Kopinang, Chenapou, Campbelltown/ Princeville, and Menzies Landing may occasionally use or travel through the area of the Hydropower Facility or Kuribrong River downstream of the powerhouse. Some mining exists along the Kuribrong River downstream of the Project Hydropower Facility.

In the transmission line and Access Road segment between the dam site and Linden, population density is very low and most land area is covered by forests. There are two settlements in this area—Kaburi and Butakari. In Kaburi, a titled Amerindian community, small land parcels of agricultural use are present, in addition to residential use. Butakari is a small residential area that provides housing and support facilities for a forestry concession. There are forestry concessions in the area between Kaburi and Linden. There are some mining activities in the area, mostly west of Kaburi.

Between Linden and the Sophia substation, land use is relatively more human driven, and mosaics of regenerating vegetation, pastures, and subsistence agricultural areas are present. In the surroundings of Linden, industrial areas related to mineral processing and sand extraction activities were found, in addition to the urban sprawl. Continuous agricultural areas were identified along the transmission line near Georgetown.

In the transmission-line area near the Sophia substation in Georgetown, there are some small buildings in the easement of the existing GPL transmission line. It was also observed that local residents use portions of the easement for small-scale activities, such as growing vegetables or raising domesticated animals.

The following are brief descriptions of the communities most relevant to the Project.

Kaburi. Kaburi is a titled Amerindian village, covering 41.57 square miles. The community, as it exists today, was established in 1935. The people who reside in Kaburi are primarily descendants of the Akawaio and Patamuna Amerindians, with the Patamuna making up the majority, plus several residents of mixed race. The Bartica Potaro Road traverses the community and is used by villagers, commercial truck drivers, including miners and loggers, and others passing through. This is a Christian community with two denominations, the Anglican Church and Full Gospel. The population of Kaburi is about 275; there are about 55 families/households. The majority of Kaburi's residents are between 25 and 50 years of age. The size of the community is decreasing due to people going to Bartica for better job opportunities and for secondary school. All land in Kaburi is owned in trust by the community council. One acre is allocated to each family for residential purposes, and they can have as many acres as they want for farming. Residents dwell relatively close to each other and near their farms. The main economic activities are logging and mining; subsistence farming and fishing/hunting play an important role in the household's economy of food production. The majority of paid work is outside the community in mining and/or logging.

Butakari. Butakari is a small, isolated rural community in Region 7 and is the center of a forestry operation by Toolsie Persaud Limited. Butakari is situated on the left bank of the Essequibo River, upstream from Bartica, 11 miles from the junction of Bartica-Potaro Road and Toolsie Road, and 25 miles northeast of Kaburi. The community is composed of company employees, and its population is approximately 60 people. The company owns all logging concessions between the Essequibo River and Bartica-Potaro Road, to the boundary with Kaburi, and south to the Potaro River. Fewer than five families currently occupy Butakari, with only four school-age children and five women, including one teacher. The workers prefer to leave their families in their hometowns. Employees work for 6 weeks and then get 4 days off, away from Butakari. Butakari has a rations store, and workers purchase food at the store; no cash is exchanged. Water is obtained by collecting rainwater, and some residents go to the Butakari River to collect water. Communication is extremely limited; there is a high-frequency radio. While there is a sports club with a television for community use, individual houses have no access to TV or radio. Access to Butakari is gained via the river or via Bartica-Potaro Road to Toolsie Road; workers get free transportation to Bartica. Graders (D.7–D.8) are used to maintain the road from Butakari to Bartica Potaro Road. There is a primary school in Butakari but no health center.

Georgetown. Georgetown is Guyana's capital city, and is situated on the coast of the Atlantic Ocean at the mouth of the Demerara River. It serves as the administrative, financial services, and retail center of Guyana. The total population, according to the Population and Housing Census of 2002, was 134,497, and the city represents the largest population concentration in Guyana. According to Renshaw (2006), Sophia (part of Georgetown) is the largest squatter settlement in Guyana, with a population of about 25,000 people, mostly Afro-Guyanese, in 2006. Its origins as a settlement can be identified in 1990, when the area previously occupied by swamp and cane fields was settled by approximately 400 families. The community is reportedly heterogeneous. Apart from the unemployed, there are some middle-income earners in regular employment. Most of Sophia's population, however, is unemployed or self-employed in the informal sector. Most houses are wooden shacks.

Linden. Linden is located in Administrative Region 10. With good river and road transport connections to the coast and Georgetown, it is an important access link to the hinterland and its natural resources. With a population of approximately 29,572, Linden is the Region's main population center. It is located inland from the coast, 107 km (66 miles) from Georgetown. Linden has an area of 142 sq km (55 sq miles), and is situated on both banks of the Demerara River. Originally a mining town with an economy based on the bauxite industry, the town is currently redefining itself as a key port of call on the way in and out of the hinterland. The population is increasingly involved in small businesses, such as merchandising, furniture manufacturing, and construction, thus transforming the town into a center for industrial and service activities. In addition to these, the main economic activities include mining, logging, agriculture, fishing, transportation, and distribution. Linden has six secondary schools, eight primary schools, and eighteen nursery schools. Linden has relatively good health services, as well as electricity, telephone, and municipal water supply.

St. Cuthbert's Mission. St. Cuthbert's Mission is a titled and demarcated Amerindian village, covering 242 sq mi. It is located in Region 4, along the left bank of the Mahaica Creek, about 35 miles from Georgetown and 25 miles from Linden. St. Cuthbert's Mission was established by the Arawak Amerindians around 1880. The mission became a titled community in 1966, and the boundaries were confirmed in 1997. While the majority of the community is Arawak, the common spoken language is English. This is a Christian community with two denominations—Anglican and Seventh Day Adventist. St. Cuthbert's is the largest Amerindian community in the project's areas of influence, in terms of both square miles and population, and it is the most developed community along the new transmission-line route; it benefits from its proximity to Linden, and also to Georgetown. Total population is approximately 1422, living in 284 households. Due to the town's proximity to more developed areas, the number of people working outside the community is larger than in other Amerindian communities. Lumbering and transportation services provided to loggers are the most important sources of income, followed by farming and handicraft production. A few community members are involved in mining in other areas.

Muritaro. Muritaro is a titled and demarcated Amerindian village, covering about 100 square miles. It is located in the Upper Demerara subregion of Region 10, and is accessible by boat, about 15 miles up the Demerara River from the mining town of Linden. Today, Muritaro has a large Amerindian population (predominantly Arawak, with some Warau), plus people of mixed ethnicity. Muritaro is a Christian community, with one denomination—Seventh Day Adventist. The population is approximately 358 people, and there are about 77 households. Men work in the region in logging, or farther away in mining operations. Logging is important in terms of generating cash income for a few individuals and families, by way of both employment and self-employment. Farming, fishing, and hunting are also important for subsistence. There is some minor commercialization of surplus farming products and meat. Fifty percent of the men work outside the community and are away for an average six weeks at a time; some men are heavy-equipment operators along the Essequibo River.

Kopinang. Kopinang is a titled and demarcated Amerindian village, covering 62.4 square miles. It is located in Subregion 1 of Region 8, west of Kaieteur National Park, in the North Pakaraimas. After the Roman Catholic Church built the school in Kopinang in 1916, the pioneers came; they were coastlanders who resettled there for the mining opportunities, and also

Amerindians who came to Kopinang for the opportunity to be informal laborers for the miners. The village today is predominantly Patamuna. Kopinang is a Christian community with two denominations—Roman Catholic and Seventh Day Adventist. The population of Kopinang is currently about 850 people, living in 102 households; some are extended families with 9–10 members. The economy is based on subsistence farming and hunting/fishing, and mining with hand tools as a source of cash income to buy food, tools, medicine, and manufactured goods. The only employment available at the village is related to government work: the Toshao, the teachers, and the health-center staff. People working outside the community usually work in mining.

Chenapou. Chenapou is a titled non-demarcated Amerindian village, located in Region 8, at the southwest border of the Kaieteur National Park, about 40 miles up the Potaro River from Menzies Landing. The community was established more than 100 years ago. Today, Chenapou's population is 90% Patamuna, and the remaining 10% are mixed-race people and people of African descent. Chenapou is a Christian community with three denominations—Roman Catholic, Seventh Day Adventist, and Wesleyan. Chenapou's total population is about 575, and it has approximately 97 households, some with extended families. Subsistence farming, fishing, and hunting are central livelihood activities. Artisanal mining for gold and diamonds is relatively common, and is one of the few available opportunities for cash income generation. There is a women's sewing group, and they get paid by the government for sewing school uniforms, thus generating some cash income that helps to support household needs. Farming, fishing, and hunting are done on a communal basis, and bartering is common.

Campbelltown. Campbelltown is a titled non-demarcated Amerindian village, covering approximately 23 square miles, and it is located adjacent to Mahdia. Campbelltown was established in the 1920s–1930s. The ethnic composition of the community today is mostly Patamuna, but the Patamuna language is hardly spoken in the village. Campbelltown benefits from its proximity to Mahdia, and has use of its schools, medical facilities, and other social services. Campbelltown is a Christian community, and the residents worship at the four churches in Mahdia. The population is approximately 500 people. There are approximately 70 households, and the average family size is about eight. The most important livelihood activities are individual gold and diamond mining, logging, and employment in mining with dredge owners, as well as subsistence farming. Most people work in Mahdia and the surrounding area, and are self-employed miners and farmers.

Menzies (Menzies Landing). Menzies is a landing—a small, isolated rural community in Kaieteur National Park on the bank of the Potaro River with an economy that depends on mining and provides support for mining activities. It developed as a result of mining activities that began in the 1960s, but the level of activity has decreased substantially to the present. The small community, eight families live there, is composed mainly of coastlanders who migrated to the area with the objective of mining gold and diamonds. There are no farms; they do not hunt, and the only collected species is cashew nuts. Most of the food is brought by air from Mahdia or Georgetown. Buildings are limited to the shop and a few houses.

Rockstone. Rockstone, established about 30 years ago, is an untitled Amerindian community. It is located in Region 10, at 17 Mile, just east of the barge crossing of the Essequibo River at Sherima Crossing, and 18 miles west of Linden. Rockstone today is a mixed community, the

predominant ethnic group being Amerindian (Arawak and Patamuna). Most people speak only English. This is a Christian community with one denomination—Seventh Day Adventist. The population is about 300, composed of approximately 26 households. In 2003, a request to create an Amerindian Community on the present site, including territory delimitations, was proposed in the Ministry of Amerindian Affairs and is still under analysis. The main economic activity is logging. Fishing has some importance, and there is some mining and hunting; four shops have been established in the community. The community has two income-generating businesses: a 24-hour toll gate and a fishing lodge at the river that generates some tourism revenue. About six people have paid positions in the community, and a few more work at part-time, lower-paying jobs such as babysitters and shop workers. The rest of the villagers are self-employed, including the owners of the four privately owned shops, and the loggers who work within the community and pay a percentage of their sales proceeds to the village. There is subsistence farming by households, and most hunting is carried out for family consumption. The majority of people work outside the community, either at day jobs (loggers and fishermen) or for extended periods of time (miners and loggers).

14 Miles. 14 Miles, Potaro, is a small, English-speaking mining village along the Issano Road, with an estimated population of 100–150 adults. A considerable percentage of the adults at the settlement are in transit as miners or sex workers. 14 Miles was established in the 1960s and mining continues to be the primary economic activity. The GMCC has an office here. Infrastructure is minimal to non-existent, being limited to Issano Road itself and to approximately 37 buildings that are used as shops, restaurants, bars, brothels, and houses. Electricity is provided by two diesel-engine generators. There is cell phone-based Internet access in one of the shops. All supplies are brought in from Georgetown. No health or education services are available.

Environmental and Social Impacts

An assessment was performed of the Project's direct, indirect, and cumulative impacts on the physical, biotic, and social environment.

Methodology

The impact identification and assessment consisted of a detailed evaluation of the impact that the Project may have on each one of the environmental and social components within the Project's area of influence, based on the Project's activities. Resulting impact is defined as the final effect of the Project on each of the environmental and social components, including impacts from all Project actions and after considering prevention, mitigation, or compensation measures.

The analysis started with the identification of impacting actions and potentially occurring impacts on each of the environmental or social components. A list of 54 Project impacting actions was identified based on an assessment of the three Project implementation phases (pre-planning and pre-construction, construction, and operations). The definition of environmental and social components adopted in this assessment refers to the set of elements that make up

each component of the environment (physical, biotic, and socioeconomic), which are subject to positive and negative impacts due to the implementation and operation phases of this project. The environmental and social components that are considered include:

- Physical environment: surface water, groundwater, topography and soils (terrain), climate and air, paleontological heritage
- Biological environment: vegetation, aquatic fauna, terrestrial and semi-aquatic fauna
- Socioeconomic environment: demographics and quality of life; economic activities and public finances; public health; land use and occupation; infrastructure and public services; landscape, historic, archaeological, and cultural heritage; indigenous populations and traditional communities; conservation units.

An impact identification matrix was then developed to match the Project's impacting actions with the potentially affected environmental and social components. The matrix resulted in a comprehensive list of potentially occurring impacts, but did not account for the effect of any prevention, mitigation, or compensation. Potentially occurring impacts are those that can be produced by the impacting actions of the Project, and are differentiated from resulting impacts, which will be those that remain after all prevention, mitigation, and/or compensation are implemented. Hence, by definition, potentially occurring impacts also include risks of impacts that may or may not occur or that may or may not be mitigated. The analysis resulted in the identification of a total of 93 potential negative and positive impacts, which are described below.

A consolidated assessment of the potential resulting Project environmental and social impacts on the physical, biotic, and social environments was then developed. The assessment represents the potential resultant impacts after mitigation. Mitigation is the comprehensive environmental and social management strategy that will be implemented to minimize the Project-induced impacts and risks and/or enhance benefits where possible. The diverse set of measures and/or procedures are structured into a manageable group of plans or programs that jointly constitute the Project's environmental and social management. For each physical, biotic, and social environment, the assessment evaluates each potential impact in terms of the following attributes: intensity, spatial distribution, timing and duration, reversibility, probability, inter-relatedness, and cumulativeness. The results are summarized in a consolidation matrix for each physical, biota, and social component and each related individual impact, which includes the applicable Project impacting actions, results for each attribute (i.e., those listed above), impacting actions, and list of mitigation measures.

In addition to the discrete impacts related to terrestrial and aquatic flora and fauna, an additional important set of potential impacts arises as a function of the combined effects of the various discrete impacts on flora and fauna and the resultant influence on biodiversity and sustainability. Thus, a complementary assessment of potential impacts to critical natural habitat and natural habitat is presented as a means of addressing the importance of these ecological features to sustainability and for supporting biodiversity.

Finally, potential cumulative impacts are assessed.

Potential Negative Project Impacts

Surface Water Resources

The most significant potential impacts on surface water resources relate to changes in flow and water quality due to the presence of the reservoir (i.e., operation phase), changes in flow and water quality downstream of the power house during operations, changes in flow between the dam and powerhouse during operations, and changes in water quality downstream of the dam during construction.

Flow Changes

Changes in river flow during construction are limited to the areas of the dam site where diversion structures will be installed for the Kuribrong and Amaila Rivers. Flows immediately above and below the diversion structure will remain the same. During reservoir filling, the flows of the Kuribrong River downstream of the dam will be reduced, causing a change in the river flow regime. The magnitude and effect depend on the length of time required for reservoir filling, which is dependent upon time of year of filling. The proposed minimum environmental flow during reservoir filling is the minimum average flow over a thirty-day period with a recurrence interval of ten years (30Q10 flow).

There are two areas of potential changes in flow regime during Hydropower Facility operations: between the dam and the powerhouse, and downstream of the powerhouse. Between the dam and the powerhouse, there are two reduced flow segments:

- Approximately 3.6 km of the Kuribrong River from the spillway to the powerhouse, which will receive the Minimum Environmental Flow (MEF) of $1 \text{ m}^3/\text{s}$ plus any flow over the spillway due to the reservoir being full as well as seepage from the dam
- Approximately 1.65 km of the Kuribrong River from the Kuribrong dam to the confluence with the Amaila River, which will only have contributing flow from only one 1,500-m-long tributary on the right bank of the river and any direct runoff from areas adjoining this river segment. It is important to note that this reach of the Kuribrong River will be contained by two physical barriers, the dam upstream and the waterfall downstream, which limits the ability of this segment to support a complex fish community.

In general, flows at the powerhouse will be higher than natural flows during the dry seasons and lower during the wet seasons due to the powerhouse discharging an average of about $50 \text{ m}^3/\text{s}$ throughout the year. Downstream of the powerhouse, the effects of flow regulation will be dampened by incoming unregulated flows from tributaries. At approximately 50 km downstream, at the confluence with Itawa Creek, natural flows increase by about 77% due to tributary inputs. For the wet season month of June, average flows are virtually identical at 266 and $267 \text{ m}^3/\text{s}$ for the pre- and post-project flows, respectively. For the dry season month of October, average flows are 14.4 and $21 \text{ m}^3/\text{s}$ for the pre- and post-project flows, respectively for

an average flow year. The most significant difference is September when the when the pre- and post-project flows differ by about 30 m³/s, 36 and 66.7 m³/s, respectively. Note that May powerhouse flows are augmented by spill flows and October powerhouse flows are limited by available water, thus minimizing differences between the pre- and post-project flow conditions.

In addition to the change in average monthly flows, the uppermost segment, where the impacts on the floodplains would be the greatest, the Kuribrong River bed is in rock with limited floodplains.

Reservoir Water Quality

The formation of a reservoir from a river and terrestrial environment will result in changes to physical, chemical, and biological properties of surface waters during operation. These changes were assessed using a water quality model for the reservoir. The results showed that short reservoir residence times and relatively high inflows to a relatively shallow reservoir will lead to a very weakly stratified system. Although there are areas of low dissolved oxygen (DO) concentrations, a well-defined hypolimnion is not predicted to exist. However, the low inflow DO coupled with warm temperatures and high organic matter in the inflow may create a system where the DO concentration in the water column can be low, but only drops to zero very near the bottom. Results of the modeling indicate that dissolved and particulate organic matter originating in the river inflows dominate oxygen demand with sediment oxygen demand playing a smaller role. Model results suggests that significant algae growth may occur in the reservoir resulting in higher oxygen in the epilimnion followed by higher oxygen demand and recycling of nutrients in the hypolimnion.

According to model predictions, high carbon dioxide (CO₂) levels in the reservoir result from high CO₂ concentrations in the river inflows and that much of this CO₂ will be emitted to the atmosphere within the reservoir, and most of the rest will be passed to the river downstream. Hydrogen sulfide (H₂S) and methane concentrations were predicted to be fairly low. Due to relatively short residence time of the reservoir, the model predicts that reservoir water quality will be dominated by the water quality of the river inflows.

Downstream Water Quality

The assessment of potential changes in Kuribrong River water quality downstream of the powerhouse during operations focused on DO and H₂S, the two parameters that could impact aquatic biological resources. DO concentrations in that stretch of river are heavily influenced by the DO in the flows from the powerhouse tailrace and the DO in the flows passing over Amaila Falls (i.e. environmental flow and spill flows, when they occur). These flows from the falls are nearly oxygen saturated (DO ~ 8 mg/l) because of the aeration at both the spillway and Amaila Falls. The concentrations of DO in the Kuribrong River after mixing with the flow from the tailrace show, for example, DO concentrations exceed 3 mg/l about 80 % of the year and are greater than 4 mg/l about 45 % of the year. As an annual average, DO concentrations in the combined flows downstream of the tailrace increase gradually from about 4 mg/l to about 4.5–5 mg/l in the first 20 km and increase further due to enhanced aeration in the falls and rapids beyond this point. Beyond 40 km downstream of the powerhouse, DO concentrations continue

to increase until they reach saturation at about Mona Falls. The maximum H₂S concentration at the powerhouse intake is just below 2 µg/L.

Other Surface Water Impacts

Other potential but less significant impacts on surface water resources include:

- Changes in surface water quality and siltation during construction, which should only cause local and temporary changes to the physical water quality parameters, particularly those related to total and suspended solids, and be prevented and controlled assuming sound implementation of adequate control measures.
- Sediment accumulation in and immediately upstream the reservoir, which could decrease the usable life of the reservoir if sediment inflows increase due to upstream watershed development without proper management and erosion control.

Mitigation Measures

Various Project Environmental and Social Management Programs (ESMPs) and measures will help to prevent, control and monitor potential impacts on surface water resources, including Construction Contractor ESMP Environmental Management program and sub-programs (e.g., Sediment Control, etc.) and the Company ESMP (e.g., Biodiversity Monitoring Program, Reservoir Management Program, Sedimentation Monitoring Plan, Kuribrong River Management Plan, and Dam and Reservoir Safety Program, Stakeholder Engagement, Reservoir Margin Stability and Erosion Control Plan, Reservoir Water Quality and Limnology Monitoring Plan, and Aquatic Fauna Monitoring Sub-Program).

Ground Water Resources

Anticipated Groundwater Changes

The potential impacts on ground water resources are considered to be of low magnitude and importance. These will consist of locally lowering of the water table during construction, increasing it around the reservoir during operations, and changing it locally in the downstream Kuribrong during operations (sometimes higher and sometimes lower). The lowering of any water table should not be extensive and there are no uses of the ground water in the Hydropower Facility DAI, therefore this impact will not interfere with any of the region's water supply. After filling, the reservoir can cause a rise in the groundwater levels, which could result in an impact on surrounding land. This change can cause the formation of wetland areas, along a strip of varying width along the reservoir margin. Given that there are no human land uses in the immediate or nearby area to the reservoir, the results of this impact, should it occur, are not expected to be significant, though some alternation of forest structure and species may be induced. The raising of the water table may also initiate processes that cause instability of the reservoir margin due to subsurface water flows, particularly in areas of sandy soils. A possible positive impact would be the greater availability of water in some areas, resulting in vegetation

growth. Relevant programs of the Project ESMP include ground water monitoring during construction and operation and the Flora Monitoring Plan.

Topography and Soils

Topography

The principal impact on topography and soils relates to the extensive earth works necessary for the dam construction, and to a lesser degree the transmission line tower foundations and Access Road. While the portions of the directly affected area have sandy soils prone to erosion, most of the area has gentle slopes covered by forest formations, which decrease the potential for erosion. The Project ESMPs include various erosion prevention and run-off control measures. This impact is a medium magnitude impact, reversible, and relatively short duration.

Reservoir Margin Stability

The risk of instability and erosion of reservoir margins during operation may occur in shallower areas due to fluctuating water levels. At its minimum operating level, the reservoir surface area will be reduced to approximately 8 km² from its full supply surface area of about 23.3 km², leaving approximately 15 km² of exposed areas. In spite of this, the probability of significant erosion is considered to be low as most of the exposed areas are relatively flat and exposure will occur during dry months when there is less rainfall to cause erosion. If erosion occurs, it is expected to be limited to specific areas where soil type and slope favor its occurrence. Erosion of the reservoir margins will be monitored by the Reservoir Margin Stability Monitoring and Erosion Control Plan.

Soil Contamination

The risk of soil contamination is relatively low assuming implementation of the hazardous material and petroleum product management procedures and solid and hazardous waste management plans. Given the limited volumes of hazardous materials and petroleum products, the result of a spill would be relatively small in terms of affected area unless the spill is directly into a water body. Potential impacts are further decreased with the implementation of spill prevention and control procedures and emergency/contingency plans, which are part of the Project ESMP.

Wetlands

The reservoir may result in the creation of some new wetlands, which may be a positive impact in terms of enhancing overall biodiversity but may also result in creation of areas with stagnant or semi-stagnant water that could affect some of the vegetation and enhance the proliferation of disease vectors. The magnitude or size of the created wetlands will be a function primarily of the surface topography in and outside the reservoir boundary, and the permeability of the soils immediately outside the reservoir.

Riverbank Erosion

While some riverbank erosion of the Kuribrong immediately downstream of the powerhouse is possible, the affected area will be relatively small and basic construction measures can control this impact.

Increased Sedimentation

Impacts due to construction work within floodplains are mainly related to construction of the transmission line tower foundations and portions of the Access Road, which may result in sediment transport and/or instability of riverbanks. Construction environmental management procedures proposed for the Project should effectively mitigate and control this impact.

Induced Seismic Events

The risk of induced seismic events is very unlikely due to a low probability of occurrence given the absence of seismic events in the region and considering the size and volume of the Project reservoir.

Climate and Air Quality

Greenhouse Gas Emissions

The Project's impact on greenhouse gas (GHG) emissions (i.e., carbon dioxide, methane, and nitrous oxide) is an important potential impact and was carefully considered. An analysis was performed to determine the changes in GHG emissions due to clearing of the transmission line corridors and the access roads as well as the creation and operation of the reservoir. In addition, an assessment was made to determine the reduction in GHG emissions from conventional electricity generation from fossil fuels due to Project operations.

Several methods were used to determine the emissions of carbon dioxide equivalents (CO₂e), including guidelines from the Intergovernmental Panel on Climate Change (IPCC) for burning, clearing, and decay of vegetation, estimates using the Clean Development Mechanism (CDM) method, and from published literature. Emissions of CO₂e from the Project were also compared to literature values of Petit Saut, a comparable reservoir in French Guiana.

The GHG emissions estimate due to clearing of the transmission line and road assumes that 60% of the vegetation is cleared and burned, 20% is harvested, and 20% is left to decay naturally. The estimated GHG emissions for the reservoir assumes 100% of the vegetation is cleared and burned.

The net emissions from the clearing of the reservoir, transmission line corridor, and road corridor are approximately 1.1 million tons CO₂e over twenty years (average 55,000 tons eCO₂e/year). The avoided GHG emissions from oil fired thermal power plants due to project operations is estimated to be 670,000 tons of CO₂e per year or about 13.4 million tons over twenty years. Therefore, the net GHG emissions from the vegetation clearing associated with the Project are approximately 8% of the estimated avoided GHG emissions from decreased

usage of oil fired thermal power plants over a 20-yr period, which represents a 92% nationwide reduction.

The net GHG emissions from reservoir operation is the difference in the GHG emissions from the river at and downstream of the falls under the present, pre-project conditions compared to estimates of GHG emissions from the reservoir and the same downstream reach under operating conditions. The high concentrations of carbon and low pH of upstream water suggests that a large amount of CO₂ is emitted as and after the water goes over Amaila Falls and travels downstream. This is expected to be similar to the amount emitted by the reservoir; however, additional field data are needed for a more reliable estimate.

Construction Phase Air Quality Impacts

Other potential impacts on climate and air quality include changes in air quality during construction and changes in micro-climate around the reservoir. During the construction phase, impacts on air quality will be generally concentrated in areas near earth moving activity, around unpaved roads used by vehicles and equipment, and in the vicinity of temporary industrial and power generation facilities. Fugitive emissions of particulate materials will also be generated by construction of the Electrical Interconnection and Access Road, though with less intensity and duration as construction progresses. The potential magnitude of these impacts is low, and can be effectively mitigated through the relatively standard environmental control procedures to be implemented at the Project.

Operations Phase Air Quality Impacts

No significant alterations in local climate are expected given the relatively small reservoir dimensions. If any effect is exerted on micro-climate, it would likely affect only a very limited area. This effect could consist of some alterations in the heat and humidity transfer rates in the reservoir DAI and immediately surrounding areas. There are no anticipated impacts on rainfall.

A positive impact is the improvement of air quality in urban centers attributable to a significant reduction in the use of thermal power plants and burning of fossil fuels.

Paleontological Heritage

The potential impact on paleontological heritage is the risk of loss of fossil material. This is considered to be a low risk since no fossil materials were identified, and no potential locations of fossil sites have been identified during any of the fieldwork for the Project. However, control measures do include a chance find procedure as part of the Project ESMP for construction.

Vegetation

The most significant potential impacts on vegetation are reduction of native vegetation cover, forest fragmentation and the creation of new borders, risk of induced economic exploitation of forest resources, and floristic changes in mist areas around Amaila Falls

Reduction of Native Vegetation

The primary source of vegetation reduction is due land clearing for the reservoir area and along the alignment of the transmission line. The DAA of the transmission line is 100 m wide (50 m each side of the centerline) along its entire length of 270 km. While low-growing vegetation will be left in the majority of the DAA, it will be cleared of trees to facilitate construction of the transmission line and protect the line during operations from trees growing or falling too close to energized conductors. Selected forested areas within the DAA may be allowed to remain if the topography is such that the conductors have adequate clearance for operation. In addition, selective cutting of danger trees may be performed up to 25 m outside of the DAA if these tall trees could present a danger to the transmission line. For the portions of the Access Road that are not within the transmission line ROW, the clearing for the Access Road will be approximately 20 m. The service/access roads within the Hydropower Facility and those feeder roads to access the transmission line ROW from the Access Road will require a clearance width of 6–8 m.

The total area of preserved and disturbed forestland to be cleared for the Project is approximately 45.4 km² or 4,540 ha. This represents less than 0.043% of the total forested area in Guyana (approximately 10,642,280 ha). An analysis of satellite images shows that the Hydropower Facility DAA consists of approximately 23.4 km² of preserved forests and water bodies, and the Electrical Interconnection and Access Road will affect approximately 27.3 km² of a much more diverse landscape and mosaic of land uses. Approximately 35.4 km² of preserved forests composed of several forest formations located along the reservoir and transmission line up to the west bank of the Essequibo River will be impacted. The disturbed forests, located along the transmission line from the east bank of the Essequibo River to Georgetown, will be impacted over approximately 10 km². Of this total, approximately 70% of the area represents secondary forests. Even though the vegetation clearing for the Project will impact the biodiversity along the DAI, all 443 plant species registered in the floristic survey are either locally abundant in the Project DAI and Guyana as a whole, or are widely distributed throughout the Guiana Shield.

Forest Fragmentation

The clearing of the transmission line and Access Road ROW will cause forest fragmentation which could have two general effects on the surrounding landscape: (1) fragmentation *per se* will not occur in areas of primary and secondary forest, rather new continuous forest edges will be created; and (2) there will be an incremental increase in habitat fragmentation in areas already disturbed by humans.

To a large extent, areas where these different effects will occur are mutually exclusive. Edge and barrier effects will be most important in the area from the powerhouse to Kaburi where slightly disturbed or pristine primary forest formations dominate the landscape. By contrast, increases in habitat fragmentation may be more important between Kaburi and Georgetown with the effect increasing in areas where human activities have already altered the landscape through establishment of settlements, timber harvesting, roads construction, and other infrastructure. In the classic sense, habitat fragmentation consists of the creation of barriers such that populations or communities become isolated from one another.

The transmission line and access roads between the base of the Pakaraima Mountains and the Essequibo River are located within a large continuous forest that extends over a vast region with low incidence of deforested areas. In particular, this area is nearly devoid of forest edges created by roads or other man-made linear features. The cutting of these forests for the road and transmission line will create a band of clearing, forming new forest edges where previously there was only closed forest. However, since there are no existing man-made barriers in this area, the establishment of the road and transmission line will not result in habitat fragmentation. However, two general effects will follow from this action: (1) microclimatic changes such as lower canopy humidity levels will extend to varying degrees into the forest interior; and (2) the open space created by deforestation will act as a barrier to the passage of some less mobile species, primarily amphibians and reptiles.

Unlike naturally occurring barriers and forest edges due to tree falls, some impacted fauna will not be able to “go around” the obstacle and thus the road and transmission line may result in the formation of discrete populations on either side of the barrier for some of the most sensitive species. This effect would only be significant if the road or transmission line bisected a highly localized or endemic population. However, the environmental baseline survey and literature review suggest that the species most likely to be affected are widely distributed throughout Guyana, the Guyana Shield, or northern South America.

Formation of forest edges are also a natural phenomenon precipitated by windstorms that create tree falls, formation or alteration of river channels during flood events, disease, and fire. Creation of new forest edges will be beneficial to some species, such as forest edge specialists and early successional vegetation.

These impacts will be controlled and monitored by Project ESMP programs including construction phase Vegetation Clearing Procedures and Flora Monitoring Program.

Exploitation of Timber Resources

An increase in the exploitation of timber resources may occur or expand in areas of primary forest due to the establishment of new Access Roads. In addition, the transmission line easement itself may increase access to primary forest areas. This risk is most significant for the new portion of Access Road from the Kuribrong River to the Hydropower Facility, where at present there is no road access and no forestry concessions. In the segment between the Kuribrong and Essequibo rivers, increased exploitation could occur, but much of this area is already subject to exploitation since it is in forest concessions and has existing access. The remaining portion of the transmission line alignment covers areas more developed areas where forests have already been adversely impacted and resources extracted.

This impact will be mitigated by implementing the measures in the Access Control Plan, which include closing the access road to all but project traffic for the most sensitive areas west of the Kuribrong. Furthermore this potential impact will be indirectly controlled through the Influx Management Program that will control immigration into Project area.

Changes in the Mist Zone

There is a risk of floristic changes in mist areas around Amaila Falls since the majority of the water will be diverted to the powerhouse resulting in a long-term reduction in flow and a consequent reduction in the spray area. In addition, the plant community at the mist zone will be affected by the change in annual flow variation, which will tend to affect the spatial distribution of the plant community, with the expected result that a more stable community will become established in response to the more stable flow conditions.

The Project flow alterations may cause a lateral contraction of moisture-adapted plant communities with or without any changes in plant diversity. Conversely, as areas that were previously inundated for long periods become exposed, these areas will be colonized by hydrophyllic terrestrial plants, resulting in some compensation for the potential contraction along the edges of the stream channel and falls. To the extent that plants are adapted to high-humidity conditions and are not obligate spray or splash-zone plants, impacts will be mitigated naturally by maintenance of the intact riparian forest that will tend to maintain high humidity. Additionally, desiccation from direct solar insolation is also mitigated by the steep terrain that forms a canyon on either side of the river below the falls.

All species that have been identified in association with the Amaila Falls mist zone are widely distributed throughout the Guiana Shield and are not locally endemic; therefore, regional extinction of these species is very unlikely to occur as a result of reducing the flows at Amaila Falls. An upcoming dry-season survey of the mist zone is planned to further evaluate potential impacts on the local plant community.

Other Vegetation Impacts

Other potential impacts on vegetation that are not as significant include changes in forest vegetation structure due to water table elevation changes and changes in alluvial forest vegetation structure on the Kuribrong River downstream from the powerhouse. These impacts are considered indirect and potential. The main consequences of these impacts would consist of shifts in community composition, leading to species substitution and potential establishment of new vegetation types adapted to the new environmental conditions. The actual occurrence and intensity of these potential indirect impacts will be confirmed during the operation phase through the activities included in the Forest Border Monitoring Plan and Altered Wetland Flora Monitoring Plan, which are part of the Flora Monitoring Sub-Program.

Ichthyofauna and Aquatic Organisms

Construction and Reservoir Filling

The physical works in the Kuribrong and Amaila rivers during the construction period will affect the aquatic habitat, thus resulting in changes in the composition of these communities and abundance of organisms. Possible impacts include increased amounts of sediments transported as a result of earthwork activities and the consequent decreased water transparency may also alter habitat quality. Changes in habitat quality downstream of the dam and reservoir are also expected in the reservoir-filling phase in response to alterations in water discharge. The

environmental management procedures that will be implemented to control work in the rivers will mitigate these impacts. River diversion and filling of the reservoir will result in the creation of a series of flooded areas upstream of the dam and the formation of pools that trap some fish species downstream of the dam. These specimens will be removed from these confined areas and released into the river as described in the Ichthyofauna Rescue Program.

Formation of a Lentic Environment

During operations, the change from a lotic to a lentic environment will produce habitat changes and cause changes to aquatic organism populations due to the loss of habitat for riverine and rheophilic (“current-loving”) species and the establishment of populations of species adapted to lentic environments. At present, it is difficult to fully infer the extent to which habitat changes resulting from the conversion of the rivers into a reservoir will affect the ichthyofauna from the upper Kuribrong and Amaila Rivers. The complementary results of the field inventories to be conducted during the dry season will be important in providing data, especially from the future reservoir area, to adequately assess the local fish diversity.

Data from the first baseline survey indicate that the ichthyofauna of the upper Kuribrong and Amaila rivers may be comparable to that found in the upper Potaro River above Kaieteur Falls (i.e., each of the seven species found above Amaila Falls were also reported to be present in the Potaro). From the ecological data collected, it is possible to conclude that, even if some of the fish species known or supposed to occur at the Amaila and Kuribrong rivers will not adapt to the new environment created by the reservoir, they may be maintained in similar habitat above the reservoir. Creation of the reservoir may result in isolation of populations of small stream obligate species to the extent the reservoir acts as a barrier to the migration or movement of fish between tributaries.

If they are present in the Kuribrong and Amaila rivers, rapid-dwelling catfishes, such as the loricariids *Lithogenes villosus*, and *Corymbophanes* spp. and heptapterids will disappear from the rapids flooded by the reservoir. These species are expected to persist in the upper reaches of the Kuribrong River and tributaries that will not be affected by the reservoir, although their presence or absence in those areas needs to be verified by a second field campaign.

It is important to note that almost 50% or about 37.6 km of the main channel and first order tributaries of the Amaila River and 97% or about 355 km of the Kuribrong River and its first order tributaries upstream of Amaila Falls will remain unchanged, including the rapids and other habitats upstream of the reservoir. Therefore, a significant portion of the habitats used by the fish in the river system will remain intact, supporting the maintenance of populations that use these particular habitats.

It should be noted that *Lithogenes villosus* and *Corymbophanes* spp., are so far only known from the upper Potaro River (see respectively Schaefer & Provenzano, 2008, and Armbruster et al., 2000), and documentation in the upper Kuribrong and Amaila during the environmental baseline study constitutes an extension of their known range. A third species, *Poecilocharax bovalli*, was heretofore only known from the upper Potaro basin, but its known range was expanded because it was recorded in a tributary of the Kuribrong River near the dam site during the environmental baseline study.

Isolated Kuribrong Stretch

The Kuribrong River stretch between the dam and the confluence with Amaila River (about 1.5 km) will be lost as aquatic habitat because of the dam. The only flows in this segment will be the contribution from a small tributary on the right margin and direct rainfall runoff.

Downstream Effects

Below the falls, huge boulders dominate the riverbed up to the location of the powerhouse. Under existing low water conditions, water often disappears among the rocks and boulders, eliminating true surface-water flows. These conditions present a barrier to most, if not all, the ichthyofauna of the Kuribrong River. Impacts to fish species and other aquatic biota will be a function of the extent to which this segment harbors a stable fish community, and the extent to which surface water flow disappears in this reach of the river. At most, it is expected that this area may harbor highly rheophilic species, such as loricariid catfishes and some characins. It is also likely that such species exist in high current areas downstream of the location of the future powerhouse and would relocate to such areas when flows in the low flow reach get too low. Characterization of the fish community in this reach (if any) as well as estimates of the effect of operation on wetted surface area will be developed during the dry season sampling and this information will be used to strengthen or modify these preliminary conclusions.

Initial reservoir modeling indicates the potential for reductions in DO during operation, which could result in some environmental stress to fish. The severity and aerial extent of the impacts from low DO is a function of the relative sensitivity of the fish species present, the duration and severity of the low DO events, and the ability of sensitive fish species to move into more favorable areas during low DO events. The impacts of low DO on the fish community diminish with distance from the powerhouse and are likely to be low and possibly nonexistent below Waiteur Falls, the first significant point of re-aeration. Considering the uncertainty regarding impacts to fish from low DO, monitoring of DO and the fish community, especially upstream of Waiteur Falls will be an important component of the environmental monitoring during operation. Results of monitoring can then be used to determine potential mitigation or offset measures, if needed.

Potential changes on fish and other aquatic biota will be addressed and mitigated through the development and execution of the Biodiversity Monitoring Program and the Reservoir Management Program. These programs include water, sediment, limnology, surface water quality, macrophyte, and ichthyofauna monitoring activities. Monitoring data will identify the need for control measures to assure the integrity of the aquatic community as part of multiple-use water management that includes consideration of public health, and electric energy generation.

Terrestrial and Semi-aquatic Fauna

Reduction of Habitat

The most significant potential impact on terrestrial fauna populations is alteration and reduction of natural habitats resulting from construction activities and the formation of the reservoir. This

impact is irreversible, has high intensity, and affects both the direct and indirect areas of influence. Sensitive species and those dependent on forest environments will be directly impacted; however, highly adaptable species may reoccupy the new environments after the end of construction. Project ESMP impact minimization programs includes Fauna Rescue and Terrestrial Fauna Monitoring Program.

Physical Barriers

Potential population changes of terrestrial vertebrates may occur due to the size of the physical barrier associated with the reservoir and linear barrier effects associated with the Access Road and transmission line. The prevalence of natural forest formations in the area between Linden and the powerhouse means that even if a barrier effect occurs, no risk of local species extinction or severe population reduction is expected. This is further mitigated by the fact that lower-height vegetation cover can safely remain within the transmission line easement area and transverse riparian corridors will be maintained when possible. The Terrestrial Fauna Monitoring Program will allow continued evaluation of this impact.

Construction Activities

The primary potential impacts on the terrestrial and semi-aquatic fauna during construction include disturbance and displacement of during construction, and increased hunting pressure by local communities and construction workers. These are expected to have a medium intensity impact with a low significance and will be mitigated through the Construction ESHS Management Plan (Fauna Rescue and Relocation, Community Relations, Public Health and Labor Management), and Biodiversity Monitoring Plan (Terrestrial Fauna Monitoring Program).

Demographics

Migration into Forested Areas

The potential impact on demographics relates to the opening of a new access road and improvement of existing roads, which contribute to increased risk of migration into forested areas where income may be generated from extraction activities. This impact is more relevant in the areas of the transmission line west of the Kuribrong River, because the area east of the Kuribrong primarily consists of state lands under a forestry concession and the Kaburi Amerindian land. One specific area that could see an increase in activity is the small mining community of 14 Mile, since it already plays a role in distributing primary products and rendering support services to mining activities. Another possible source could be the illegal occupation of land along the access road by small commercial or residential users. The measures proposed for mitigating this impact include the Access Control Plan and other Project ESMP programs including Labor Management, Community Relations, Influx Management, and Community Stakeholder Engagement (including Community Monitoring and Grievance Mechanism).

Induced In-Migration During Construction

The Project may induce migration because of its potential to generate employment, both directly and indirectly. The existing isolated urban nuclei are sparsely populated and not close to the Project hydropower site. Kaburi village and 14 Mile are the closest communities to the Hydropower Facility, but neither offer sufficient infrastructure to support any significant immigrants. Other Amerindian communities are too far to likely attract Project-related worker migration. Butakari will experience very limited immigration, because it is a forestry concession community with restricted access. To minimize the risk of uncontrolled influx during construction, a principal measure will be the execution of Labor Management Plan with the support of Community Stakeholder Engagement (both part of Project ESMPs).

Quality of Life

Resettlement and Compensation

No people live within the directly affected areas of the Hydropower Facility or Access Road. Furthermore, nobody lives in the transmission line ROW from the Hydropower Facility to the Linden substation or on the Linden substation site. Thus, no population resettlement is required for these areas.

There are no permanent existing economic uses or activities in the Hydropower Facility area. It was stated in some interviews during the ESIA social baseline assessment that people may occasionally visit and/or travel through the Hydropower Facility area for hunting, fishing, and manual small-scale mining activities during dry seasons and when hunting for holiday meals. Some residents of Kopinang, Chenapau, and Campbelltown/Princeville are reported to carry out such activities in the Kuribrong River area near the Hydropower Facility and where the reservoir would be located. This use is limited to a relatively small group of persons and only on an infrequent basis. In addition, some residents of Menzies Landing may perform some small-scale mining in the general area. The Project will only marginally affect these uses.

The transmission corridor between Linden and Georgetown is primarily state land with some leases held by private individuals for agricultural and other uses. Near Georgetown, the transmission line will use an existing GPL utility ROW and in the final few kilometers in Georgetown, the existing transmission line ROW passes through some residential areas. During the field studies, about seventeen residential dwellings were identified in the easement of the existing GPL transmission line in Georgetown. It was also observed that local residents use the easement for small-scale subsistence activities, such as small-scale gardening and raising domesticated animals. Some physical resettlement or compensation for economic displacement may be required in these areas where squatters have encroached on the GPL ROW.

A Land Acquisition and Resettlement Plan (part of the Company ESMP) includes transmission line resettlement actions and forestry concession compensation plan. With the objective of mitigating negative impacts of these processes, the Plan will include the physical and social registration of the population and activities to be relocated and/or compensated. The Plan will establish social, economic, and logistical support guidelines to comply with the guidelines for

maintaining and improving existing living, housing, and working conditions, social integration, and cultural aspects.

Conflicts with Local Population

The Project may cause tension between out-of-region construction workers and local population. Since most of the employed workers, whether immigrant or local, will be lodged at Project construction camps, with the principal one at the Hydropower Facility, the Project will not create a significant direct demand for housing or urban infrastructure in any nearby communities or cities. However, indirect demand from Project suppliers and from any induced population influx may affect living conditions of the existing nearby communities and cause social conflicts.

Project workers and service providers may contribute to the spread of communicable diseases, including sexually transmitted diseases, which may contribute to negative attitudes toward outsiders working for the Project, even when they are from other parts of Guyana. For workers coming from other countries, with cultural and language differences, this potential impact could be more severe. It is likely that much of the contracted labor force will be foreign workers of Chinese origin, and this fact may aggravate social tensions. This risk will be reduced significantly through provisions in the labor force work contracts. All workers involved in construction, including subcontractor personnel, will receive initial training where workers will be instructed on the proper code of conduct toward other workers and the local population. Employees will be required to comply with a Code of Conduct.

Project Expectations

The Project may generate high expectations associated with job creation, stimulation of local commerce and services, and increased tax revenues. Negative expectations could be associated with influx to local communities as well as public health and safety risks. Furthermore, there may be opposition to the Project resulting from perceived negative impacts on environmental resources, such as forests, water quality of the Kuribrong River, and fisheries. These expectations can be managed through an adequate consultation and communication process (e.g., Project Stakeholder Engagement Program). This Program will include a Grievance Mechanism, and a register will be kept of all inquiries, complaints, and demands, and how each was resolved.

Economic Activities (excluding indigenous communities)

Project Induced Employment

A significant positive impact is job generation and demand for products and services during construction, which can help stimulate the national economy and the economies of municipalities near the Project with an indirect impact on the growth of tax revenues. The Labor Management, Local Worker Training and Hiring Plan, and Local Supplier Development Plan may enhance these positive impacts.

There will be workforce demobilization at the end of construction and reduced demand for goods and services, thus generating a slowdown of local and national economies. Benefits resulting from job generation and income growth during the operation phase may help compensate this.

Mining Activities

The potential impact on mining in the transmission line and Access Road ROW is minor with mining activities being excluded from the ROW itself as well as a 200 m buffer on either side of the ROW centerline.

There are no mining concessions in the Hydropower Facility area. However, there are various mining claims in sections of the Kuribrong River from Amaila Falls to its confluence with the Potaro River. Some limited small-scale mining activities were reported by members of the Kopinang community in the area of the future reservoir. The construction and operation of the Project will affect any large-scale attempt to explore and remove mineral resources in the watershed upstream of Amaila Falls.

Forestry Concessions

The potential impact on forestry concessions relates to the cutting of trees in the transmission line or Access Road ROW that have potential economic value. There are seven forestry concessions in the transmission line and Access Road alignment, consisting of six State Forest Permits on the east bank of the Essequibo River and one Timber Sales Agreement from the west bank. There are no forestry concessions in the Hydropower Facility area. While the trees in the transmission line and Access Road ROW would be cut by the Project, commercial timber will be made available to the concession holder. No other impacts are anticipated, because the Project will not impede other permitted timber operations.

Induced Development

Due to the new Access Road, there is a risk of induced development, especially illegal mining and forestry activities. The primary potential area for illegal forestry activities would be from Kaburi to the hydropower site in currently unallocated forests. The extent of any such impacts would be determined by the Guyana Forestry Commission's (GFC) capacity to control illegal forestry and the effectiveness of controls placed on the Access Road west of Kaburi. GFC has relatively good institutional capacity related to controlling forestry development, which should be further improved in association with the country's Low-Carbon Development Strategy. Implementation of this strategy includes capacity building for monitoring and enforcement in order to assess and control actual deforestation on a nation-wide bases to ensure future payments to Guyana from Norway related to forest protection.

Mining activity is highly dependent on access, but also the commodity price and the perceived potential for finding the desired mineral resource in an area. It is reported that there is very little small-scale mining activity taking place in the hydropower site area or near the transmission line corridor. It is believed that the land-based operations are likely to produce much greater returns

than the river-based operations, but river-based operations are the primary ones currently being exploited. With the Project, intensification of existing activities may occur due to improved access for transporting raw materials and supplies. New exploration fronts may be opened as well. This may strengthen the existing informal markets of manual mining exploration.

Agricultural Impacts

The only Project area with agricultural land is along portions of the transmission line between Georgetown and Linden. The Project impact on regional food production is insignificant given the limited area affected and the temporary nature of the effect.

National Economy and Finances

The Project impacts on national economy and finances are all of a positive nature and include:

- Balance of payments improvement due to the expected reduction of public expenditures on fuel imports for thermal power plants
- Increased tax revenues due either directly or indirectly to the Project
- Enhancement of national industry competitiveness
- Reduction of long-term energy cost to GPL and consumers
- Alleviation of demand for government investment in infrastructure
- Enhanced potential for attraction of industrial and other private sector investment

Public and Occupational Health and Safety

Occupational Health & Safety

The Project will increase the risks to worker health and safety and to accidents in the construction camps, work fronts, and service routes in a manner consistent with any similar sized project. The extent and magnitude of these risks will be controlled through the implementation of detailed construction phase Health and Safety Management Systems, which includes accident-prevention procedures, safety procedures, personal protective equipment, supervision at the Project work sites, and employee medical care, among others.

Community Public Health

The principal community or public health risks during Project construction are: increase in the number of possible carriers of infectious and contagious diseases due to higher population numbers during Project construction; increasing the variety of diseases contracted due to presence of workers from other areas; higher incidence of waterborne diseases due to the reservoir and changed water flow regimes; and accidents involving local community members and Project vehicles.

Specific concerns relate to endemic diseases such as malaria, typhoid fever, dengue fever, and leishmaniasis. There are also indirect risks to public health related to pressures on the infrastructure system and public services in communities or towns receiving an influx of migrant workers due to the population growth caused indirectly by the Project. The presence of the reservoir during Project operations may increase the risks of water-borne diseases by creating more favorable conditions for disease vectors (e.g., mosquitoes). However, since the Hydropower Facility area is not inhabited, this risk is low.

A positive impact to public health is the reduced air emissions resulting from substitution of hydropower for thermal energy sources. The effects of this impact will be more significant for the populations living in areas near existing thermal plants that reduce generation.

Measures to help control this impact include Construction Contractor labor management, The Construction ESMP (Health and Safety Management and Public Health sub-programs), Community Stakeholder Engagement, ESHS Management Plan, and Reservoir Management Program.

Land Use and Occupation

Land Use

The major land-use impact of the Project will be the conversion from forest to water for the reservoir. The transmission line will not result in significant changes to land use, mostly in limitations placed on that use. The two substations will result in a change of land use, from open space to industrial, but the total surface area is relatively small (approximately 7 ha in total). Near the Sophia substation, lands under the existing GPL transmission line that will be used for the Project do not involve a formal (legal) change in land use (i.e., the formal ROW was established previously to define the land use).

Access and Transportation

The construction of the new Access Road and the improvement of the existing access road sections can induce changes in land-use patterns due to increased accessibility. In the segment between Butakari and Kaburi, the risk is relatively limited, because all of these lands are currently under a single forestry concession. Significant land-use changes in the Kaburi community are unlikely, given that it would require legislative changes to be approved. West of Kaburi, there is a potential for induced changes, especially due to mining and forestry development. There may also be the potential for minor land-use changes due to small commercial activities that cater to the increased traffic generated by construction, such as snack bars and automobile-related services (e.g., tire repair shops). It is important to remember that the land directly affected by the Project is currently owned by the state (GoG); thus, changing land use is controlled within the governmental framework.

The execution of measures planned in the Environmental Compensation Program, Community Stakeholder Engagement, Land Acquisition and Resettlement Plan, Transmission Line Vegetation Management Program, Influx Management Program, Access Control Plan, and Dam

and Reservoir Safety Program will prevent or minimize risks and promote a balance between conservation and multiple uses along the transmission line and the land around the reservoir.

Infrastructure and Public Services

Public Transportation

The use of existing roads for construction of the Project and the transmission line is limited to portions of the Mabura Hills Highway from south of Linden, roads within Linden, and the paved Linden-Georgetown Highway. Some roads within Linden and Georgetown, and some roads (mostly unpaved) may be used to access the transmission line from the Mabura Hills Highway between Linden and Georgetown. The portion of the Mabura Hills Highway south of Linden and the existing portion of the Bartica Potaro Road that are part of the Access Road component will be improved and maintained as part of the Project. The use of local roads may cause some increased deterioration, but given the relatively low volume of Project traffic, this impact should not be significant. Impacts may be more significant in the urban traffic of Georgetown and Linden. With the adoption of the measures planned in the ESMPs including specifically the Access Control Plan, the magnitude of this impact can be controlled at low levels. The improvements of the Access Road will be a positive benefit for the Kaburi community.

Public Healthcare

Increased demand for public healthcare services during construction is likely, but is anticipated to be low volume. Public healthcare services in Linden, Bartica, and Georgetown could be affected by increased demand for medical, ambulatory, and hospital services. Through the Construction Contractor and Company ESMPs (Health and Safety Management, Labor Management, Community Relations and Public Health), all safe work procedures, training and medical evaluations for employees will be adopted as required by law. The Public Health program will include prevention and control procedures for infectious diseases and monitoring of public health indicators in the affected communities.

Existing Infrastructure and Services

Pressure on urban infrastructure and public services in Linden and Georgetown may occur as an indirect consequence of the Project, but this should be limited since most of the direct workforce will be housed at the Hydropower Facility or at other camps along the transmission line alignment. Through the Local Community Support Program, demands from local communities, especially those related to health, will be monitored.

Energy Supply

An improved, renewable supply of electrical energy will be a significant positive impact. The Project will have an installed capacity of approximately 165 MW and an average potential energy of about 1000 GWh will be available to the national grid. The installed capacity of Hydropower Facility corresponds to a significant portion of the current installed capacity in Guyana, considering energy generation from all sources. The Project will help provide the

energy necessary for the growth of the country's industrial production and provide a source of reliable, clean, and renewable energy that will support the sustainable long-term growth of the national economy. New commercial activities may emerge due to the higher quality and lower cost of energy, increasing the number of available jobs and consequently the national gross domestic product.

Landscape

The one potential impact on the landscape is the reduced flow over Amaila Falls. Though this is a negative impact on a scenic resource, there is no present access to the falls. There are other falls in the general area of Amaila, including the significant tourist attraction, Kaieteur Falls in Kaieteur National Park as well as Art Falls and Mariana Falls just east of Amaila Falls. Due to the lack of current access to Amaila and availability and accessibility of alternatives, the change in landscape due to the decreased flow over the falls is not anticipated to have a significant impact. With the reservoir formation, a potential positive landscape feature will be created. Less significant changes in landscape relate to transmission line towers and lines and the two electric substations.

Historical, Archaeological, and Cultural Heritage

There is a low risk due to loss of historical, cultural, and archaeological sites and properties. The assessment of archaeological potential and cultural interest, carried out for the Project baseline assessment, showed that the likelihood of historic sites occurring in the IAI is low given the nature of the geologic deposits to be crossed. Although no sites have been identified, the Project may affect the archaeological and/or cultural heritage if towers are built and easements opened on locations containing such resources. This potential impact will be effectively prevented through a chance find procedure.

It is the Amerindian belief that spirits protect all natural resources and certain rituals are performed before any activity is undertaken in areas with natural resources. The Kuribrong River area is not a revered place but a respected one. The Amerindians care and respect the area so it can take care of them by providing their livelihood. The Amaila Falls are named after a teen-aged girl named Amelia who disappeared in the area of the falls during a hunting trip many years ago and was never found. Changes and/or reduction of flow of the falls could potentially have a cultural impact but this issue has not been raised during consultations and is expected to be low.

Indigenous People

Mining

The Project may marginally reduce some of the areas traditionally used by Amerindian communities for mineral extraction. Results from the social baseline assessment suggest that some of the Kopinang, Chenapou, Campbelltown/Princeville, and Menzies Landings community members may occasionally visit or travel near the reservoir or powerhouse area to hunt, fish, or conduct mining activities. This use is apparently limited to a relatively small

group of persons and only on an infrequent basis. The extent of such mining activities appears relatively limited, in terms of both the numbers of persons and length of time, and does not constitute a significant source of livelihood. However, the income could represent a potential source of cash income to some Amerindian individuals and households.

Hunting and Fishing

The Project may also create a marginal reduction of hunting areas and interference with fishing areas. This impact should be low as hunting and fishing in Project DAI does not represent a significant activity by Amerindian communities. The difficulty and time needed to access the Project area, including the downstream area (Wailang), from Kopinang limits the amount of game meat that can be taken back to the community and, as consequence, its relevance for guaranteeing the community's food security. Mining trips from Kopinang and possibly other Amerindian communities in the area incorporate hunting, and especially fishing, activities. Information from the social baseline assessment, suggests that one of their hunting areas at the moment is located downriver of Amaila Falls. The Patamuna reference to the hunting areas below Amaila Falls is known as Wailang, and it is located about three hours by boat (with an outboard engine) from the dam site. Although reductions in hunting and fishing resources due to the Project do not appear to create food security concerns, they may be considered by the Amerindian population to be important resources symbolically. The Project Access Control Plan and Amerindian Monitoring Program will mitigate these impacts.

Nuisances/Safety

There may be some disturbance in Amerindian communities caused by increased road traffic during construction due to dust, air quality, and accidents. In the case of Kaburi, improved access is considered a positive impact, and an increase in road traffic is seen as presenting additional income opportunities through the sale of goods by the roadside and in the shops in Kaburi.

The proposed Access Road includes a bypass road around the Kaburi village. During the public consultation meetings with the Kaburi community, a consensus was reached to improve the existing road through the community to capture the benefits of improved access and economic opportunities, while providing a bypass around the community to avoid the negative impacts. As a result of this stakeholder engagement, the intensity of the negative part of this impact should be low. However, if expectations are not met and discontent arises within the Kaburi community, the negative impacts could become significant. With implementation of the Access Road ESMPs, Community Stakeholder Engagement, and the Amerindian Community Plan, the intensity and magnitude of impact can be controlled.

Economic Impacts

Possible income generation for Amerindian communities during construction is a positive impact. Coordination of the Amerindian Community Plan with the Local Worker Training and Hiring Plan and the Local Supplier Development Plan can increase the access of Amerindians to these opportunities. Income generation for Amerindian communities during operation is also a

positive impact, albeit of low intensity due to the relatively small amount of employment needed for operations. Non-Project related jobs or enterprises can be more significant, and can be a result of training provided for Amerindians during the construction phase.

Amerindian Health

There is a limited increased risk to Amerindian people's health resulting from inter-cultural contact. The geographic extent of this risk coincides with that of the Amerindian communities having individuals working on the Project or those that are accessed by Project personnel. With implementation of both the Public Health program and the Construction Contractor ESMP, the risk can be controlled and any impacts that develop from this risk can be mitigated and controlled.

Loss of Identity

There is also some risk of increased acculturation. The Amerindians in the IAI are not isolated and have experienced non-Amerindians in their lands. Ongoing stakeholder engagement will help identify changes and develop strategies to mitigate changes that the communities identify as undesirable, such as those associated with social disruption. The construction ESMPs will decrease the likelihood that the Project workforce creates issues.

Conservation Units

The location of the Hydropower Facility and the planned route of the Transmission Line and Access Roads do not impact any protected areas or conservation units. The Kaieteur National Park, the main protected area of Guyana, is located about 20 km from the dam and approximately 3 km from the reservoir's DAI. The adoption of measures proposed in the Influx Management Program and Access Control Plan will control access to the dam site and the construction ESMPs will ensure that the workforce respects the park's rules. Measures present in the Reservoir Use Plan will also be important to control future land use around the reservoir.

Critical Natural Habitats

No critically endangered (CR) species are expected to occur in the Project Area based on reviews of the IUCN Red List and literature, and none were found during the field survey. Only one endangered (EN) species (the giant otter, *Pteronura brasiliensis*) was observed to be present in the Project Area. Four species of EN birds could occur in the Project Area based on the literature, but none were observed during the field investigation. There are no CR or EN species of amphibians, reptiles or fish listed by IUCN for Guyana and none were observed. One EN plant species was listed as possibly occurring in the Project Area and it was observed during the field survey.

Due to the nature of impacts and life histories (i.e., known species ranges and habitat requirements) of listed species, the Project is not expected to have any significant impacts on CR or EN species. With respect to *P. brasiliensis*, two family groups were observed during the field investigation in the Essequibo River at Sherima Ferry Crossing and one individual was

observed in the Kuribrong River at the Powis Landing camp (about 70km downstream of the powerhouse). Impacts from flow regulation or water quality are not expected to extend sufficiently downstream to impact *P. brasiliensis* habitat.

The home ranges of all vulnerable (VU) or near-threatened (NT) terrestrial vertebrate species are reported to be sufficiently large relative to the DAI and IAI, and the potential impacts presented by the Project are not sufficiently severe (degree and duration) to result in significant adverse effects to these species. There are no VU or NT species of fish listed by IUCN for Guyana. Of the 218 tree species identified during the field investigation, the IUCN Red List lists only four and all four show a wider distribution than the Guiana Shield.

The mist zone of Amaila Falls presents a specialized habitat for plant communities and it is used by two bird species observed during the field campaign. The total habitat available to support obligate high-humidity plant species may contract due to reduced flows, but this contraction will be offset to some degree during operation because areas that are currently scoured rock will become exposed and thus available as “new” habitat for plant colonization. Decreased flows over the falls may also result in the displacement of the two swift species that are waterfall habitat specialists (*Cypseloides cryptus* and *Streptoprocne zonaris*). All plants identified in the spray zone to date have broad geographical distributions and the two species of swift are broadly distributed in the Americas. Several other named waterfalls exist along the escarpment in proximity to Amaila Falls, including Kaieteur Falls in Kaieteur National Park, Art Falls and Mariana Falls, all of which within 20 km of Amaila, thus local extinctions are not expected.

It is possible that a number of endemic fish species occur above the proposed dam, although none was actually registered during the initial field inventory. Fish communities described during the inventory for the future reservoir area so far are comparable to those described for the Potaro River. Although critical natural habitat (CNH) is not expected to occur in either of these two areas, additional fieldwork (i.e., second environmental baseline survey field campaign) is needed to verify this hypothesis and fully conclude the Project will not result in significant conversion or degradation of CNH. Considering the length of their main channels and tributaries upstream of Amaila Falls, almost 50% of the Amaila River, corresponding to about 37.6 km, and 97% of the Kuribrong River, corresponding to 355 km, will remain unchanged, including the rapids and other habitats upstream of the reservoir.

A comparison of the extent of the Project Area to the extent of the total available habitat throughout the range of migratory bird species indicates that the Project will not result in the significant degradation or conversion of CNH for migratory species. There are no other groups of terrestrial migratory vertebrates in the area. To the extent some fish species migrate between the main stem of the Kuribrong and Amaila rivers, and tributaries upstream of the falls, these species will have their migratory routes interrupted by the reservoir. These impacts will not occur upstream of the reservoir where the hydrological cycle will remain unchanged and tributaries unaffected. As noted above, almost 50% of the Amaila River, and 97% of the Kuribrong River will remain unaffected by the reservoir. Potential impacts on migratory routes (primarily reproductive migration above the dam and ontological or foraging migration in flow-modified portions of the Kuribrong) will be evaluated during project monitoring.

No single-site endemic species were found in the Project Area during the ESIA field campaign. One small-mammal species and five amphibian species endemic to the Guiana shield were identified for which the Project Area likely supports more than 1% of the species' global population, where the calculated percentage is based on Project Area divided by literature-reported species habitat area. However, this estimate is probably overly conservative because the ranges of these species continue to increase with new observations, and, in fact, the observation of the small mammal (*Neusticomys venezuelae*) and one frog species (*Leptodactylus lutzi*) during the April survey both represent an expansion of the documented range for these species.

The conclusions are that the Project meets criteria concerning CNH in all respects with the following areas still pending confirmation following completion of the upcoming second field campaign of the environmental baseline survey:

- Potential existence of adverse effects on CNH for endemic fish species upstream of Amaila Falls. Based on this analysis, it appears that there is no CNH in this area or if there is, the conversion or degradation will not be significant. However, refinement and finalization of this conclusion requires additional data collection during the dry season (i.e., upcoming second field campaign).
- Potential existence of and adverse effects on CNH for plants and the swifts that are habitat specialists (but not endangered species) in the spray zone of the falls. Based on this analysis, it appears that these effects will not be significant due to the availability of similar habitat at multiple locations within Guyana and/or the ability to bypass flows in order to maintain this habitat, if necessary. This conclusion should be confirmed during the dry season to determine whether these areas provide CNH.

Cumulative Impacts

The Project will not facilitate or induce any significant development nor are any other projects of any significance anticipated in the Project's watershed or in the general vicinity of the Project.

Energy from the Project will be used in Linden and Georgetown to replace existing fossil generation and to accommodate new growth in Guyana electric system demand. The Project will replace energy generated from existing GPL fossil fueled thermal stations.

The infrastructure developed for the Project, the new access road and transmission line, is primarily intended for the Project and will not provide significant benefits to other projects. The Company and GoG will implement an Access Control Plan to restrict access along the final portion of the new access road to only Project activities and limited use by local Amerindians, which will minimize the potential for induced development.

No other hydro projects have been identified in the immediate project area that could contribute to cumulative impacts.

There are no known plans to utilize Amaila's reservoir or powerhouse by other projects to benefit from any kind of trans-basin transfer of water, nor does the Company have any plans to increase the reservoir size or capacity of the Project beyond the 165 MW described in this document.

Positive Project Impacts

The primary benefits from the Project include:

- **Lower Energy Costs**—The GoG calculates that the Project will lower the long-term average cost of wholesale electricity, especially after the initial debt term, by replacing energy from expensive thermal generation units that use imported fuel oil.
- **Advance Low-Carbon Development Strategy**—The GoG has committed itself to a low-carbon development strategy. The Project advances this goal by taking advantage of a key natural resource in the country, its flowing rivers, to generate clean and reliable electricity and lowering Guyana's carbon footprint. The Project will displace energy generation from existing thermal power plants, which use oil, eliminating their carbon (greenhouse gas) and other air quality pollutant emissions. It can also reduce the need for local businesses to use inefficient diesel-fueled self-generators, which emit greenhouse gases.
- **Energy Supply for the Future**—The Project will be the foundation for meeting Guyana's future energy needs through the creation of a double-circuit 230-kV transmission network that will form the backbone of a new high-voltage transmission system. Twenty years after the start of operations, the Hydropower Facility and Electrical Interconnection will be transferred to the Government of Guyana at zero additional cost; thereby bequeathing an asset that provides long-term energy independence, national competitiveness and environmental sustainability to future generations.
- **Communications Network**—The Project transmission line will provide the opportunity to expand Guyana's high-speed communications network using fiber optic technology built into the transmission interconnect design.
- **Economic Stimulus**—The Project will help stimulate the economy during construction and beyond, because it provides opportunity for jobs and service providers during construction and operation, and a more reliable source of affordable electricity for Guyana's economy. This direct stimulation also provides the basis for creation of secondary and tertiary jobs and economic activity during both construction and operation.
- **Benefit Local Communities**—The Project will include community development programs that include, among other things, assisting communities to prepare for obtaining employment from and providing goods and services to the Project.

The Project will create direct employment, including an estimated peak workforce of 1,200 for the Hydropower Facility, 650 for the Electrical Interconnection, and 50 for the Access Road. The general labor types required for construction include equipment operators, plant operators, mechanics, surveyors, truck drivers, foremen, electricians, carpenters, concrete masons, ironworkers, skilled laborers, and common laborers. Guyanese workers can fill many of these positions. The scheduled construction period is approximately 40 months.

In addition to increased salaries and benefits, the hiring process will promote inclusion of personnel in professional training programs, work health and safety, and environmental education training programs, as required by law. Knowledge and experience acquired by workers can be considered permanent gains, because their qualifications and future employment possibilities will improve, even for temporary workers.

The distribution of indirect jobs during the construction phase will be very broad. Some goods and services with higher added value, such as the manufacturing of electromechanical equipment (turbines, generators, transformers, conductors, etc.) will be imported to Guyana. However, some indirect jobs will be created at the national level, mainly to fulfill demands for less sophisticated goods and services of the EPC Contractor, subcontractors, and their employees. Also, the multiplier effects of economic activity due to increased incomes and public budget are positive impacts related to the Project. Indirect jobs may be created both near the work fronts and in urban centers that are farther away. Therefore, it is important to note the potential jobs created by service activities, such as in restaurants, snack shops, mechanical workshops, and entertainment.

The direct job creation potential during the operations phase of the Hydropower Facility and Electric Interconnection is fewer than 100 direct jobs, but the indirect employment will increase these numbers substantially. Indirect employment will be created by operations of Project offices, services (lodging, transport, food, etc.) for project visitors as well as repair and maintenance personnel, and outsourced services such as maintenance, repair, and security. Most of the operational positions, which require more highly skilled workers, will be occupied by technicians from Georgetown or abroad. These workers will become permanent residents of the host communities in which the Project operational headquarters are located.

The Project will stimulate the local economy during construction. The scheduled construction period, which is estimated to be about 3½ years, will significantly increase the demand for goods and services in the Project's region of influence, especially for construction materials, nondurable consumer goods (e.g., food, medicine, personal hygiene products, etc.), and services (e.g., transport, lodging, telephone and mail services, etc.).

Other identified Project positive impacts include:

- Improvements in the national balance of payments will result from reductions in public expenditures for imported fuel for thermoelectric plants, and in imports of components for new thermoelectric plants
- Tax revenues for the public sector from taxes on services rendered and goods consumed

- Enhancement of national industry competitiveness by more reliable energy because of increased supply, possible tariff reductions, and increased capacity of the public sector to invest in infrastructure
- Enhanced potential for attraction of industrial and other private-sector investment
- Presence of the reservoir can cause local groundwater levels to rise; thus, a possible positive impact would be greater availability of water in some areas, possibly resulting in [lowland forest] vegetation growth, and new wetlands are expected to be created along the former alluvial plains in the Kuribrong and Amaila River watersheds.

Analysis of Alternatives

This section presents an assessment of major alternatives related to the Project, including alternatives for energy generation technologies and for various aspects of the Hydropower Facility, Electrical Interconnection, and Access Road.

Alternative Energy Generation Technologies

Alternative energy generation technologies were analyzed in terms of their ability to produce a substantial displacement of the current fossil fuel generation and a significant reduction of the long-term average wholesale electricity cost in Guyana while maintaining adequate levels of system reliability.

Based on information provided by the GoG, the Amaila Hydropower Project would reduce the cost of generating electricity under the prevailing estimates for capital and operating costs, when compared to a expansion of thermal generation, which is estimated to cost approximately \$140/MWh.

To compare the Project with other renewable generation alternatives, the scale and operating characteristics of the proposed alternatives have to be considered in the context of the infrastructure required to integrate the proposed alternative into the system. Integrating significant amounts of intermittent renewable resources such as wind and solar poses significant challenges to system operators; thus, these alternatives must be supplemented with a more controllable generation resource. The intermittent resource would cost more than the hydropower option before the need for thermal firming generation is considered, and would have an even higher cost when considering the thermal generation required to firm up the product and make it comparable in energy quality to the hydropower option. Biomass (such as bagasse, a by-product of the sugar plantations) is used for cogeneration in Guyana; however, due to its limited potential, it is not an option that can be considered to replace the existing fleet of fossil-fueled power plants. A large-scale solar project is not economical in Guyana's humid, tropical climate. To exploit on- or offshore wind resources would cost substantially more than the hydropower option considered by the GoG, even without factoring in the need for thermal firming generation.

One option to meet Guyana's energy needs is the use of only small hydropower projects (i.e., projects less than about 20 MW). For example, this could consist of 18 projects producing 168 MW of electricity, as identified in the inventory of projects listed by Guyana's Energy Agency. Even assuming that the total capital cost of the small hydro projects is the same as the Project on a \$/kW basis (which is a conservative assumption), additional transmission lines would be required to aggregate the power from the geographically dispersed projects and deliver it to Georgetown and Linden, thus increasing the cost. From an environmental and social perspective, while an individual small hydropower plant would likely have less impact than a large one, the aggregate or cumulative impacts of multiple small hydropower projects could be worse than those of a single larger hydropower project. For example, the projects would affect more streams/rivers, and thus exert more geographically diverse ecological impacts on a wider range of ecosystems. They would require more transmission lines and access roads, which would increase the risk of opening more areas to new development and resultant induced or indirect negative impacts.

In terms of site selection for a large hydropower project in Guyana, the final choice for the Project was based on a review of various potential sites, including Amaila, Turtruba, and Kaieteur. In addition to these three sites, the GoG granted the exclusive rights to develop the Upper Mazaruni or Sand Landing hydropower project to RUSAL, the Russian aluminum company, in February 2007. Table EX.1 provides a summary comparison of alternatives. The Turtruba and Upper Mazaruni hydropower projects are very large, many times the total installed capacity of the country, and therefore require either the development of large industry within Guyana or export of electricity from Guyana, neither of which is consistent with the Guyana National Development Strategy or Low Carbon Development Strategy. As a result of their size, these projects would produce significantly greater physical impacts and are therefore assumed to have significantly greater environmental and social impacts. The Kaieteur hydropower project would produce about the same amount of power as Amaila, and would match the current requirements of GPL, but would significantly affect the only national park and one of the most popular tourist attractions in the country.

In conclusion, given the base-case assumptions, the Project offers the only alternative consistent with Guyana's National Development Strategy and Low Carbon Development Strategy, will produce the least onerous physical and social impacts of all the hydroelectric options, will cost the least of the renewable options, and is the only renewable option that is technically feasible. No other renewable alternative could offer a substantial and rapid displacement of fossil-fuel generation while meeting the system reliability requirements in a cost-effective manner.

Table EX.1. Summary comparison of hydropower options in Guyana

Comparison Factor	Hydropower Project				
	Amaila	Turtruba	Kaieteur	Upper Mazaruni	Generic Small Hydros
River System	Kuribrong & Amaila	Mazaruni	Potaro	Mazaruni	Various
Feasibility Status	Feasibility Study Complete	Pre-Feasibility Study	Pre-Feasibility Study	Pre-Feasibility Study	No Comprehensive Study
Installed Capacity (MW)	165	800	216	1320	170
Reservoir Size (km ²)	23	1,174	Unknown	500	Various, assumed small
Live Storage (km ³)	0.14	14.6	Unknown	13.8	Various, unknown
Gross Head (m)	365	195	~300	430	Various
Resettlement (approx. number)	0	Unknown, assumed significant	0	4000	Unknown
Transmission Requirements (km)	270	580	~270	300 Estimated	Assumed 900
Amerindian Lands Required	None	Unknown	None	Yes	Unknown

Project Hydropower Alternatives

Three different reservoir sizes (equivalent to dam heights) were evaluated as part of the Project development (alternative analysis): an approximately 23.3-km² reservoir corresponding to a dam height of about 431.55 masl (Alternative 1), an approximately 38.7-km² reservoir corresponding to a dam height of about 435.4 masl (Alternative 2), and an approximately 54.1-km² reservoir corresponding to a dam height of about 438.3 masl (Alternative 3). These options were analyzed for environmental and social and economic considerations.

The primary impacts associated with an increase of reservoir size will be habitat loss from clearing of forest within the reservoir area, changes in the aquatic environment due to conversion of a lotic system to a lentic system, and both aquatic and terrestrial habitat fragmentation. The nature of the impacts and risks to flora and fauna remain the same for each reservoir size alternative, and the difference in the magnitude of impacts is expected to be roughly proportional to the areas affected. In comparing reservoir alternatives, there is relatively small difference in terms of changes in the length the Amaila River that would be flooded (approximately 11.36 km for Alternative 1 and 13.78 km for Alternative 3), while there is a notable change related to the Kuribrong River from Alternative 1 (approximately 6.88 km) to the two larger options (approximately 26.99 and 28.19 km, respectively for Alternatives 2 and 3). The area flooded by Alternative 1 consists of approximately 19.6 km² of preserved lower montane rainforest (upland forest), 3.4 km² of periodically flooded lower montane riparian tropical forests and 0.3 km² of water bodies (i.e., existing river). The larger two reservoirs will result in a greater loss of upland forests (approximate total loss of 29.1 and 37.0 km², Alternatives 2 and 3, respectively), but similar levels of periodically flooded forest (approximately 3.56 and 3.64 km² for Alternatives 2 and 3, respectively). In addition, there would be the loss of other vegetation types of approximately 6.1 km² and 12.6 km², for Alternatives 2 and 3, respectively.

In terms of reservoir water quality, the differences between the alternatives would result from the wide range of volumes, surface areas, and residence times of the reservoirs. The volume of Alternative 1 (135 million m³) is 34 percent of Alternative 3 (396.4 mcm), and the area of Alternative 1 (23.3 km²) is 43 percent of Alternative 3 (54.1 km²). Given the average flow rate of 64 m³/s, the average residence time of the small reservoir would be 23 days. This is 34 percent of the average residence time of 68 days for the larger reservoir. The following changes to water quality of Alternatives 1 and 2 relative to Alternative 3 would be expected:

- The shallower depth and higher water velocities would increase vertical mixing and decrease stratification
- Oxygen in the hypolimnion (lower depths of reservoir) would be less depleted, because organic matter would have less time to decay and a larger fraction would be passed downstream
- Particulate organic matter would have less time to settle out and contribute to sediment oxygen demand

- The reduction in the volume of low-dissolved-oxygen water would result in less anaerobic nutrient release and thus less algae growth
- Downstream water quality impacts would decrease due to the general improvement in reservoir water quality outlined above.

Construction-related impacts are expected to be approximately equivalent in all three of the reservoir size alternatives. The larger reservoir alternative will require slightly larger values of fill, concrete, excavations, and related construction quantities, this variation will not materially affect the size of the direct construction footprint or the intensity of the associated impacts. In terms of social impacts, no significant differences exist between the three alternative reservoir sizes.

In terms of greenhouse gas (GHG) emissions, the estimated GHG emissions amount related to vegetation clearing for Alternative 1 is approximately 491,000 tonnes of CO₂e (carbon dioxide equivalent). The Alternative 2 clearing would cause about 66% additional emissions, and Alternative 3 would cause about 132% additional emissions. The estimated net GHG emissions from operating the reservoirs require further information to quantify, but given its longer residence time, Alternative 3 would be expected to have incrementally higher GHG emissions compared to both Alternatives 1 and 2.

The major economic factors affected by reservoir size are capital cost for construction, which increases as reservoir size increases; amount of generation, which increases as reservoir size increases; and cost of power or net present value (NPV) of the project, which changes depending on the specific relationship between capital cost and generation. The major economic factors affected by installed capacity are the same as for reservoir size noted above, with the same basic relationships. A summary comparison of the economics associated with the three reservoir sizes and the three installed capacities is presented below.

Gross Capacity (MW)	Dam Height (masl)	Change in Energy (GWh)	Change in Avg Tariff (US\$MM/yr)	Change in 20-Yr NPV (US\$MM)	Change in Avg Rate (US¢/kWh)	Power Density (W/m ²)
165	431.55	Base case	Base case	Base Case	Base Case	7.1
165	435.4	80	14.6	51.5	0.6	4.3
165	438.3	149	21.9	134.6	0.6	3.0
220	438.3	338	38.8	188.4	0.3	4.1

The results indicate that energy increases both with increasing dam height/reservoir size and with increasing installed capacity for a given dam height. The annual tariff paid by GPL for the capacity provided by the Project increases as the capital cost increases with dam height/reservoir size and installed capacity. The effective cost of electricity in terms of dollars per kWh increases for all options when compared to the base case. The cost of the Project to the GoG and its citizens in terms of the 20-year NPV increases both with increasing dam height/reservoir size and with increasing installed capacity for a given dam height.

The minimum environmental flow (MEF) can have a major economic impact due to:

- Capital costs increase when a minimum environmental flow capacity is added, but costs do not change significantly as the flow requirement is increased
- Amount of generation decreases as the minimum environmental flow increases
- Cost of energy increases as the minimum environmental flow increases
- Value of the Project, as measured by the NPV of the cost of the Project, decreases as the minimum flow increases.

An analysis of the economic impacts of alternative MEFs shows the following:

Minimum Environmental Flow (cms)	Change in Generation (GWh)	Change in 20-Year NPV (USD)	Change in Rate (US¢/kWh)
0	Base case	Base case	Base case
1	-12	14 million	0.1
3	-37	42 million	0.4
4.5	-57	65 million	0.6

These results imply that the MEF has a major economic impact on:

- Capital costs, which increase when a minimum environmental flow discharge capability is added, but does not change significantly if the flow requirement is increased
- Amount of generation, which decreases as the MEF increases
- Cost of energy, which increases as the MEF increases
- Cost of the project or 20-year NPV, which increases as the MEF increases. A higher NPV results in higher electricity rates for consumers.

The potential environmental impacts affected by MEF include: changes to flow quantity over the falls and in the mist zone, changes in flow quantity between the falls and the powerhouse, and changes in water quality in the mixing zone of the powerhouse tailrace. If the biodiversity value of the mist zone and bypass reach is less than US\$65 million, or even \$42 million after the biological studies are completed, a higher overall economic value can be achieved by eliminating the MEF and using a portion of the savings to protect a biodiversity offset while allowing the ratepayers and Government of Guyana to retain the remainder of the savings in the form of a lower tariff and lower electric rates.

Transmission Line Alignment

Given the Project Hydropower Facility location and the need for the power generated to be delivered to Linden and Georgetown (i.e., load is in Georgetown and along the coast; some load is in Linden and connects to an isolated system of GPL), the basic alternatives examined were to run the transmission line from the Hydropower Plant to Linden and from Linden to Georgetown. The Project design originally (2002) contemplated connecting with the Omai mine. Subsequently, in 2008, the Project design was changed due to the mine being closed and having no need for the power.

The selection of the transmission-line alignment from the Hydropower Facility to Linden considered the following:

- Avoid crossing Amerindian areas (specifically Kaburi, Muritaro, Malali, and Rockstone)
- Maintain proximity to the existing roads that would be upgraded and used for the Project Access Road (e.g., portions of Bartica-Potaro Road, portions of road in the Toolsie-Persaud forestry concession)
- Minimize the crossing of broad wetland areas (e.g., adjusted around the wet area east of Portage Falls)
- Avoid multiple crossings or encroachments on the Kuribrong River in the area west of Portage Falls
- Minimize the long river crossing on the Essequibo (e.g., by using islands for towers)
- Avoid rivers and escarpment at entry to Hydropower site
- Minimize the crossing of areas with poor soils (in terms of tower foundations) and changing topography
- Minimize the need for bends or changes in direction
- Avoid houses and communities where the alignment enters near Linden.

The factors considered in selecting the proposed transmission-line alignment from Linden to Georgetown were:

- Run parallel to existing Mabura Hills Highway from Linden to Georgetown
- Avoid crossing Amerindian areas (specifically St. Cuthbert's)
- Avoid houses and communities around Linden, Mabura Hills highway, and entering Georgetown

- To the extent possible, use any existing GPL transmission line corridor, in particular near the Sofia substation where two short section options were evaluated
- Follow the land boundary along the flood reserve south of Georgetown
- Minimize the span over the Demerara River.

The transmission-line design also evaluated the following design alternatives to meet the operational needs (e.g., transfer power, protection, system stability, redundancy and reliability, flexibility for future expansion): system voltage 230 KV; dual circuits; corridor width in terms of outage risks, tree hits, maintenance of corridor, high reliability standard, and remoteness; tower height (trees, wind); foundation and tower types (soils, topography); and triangular version vertical-conductor suspension.

The selection of the two substation locations was based on the following:

- Georgetown: connect with the Sophia substation, which is connected to GPL grid; utilize to the extent possible existing transmission-line alignments;
- Linden: avoid entering Linden with a high-voltage transmission line, locate in open area (preferably that has already been affected by man), minimize distance and impacts by passing to the north of Linden (because the transmission line needs to continue on to Georgetown).

The substation design also evaluated the following design alternatives to meet the operation needs (e.g., transfer power, protection, system stability, redundancy/reliability, flexibility for future expansion, security).

Access Road Alternatives

Three principal corridor options were evaluated for the Project access road:

1. Use the existing Mabura Hill Road to Mahdia, cross the Potaro River, and build a new road to the hydropower site (approximately 225 km in total, 191 km upgrade and 34 km new)
2. Use the existing Mabura Hill Road to Omai, cross the Essequibo River, upgrade existing forestry concession roads, and build a new road to the hydropower site (approximately 256 km in total, 161 km upgrade and 95 km new)
3. Use the existing Mabura Hill Road, cross the Essequibo River at Butakari, upgrade the existing forestry concession road and a portion of Bartica-Potaro Road to Kaburi, and build a new road to the hydropower site (approximately 205 km in total, 122 km upgrade and 83 km new).

The Mahdia option is a longer distance, and certain portions of the road upgrades include steep topography and tight turning radii, which limits the use of large, heavy trucks, unless extensive cut-and-fill work is done. Another significant problem with the Mahdia route is that the road is not close to the transmission-line corridor, and therefore cannot provide access to it, so an additional access road would be required (albeit not to the same design width and characteristics as the Project access road). The Omai option presents a longer overall route (approximately to the hydropower site) and therefore higher costs. Like the Mahdia option, the Omai option does not follow the transmission-line corridor, thus presenting a problem with access for transmission-line construction and maintenance. The selected Project option is the shortest route, requires less upgrade of the Mabura Hill Road, and uses existing roads on the west side of the Essequibo River until a new road portion begins south of Kaburi.

The specific route within the corridor was assessed in various ways. As part of the contract issued by the GoG for the Project Access Road, the Access Road Contractor performed initial fieldwork to assess road alignment options within the desired corridor. Various specific technical and environmental selection criteria were established in the contract. Using existing maps and information, the Access Road Contractor initially selected the closest ridges to fit in the proposed road corridor. A reconnaissance team was sent into the field to verify that the selected alignment was actually on a ridge, and they made field adjustments when the proposed route encountered unmapped valleys and low-lying areas. In parallel with field work by the Access Road Contractor, the Company contracted environmental specialists to assess environmental conditions (especially flora and fauna) in the corridor for the two new access road areas: Mabura Hills Road to Essequibo River, and near Kaburi to the hydropower site.

One key alternative evaluation was related to whether to route the access road through the village of Kaburi (which would require upgrading the existing road) or route it north of Kaburi along an existing forestry concession road. The route around Kaburi is longer than going through the village. During the Company's public consultations with the Kaburi residents done as part of this study (see Section 8 for details), some community members expressed a preference to run the road through the village. However, the final option selected in consultation with the Kaburi community was to use a bypass road to avoid the significant impacts that would occur by using the existing road that goes through the village. These impacts include:

- The road would need to be widened to about 20 m or more, which would affect Kaburi residents' properties along the road, and may even cause the need to relocate some existing buildings and/or homes
- Increased heavy truck traffic (potentially up to 100 trucks a day) would create an increased risk for accidents (possibly involving Kaburi pedestrians and children), as well as noise and dust
- Increased presence of Access Road construction workers, as well as those passing through the community, possibly producing social conflicts.

Environment and Social Management

The Environmental and Social Management for the Project provides the prevention, control, mitigation, monitoring, supervision, reporting, training, and institutional measures to be taken to eliminate adverse Project-related environmental, social, and health and safety (ESHS) impacts, offset them, or reduce them to acceptable levels.

Based on the Project consisting of components being managed by two different entities, the environmental, social, and health and safety management (ESHSM) is separated and presented as follows:

- ESHSM for the Hydropower Facility and Electrical Interconnection components of the Project, which is the responsibility of the Company
- ESHSM for the Access Road component of the Project, which is the responsibility of the GoG.

The focus of the ESHSM is to assist in prioritizing risk management strategies, with the objective of achieving an overall reduction of risk to human health and the environment, and emphasizing the prevention of irreversible and/or significant impacts, by methods such as:

- Favoring strategies that eliminate the cause of the hazard at its source; for example, by selecting less hazardous materials or processes that avoid the need for ESHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.
- Improving ESHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

Hydropower Facility and Electrical Interconnection Environmental, Social, Health and Safety Management

Control and Mitigation Measures

A series of programs have been established to prevent, control, and mitigate environmental, social, health and safety, and labor impacts and risks. These programs have been separated based on the relevant responsible party for their implementation, and the detailed measures are presented as:

- Construction Contractor Environmental and Social Management Plan, which includes the programs/measures related to the construction of the Hydropower Facility and Electrical Interconnection that the EPC Contractor is responsible for implementing (see Table EX.2).
- Company Environmental and Social Management Plan, which includes the programs/measures related to the construction and operation of the Hydropower Facility and Electrical Interconnection that the Company is responsible for implementing (see Table EX.3).

Table EX.2. List of control, mitigation, and monitoring programs in Construction Contractor ESMP

Environment Management
– Vegetation clearing
– Earth moving
– Excavations
– Tunneling
– River and floodplain crossings
– Concrete and cement works
– Transmission line assembly
– Demobilization and bio-restoration
– General housekeeping and pollution prevention
– Erosion control and storm water management
– Hazardous materials management
– Waste management
– Water and effluent management
– Air quality management
– Noise management
– Construction camps
– Industrial plants
– Quarries and borrow pits
– Surplus deposits (spoil areas)
– Equipment and vehicles
Health and Safety Management
– Integrated health and safety plan
– Staffing
– Committee for accident prevention
– Safe work procedures
– Training
– Supervision
– Worker health
Spill Management
Emergency Response Management
Labor Management
– Labor requirements/guidelines
– Camp regulations
– Worker code of conduct
Security Management
Transportation Management
Community Relations
Public Health
– Prevention and control of contagious disease
– Monitoring community public health
– Monitoring endemic disease vectors
Fauna Rescue and Relocation
– Ichthyofauna
– Terrestrial fauna
Cultural Property Management

Table EX.3. List of control, mitigation, and monitoring programs in Company ESMP**Influx Management Program****Land Acquisition and Resettlement Plan**

- Transmission line land lease and resettlement action plan
- Forestry concession compensation

Amerindian Community Plan

- Kaburi community plan
- Amerindian monitoring program
- Amerindian community development

Local Community Support Program

- Local worker training and hiring program
- Local supplier development program
- Community investment program

Biodiversity Monitoring Program

- Flora monitoring program
- Aquatic fauna monitoring program
- Terrestrial fauna monitoring program

Environmental Compensation Program

- Potential compensation/offsets
- Compensation/offsets framework plan

Community Stakeholder Engagement

- Project implementation stages
- Access control
- Project Environmental/compensation offset
- Information communication approaches
- Community monitoring plan
- Grievance mechanism

Public Health

- Monitoring public health indicators
- Monitoring populations of endemic disease vectors
- Public health control measures

Reservoir Management Program

- Water quality and limnology monitoring plan
- Reservoir margin stability monitoring and erosion control plan
- Groundwater monitoring plan
- Sedimentation monitoring plan

Kuribrong River Management Plan

- Downstream water quality and limnology monitoring plan
- River margin stability monitoring plan

Operation Health, Safety and Environment Plan**Transmission Line Vegetation Management Program****Dam and Reservoir Safety Program**

- Dam design
- Construction supervision and quality assurance plan
- Instrumentation plan
- Operation and maintenance plan
- Emergency preparedness plan
- Reservoir use plan

Compliance Monitoring

Monitoring Programs

Various environmental and social monitoring programs will be implemented by the Company during construction and operation, including biodiversity (flora, aquatic fauna, terrestrial fauna), river-water quality, public health, Amerindians, local labor and suppliers, and land acquisition and resettlement. Environmental and social monitoring that will be implemented by the EPC Contractor or the Company to assess compliance and performance include air quality, noise, potable water, wastewater, waste management, flora/fauna, erosion and sediment runoff, social (including community complaints/grievances), ESHS training, job generation, acquisition of local goods and services, and worker health and safety.

The environmental and social monitoring activities during operation include biodiversity (flora, aquatic fauna, terrestrial fauna), environmental compensation, community stakeholder engagement (community monitoring, grievance mechanism), reservoir (water quality and limnology, reservoir margin stability and erosion control, groundwater, sedimentation), Kuribrong River (downstream water quality and limnology, river margin stability), dam and reservoir safety, operation Health, Safety and Environment, and transmission-line vegetation. The environmental and social monitoring during operations focuses on assessing compliance and includes noise, potable water, wastewater, waste management, social (including community complaints/grievances), ESHS training, and worker health and safety.

Supervision and Reporting

During construction, the EPC Contractor will perform routine daily and weekly supervision activities (e.g., inspections, audits), and reporting thereof will be implemented by the EPC Contractor ESHS Manager. Monthly meetings, including ESHS matters, will be held with senior managers of the EPC Contractor. The Company will supervise compliance with commitments included in the Construction Contractor ESMP. This will be achieved through systematic inspections and reviews. The Company will be responsible for preparing quarterly ESHS Monitoring Reports for Company management review.

During operations, routine supervision activities (e.g., inspections, audits) and reporting thereof will be implemented by the Company's ESHS Manager. Supervision and monitoring reports, records, forms, and photographic records shall be prepared. Monthly meetings regarding ESHS matters will be held with the Company management team. When an ESHS non-conformance is detected and is not, or cannot be, immediately resolved, then an ESHS corrective action process will be initiated.

Responsibilities

The responsibilities for implementing the Hydropower Facility and Electrical Interconnection ESHSM are divided among the following:

- Company, which will supervise implementation of the Construction Contractor ESMP and contractually enforce compliance, and implement all aspects of the Company ESMP. The Company is also responsible for

implementing all operation-related ESHS plans. The Company will allocate an ESHS Manager to coordinate this effort.

- EPC Contractor, which will be directly responsible for executing construction in compliance with the Construction Contractor ESMP. The EPC Contractor will be responsible for ensuring that all subcontractors are in compliance.
- Construction subcontractors, which will be required to comply with the Construction Contractor ESMP as it applies to their respective contract scope and will be supervised by the EPC Contractor.

Environmental monitoring associated with construction activities will be a shared responsibility between the EPC Contractor and the Company.

The Company's key personnel include the Project Manager, the ESHS Manager, and ESHS staff. The EPC Contractor's key personnel include the EPC Contractor Project Manager, EPC Contractor ESHS Manager, EPC Contractor Environment and Community Relations Coordinator, EPC Contractor Health and Safety Coordinator, and staff to adequately implement ESHS requirements. The EPC Contractor will require that each of the subcontractors nominate an ESHS representative.

Training

The EPC Contractor will provide ESHS training to all construction workers under their control. A formal training module shall be created that encompasses both standard ESHS aspects but also reflects specific conditions of the Hydropower Facility and Electrical Interconnection. The training module shall be reviewed by the Company. Additional training will be provided for those workers involved directly in environmental and social matters or exposed to specific worker health and safety risks. Subcontractor ESHS representatives will undergo specific induction on the EPC Contractor's ESHS requirements, corrective action process, the Company's non-compliance procedure, and reporting standards.

The Company will develop and implement an ESHS training program for operation of the Hydropower Plant and Electrical Interconnection as part of the operation-phase ESMP that will be developed prior to completion of construction.

Access Road Environmental, Social, Health and Safety Management

The Access Road Contractor has been contracted by the GoG to construct the Project Access Road. The GoG is responsible for the Access Road operational phase but may contract the execution out to a third party.

Control and Mitigation Measures

The Access Road control and mitigation measures have been separated based on the relevant responsible party for their implementation, and the detailed mitigation measures are presented as:

- Access Road Contractor Environmental, Health and Safety Management Plan, which includes measures related to the construction of the Access Road that the Access Road Contractor is responsible for implementing (see Table EX.4)
- Access Road Sponsor Environmental and Social Management Plan, which includes measures related to the construction and operation of the Access Road that the GoG is responsible for implementing (see Table EX.5).

Table EX.4. List of programs in Access Road Contractor ESMP

Vegetation/Forest Clearing	Training
Erosion Control and Stormwater Management	Spill Management
Road Base Construction and Road Rehabilitation	Emergency Response
Quarries, Source Material, and Waste Soil Disposal Area Management	Labor
Equipment and Machinery	Work Camps
Water Crossings	Job Creation and Acquisition of Local Goods/Services
Demobilization	Security Management
Restoration and Revegetation	Air Quality
Drilling and Blasting	Noise
Health and Safety Management	Amerindian communities
Hazardous Materials Management	Archaeological
Waste Management	Communication
Traffic Management	Supervision
	Monitoring

Table EX.5. List of programs in Access Road Sponsor ESMP**Framework Access Control Plan**

- Approach to access control
- Potential impacts arising from improved access
- Planned mitigation measures
- Legal basis for implementation of access control
- Public consultations
- Institutional arrangements for controlling access
- Implementation schedule and work plan
- Sources of financing for tasks

Stakeholder Engagement

- Roles and responsibilities
- Community monitoring plan
- Grievance mechanism

Kaburi Community Plan**Access Road Compensation/Offsets Framework**

- Offset approach
- Stage 1—Access road direct offset
- Stage 2—Overall Project offset

Operation Phase Management

- Mitigation Measures
- Monitoring

Monitoring Programs

Monitoring by the Access Road Contractor during construction includes the following components: air quality, noise, water quality, waste management, flora/fauna, erosion and stormwater runoff, EHS training, job creation, acquisition of local goods and services, and health and safety.

Supervision and Reporting

During construction, the Access Road Contractor will perform routine daily and weekly supervision (e.g., inspections, reviews), and reporting thereof will be implemented by the Access Road Contractor EHS Manager. Supervision and monitoring reports, records, forms, and photos shall be prepared. Monthly meetings, including ESHS matters, will be held with senior managers of the Access Road Contractor. The Access Road Contractor will include in the monthly report to the GoG any relevant ESHS issues associated with its activities. When an ESHS nonconformance is detected and cannot be immediately resolved, a corrective action process will be initiated.

The GoG will retain overall responsibility to ensure Access Road Contractor compliance with all ESHS measures, and has hired an independent oversight consultant, SRKN, to oversee the Access Road Contractor, including technical, engineering, construction, environmental, and health and safety aspects. The GoG will supervise compliance with commitments included in the Access Road Contractor ESMP. This will be achieved through systematic inspections and reviews of construction activity and of associated Access Road Contractor ESHS documentation. Routine inspections will focus on verification of compliance with components of the Access Road Contractor ESMP, worker health and safety, scope and intensity of

environmental impacts induced by construction work, and disturbance to local communities resulting from construction work. Additionally, monthly meetings with the Access Road Contractor will be held.

Training

The Access Road Contractor will provide ESHS training to all Access Road workers. A formal training module shall be created that encompasses both standard ESHS requirements but also reflects specific conditions to the Access Road.

Responsibilities

The Access Road Contractor will be responsible for maintaining and implementing the Access Road Contractor ESMP. The GoG will be responsible for maintaining and implementing the Access Road Sponsor ESMP, and monitoring the performance of the Access Road Contractor.

The Access Road Contractor key personnel include the Access Road Project Manager, EHS Manager, and EHS staff.

The GoG has hired an independent oversight consultant, SRKN, to perform oversight of the Access Road Contractor, including technical, engineering, construction, environmental, and health and safety aspects.

Public Participation

The Company and its predecessors in developing the Project have been conducting public consultations since 2001. The goal of the public consultation is to facilitate citizen participation as a management tool to aid successful project design and implementation by incorporating community knowledge into the project, reducing immediate and future conflict, and establishing a base of trust and communication between the population and the project. The objectives are to:

- Allow relevant stakeholders to better understand the proposed project and provide them an opportunity to express their opinions, concerns, and questions
- Incorporate elements into the project that address the topics brought up during consultation; in particular, improving the proposed mitigation and monitoring of Project negative impacts.

The principal consultations already performed include those conducted during the preparation of the EIA and the ESIA Addendum, and as part of the development of this Updated ESIA. Additional future/ongoing consultations will be implemented by the Company, including discussing comments associated with the Updated ESIA.

Prior Consultations Conducted for Project ESIA

Public consultation was performed as part of the development and approval of the original Project EIA in 2002 and subsequently during preparation the Project ESIA Addendum in 2008.

During the preparation of the EIA, a draft Terms of Reference (TOR) was prepared, and EPA published a notice of the project in at least one daily newspaper, and a summary of the project was made available to members of the public for a period of 28 days. Within this period, EPA accepted written submissions related to the Project and three public consultation meetings were held after this 28-day period. The public's comments were noted by the EPA and considered in the finalization of the TOR of the EIA. The public consultation meetings were chaired by the Environmental Assessment Board (EAB).

During the EIA development process, members of the public, interested entities, and organizations were consulted, and information was provided to members of the public on request. The EIA was prepared and submitted to EPA for evaluation and recommendations. EPA published a notice of the availability of the EIA. The public had 60 days from the publication date of the notice to make submissions to the EPA and/or the EAB related to the EIA. EPA, along with relevant sector agencies, reviewed the EIA during this 60-day period, to ensure that the EIA was in line with plans, guidelines, and regulations or codes of practice developed by the EPA and sector agencies. Public meetings in Georgetown and Mahdia, chaired by the EAB, were held at the end of the 60-day period. Additional comments were provided by members of the public at these meetings.

As part of the development of the Project ESIA Addendum regarding the change in a portion of the transmission line and access roads alignment, meetings were held on April 25, 2008, with the Ministry of Amerindian Affairs, and on May 2, 2008, with the Ministry and three non-governmental organizations (NGOs) (Amerindian Peoples Association, Guyana Organization of Indigenous Peoples, and The Amerindian Action Movement of Guyana). During the meetings, the participants were informed of the scope and potential of the proposed Project, the likely social impacts that could result from the Project, specifically related to the Kaburi community, and how the Project could contribute to ensuring that the history and culture of the community are preserved. A community consultation meeting was held on May 10, 2008, at the Kaburi Amerindian community. Sixty-eight residents were present, forty of whom were adults (18 years and older). Prior to the meeting, The Ministry of Amerindian Affairs had informed the Kaburi community of the proposed meeting. The issues discussed included the scope and potential of the project and the likely impacts on the community. Questionnaires were randomly administered to forty members of the audience present at the meeting. The data acquired from the questionnaires were considered and used in the preparation of the ESIA Addendum.

Consultations Conducted for Updated ESIA

As part of the process for developing this ESIA, additional public consultation and information disclosure activities were conducted. These activities were defined as part of the Public Consultation Strategy, with a goal of facilitating citizen participation as a management tool to aid successful project implementation, by incorporating community knowledge in the Project,

reducing immediate and future conflict, and establishing a base of trust and communication between the population and the Project. The objectives are to:

- Provide information to allow relevant stakeholders to better understand the Project (including the access road component)
- Facilitate stakeholder input regarding potential concerns or issues with the Project, which can be addressed as part of this ESIA and, in particular, the Environmental and Social Management Plan
- Facilitate the development of positive benefits from the Project, such as increased local employment, sale of local goods and services, etc.

The main public consultation activities conducted in the preparation of this document include:

- Consultation with independent third-party experts were held related to the draft Scope of Work for the Environmental Baseline Survey, which was part of preparing this ESIA.
- Information disclosure and consultation with communities and other stakeholders as part of the social baseline assessment to prepare this ESIA (see below for summary).
- Individual meetings (consultations) with various stakeholders as part of developing information for specific parts of this ESIA, in particular regarding environmental and social mitigation measures and mechanisms to enhance local benefits. This included discussions related to offsets of natural habitats, control of potential impacts due to the opening of an access road, stakeholder monitoring, greenhouse gas emissions, and local employment and community development programs.
- Consultation with the Kaburi Amerindian community related to the Project access road (see below for summary).

During the social baseline assessment work for preparing this ESIA, consultation with relevant stakeholders was held in May 2010. The focus of these meetings was to provide information on the Project to stakeholders, allow stakeholders to comment on the Project (e.g., expectations, concerns, etc.), and collect social baseline information to assist in enhancing the mitigation measures and benefit programs. The supplemental consultation consisted of formal consultation meetings with Amerindian communities and other mixed communities and interviews with individual community members. Communities where both public consultation meetings and interviews with individual community members took place included: Kaburi, Rockstone, Butakari, Muritaro, Malali, Micobie, Campbelltown, Princeville, Kopinang, Chenapou, and St. Cuthbert's Mission. Communities where only interviews with individual community members took place included: 14 Mile Potaro Road, Mahdia, and Menzies Landing.

The communities were informed prior to the meeting (written and/or verbal communication as most appropriate for the individual community) regarding the objectives of the meeting. To facilitate a more informed consultation, a brief written summary of the Project was prepared and was distributed prior to the meeting (e.g., for all communities prior to the community meeting). The public consultation meetings in most communities were relatively well attended. During all meetings, there was active participation from the community members, and many came prepared with questions and comments about the Project. In general, meeting attendees had a positive view of the Project, because they anticipate that it will bring job opportunities and needed development to their communities. Three main themes were common to the meetings and interviews: community member interest in jobs associated with the Project or economic opportunities that would be generated by the Project, community interest in obtaining electricity, and community interest in addressing certain social issues of the communities. Site reconnaissance visits were also performed related to Linden and Georgetown, and the properties to be affected along the transmission line from Georgetown to Linden.

One key issue was whether the Project should upgrade an existing old logging road that passes north of the Kaburi community and use that road during construction to reduce the negative impacts on the Kaburi community, or upgrade the existing road that passes through the Kaburi community and use that road. A second public meeting was held with the Kaburi community on August 25, 2010, to allow the Kaburi community members to better understand the advantages and disadvantages of these two options, with an objective of reaching a consensus on the location of the access road. To facilitate a more informed consultation, a brief written summary of the Project and the access road issue was prepared and was distributed several days prior to the meeting. During the meeting, a presentation was made on the potential advantages to the Kaburi community of using the existing road that goes through Kaburi, the potential disadvantages to the Kaburi community of using the existing road that goes through Kaburi, the potential advantages to the Kaburi community of using the old logging road to the north that bypasses Kaburi, and the actions that would be implemented if the decision is to use the bypass road. During the meeting, the community members became more supportive of the bypass road option after learning during the meeting of the distinct disadvantages of using the existing road that goes through Kaburi, including community health and safety risks resulting from the daily high volume of large, heavy trucks generating dust, noise, and vibration, and the potential for accidents, in addition to the need to expand the road up to three times its current width, which will result in the need to resettle some businesses and 10–20 families living along the road.

The public consultation meetings with the potentially affected Amerindian communities were conducted by the Company in accordance with the IDB Operational Policy on Indigenous Peoples (OP-765), and permitted evaluation of the extent of potential adverse and positive impacts of the Project on these communities. The results of these consultations were incorporated into this ESIA, including the socioeconomic baseline. No significant adverse impacts of the Project on physical and food security, lands, territories, resources, society, rights, the traditional economy, way of life, and identity or cultural integrity of indigenous peoples have been identified.

Consultation on ESIA

To provide stakeholders with detailed information on the environmental and social aspects of the Project, which will allow them to be better informed and increase their understanding of the Project, disclosure and consultation will be performed on this ESIA. The ESIA and/or Executive Summary will be made public at various locations and via the Internet. A series of community meetings and public workshops will be held in potentially impacted communities along the route of the transmission line and in selected key cities. The objective is for stakeholders to become more informed about the Project and the results of this ESIA analysis, and to have an opportunity to present their opinions, comments, and suggestions. The consultation activities performed will be documented. A final ESIA will then be produced based on comments received from Project stakeholders.

Ongoing Consultation

As part of the Environmental and Social Management Plan, ongoing public participation activities will be implemented during Project construction and operation. The proposed actions include routine disclosure of information on Project status and performance, ongoing actions to consult with relevant Project stakeholders, and a complaint/grievance mechanism to provide a formal means of receiving, resolving, and following up on any complaints from the local population related to the Project.

The Company and GoG plan to continue consultations with directly affected communities to fully explore and evaluate the potential impacts within these communities. Should adverse impacts be identified, necessary measures to mitigate those impacts will be discussed with the affected communities based on the extent of the impacts. If any community is significantly affected by the Project, the Company and GoG will strive to reach agreement with the community to appropriately address the impacts and to ensure the socio-cultural viability of the Project.