Government of Saint Lucia

# Environmental and Social Management Plan

## Saint Lucia Geothermal Resource Exploration Project

**February 2018**

PANORAMA ENVIRONMENTAL, INC.

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Government of Saint Lucia

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## Saint Lucia Geothermal Resource Exploration Project

**February 2018**


Prepared for:
Government of Saint Lucia
Department of Sustainable Development
Point Seraphine, Castries
Saint Lucia

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# EXECUTIVE SUMMARY

## ES.1 PROJECT SUMMARY

The Government of Saint Lucia (GoSL) proposes to conduct the Saint Lucia Geothermal Resource Exploration Project (project) within the Soufrière, Choiseul, and Laborie regions of Saint Lucia to assess the feasibility of commercial development of geothermal resources in Saint Lucia. A pre-feasibility study has identified three potential drilling areas: Belle Plaine, Fond St. Jaques, and Mondesir-Saltibus (see Figure ES.1-1).

The project includes drilling slim-hole wells and potentially full-size geothermal exploration wells to evaluate the feasibility of commercial geothermal development in Saint Lucia. Slim-hole wells would be drilled first. Slim-hole wells (3.78-inch bottom hole diameter) typically require less capital investment and cause less environmental and social impact than deep full-sized wells because they are drilled with smaller drill rigs on smaller well pads, drilling takes less time, and less fluid is produced. The project would include the following activities and components:

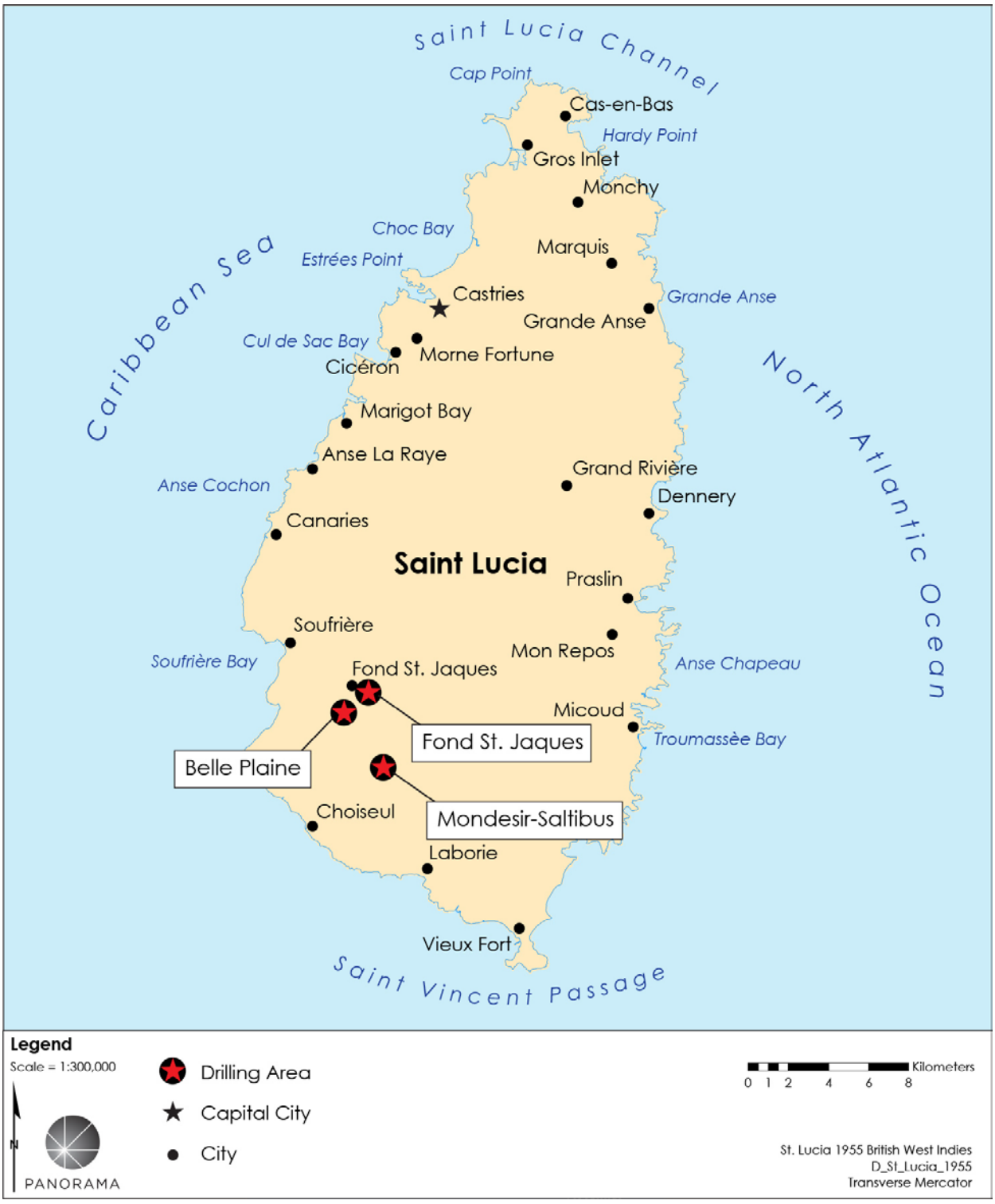
- Civil works and site development at three potential drilling areas
- Drilling up to four slim-holes and up to two full-size wells
- Well testing
- Well abandonment and site reclamation

## ES. 2 ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

Panorama Environmental, Inc. has completed a Scoping Studies Report to define the baseline environmental and socio-economic conditions in the potential drilling areas. The drilling sites are characterized as non-native habitats and agricultural land use. There is limited flat land available for drilling in the Fond St. Jacques area and two of the Mondesir-Saltibus sites (MS-3 and MS-4). Residential communities are also located in close proximity to the drilling areas in Fond St. Jacques and MS-3 and MS-4 making these areas only suitable for slimhole wells rather than full-size geothermal exploration wells.

The Belle Plaine and Mondesir-Saltibus drilling sites are currently used for agricultural development. The Belle Plaine and Fond St. Jacques areas are primary owned by families. The Mondesir-Saltibus area is primarily government owned land that is leased to farmers.

## Figure ES.1-1 Project Location




*Sources: (ESRI 2017, Jan Kindsay 2002)*

## ES. 3 KEY FINDINGS OF STAKEHOLDER ENGAGEMNT

During the ESIA scoping process, Panorama Environmental, Inc and the Department of Sustainable Development held consultation meetings with governmental agencies and local stakeholder representatives. Ministers provided comments that generally reflected issues related to previous geothermal exploration in Saint Lucia. Physical Planning agency expressed concerns about the topics covered in the ESIA. Tourism and Broadcasting agency expressed concerns about the potential impacts of drilling activities have on local tourism businesses. Local stakeholder representatives' comments generally reflect environmental issues related to geothermal development, and recommended developing education programs for local residents.

## ES. 4 KEY MITIGATION MEASURES

The ESIA has identified mitigation measures to reduce and avoid impacts associated with the project. A summary of the ESIA mitigation measures is listed in  This ESMP defines:

- Procedures for implementation of the mitigation measures in the ESIA
- Roles and responsibilities for mitigation implementation and reporting
- Costs for mitigation
- Institutional structure for oversight and management of the mitigation
- Capacity building requirements

## ES. 5 ESMP ORGANIZATION

This ESMP is organized as follows:

- **Chapter 1: Introduction**. Provides an overview of the ESMP, background, and the proposed project
- **Chapter 2: Mitigation Management and Monitoring Plan**. Includes the detailed mitigation measures, roles and responsibilities for implementing the measures, and reporting procedures.
- **Chapter 3: Roles and Responsibilities**. Outlines the roles and responsibilities of parties involved with direct implementation of mitigation measures or implementation oversight.
- **Chapter 4: Implementation and Verification Procedures**. Defines implementation phases and describes documentation procedures for implementing mitigation measures.
- **Chapter 5: Institutional Structure and Capacity Building**. Defines the institutional structure and capacity for the PCU and key actions for capacity building.

### Table ES.4-1 Summary of Mitigation Measures

**Error! Reference source not found.**. This ESMP defines:

- Procedures for implementation of the mitigation measures in the ESIA
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- **Chapter 5: Institutional Structure and Capacity Building**. Defines the institutional structure and capacity for the PCU and key actions for capacity building.

## Table ES.4-1 Summary of Mitigation Measures

| Resource | Mitigation Measures |
|---|---|
| Water Resources | Water-1: Stormwater, Erosion, and Sediment Control<br>Water-2: Water Quality Monitoring Program<br>Water-3: Drilling Waste and Effluent Management<br>Water-4: Blowout Prevention<br>Water-5: Water Supply System Protection<br>Water-6: Water Extraction Strategy |
| Air Quality | Air-1: Fugitive Dust Management<br>Air-2: Construction Emissions Controls<br>Air-3: Air Quality Monitoring and Noxious Gas Management |
| Geology and Soils | Soils-1: Topsoil Preservation and Restoration<br>Soils-2: Geotechnical Investigation |
| Noise | Noise-1: Noise Abatement and Community Coordination |
| Natural Habitats and Biodiversity | Biodiversity-1: Pre-Construction Surveys is MS-3 and MS-4<br>Biodiversity-2: Invasive Weed Control<br>Biodiversity-3: Nesting Bird Avoidance and Impact Minimization |
| Archaeological and Cultural Resources | Cultural-1: Archaeological Testing or Monitoring<br>Cultural 2: Pre-Construction Surveys in MS-3 and MS-4<br>Cultural 3: Worker Cultural Resources Sensitivity Training |
| Landscape and Visual Character | Landscape-1: Site Reclamation and Restoration |
| Traffic Circulation and Safety | Traffic-1: Traffic Control<br>Traffic-2: Road Hazard Avoidance |
| Utilities and Communication Systems | Utilities-1: Protect Overhead Utility Lines |
| Hazards and Hazardous Materials | Hazards-1: Hazardous Materials Management Plan |
| Fires | Fires-1: Fire Prevention and Response |
| Solid Waste | Waste-1: Waste Management Plan |
| Livelihoods | Social-1: Compensation for Loss of Agricultural Production |
| Working Conditions and Equality | Social-2: Working Conditions and Equality<br>Social-3: Community Engagement and Sensitivity |
| Recreation | Social-4: Recreation |
| Worker Health and Safety | Safety-1: Health and Safety Plan<br>Safety-2: Personal Protection Equipment<br>Safety-3: First Aid and Emergency Response Equipment |
| Community Health and Safety | Safety-4: Community Safety |

# 1 INTRODUCTION

## 1.1 PURPOSE

The Government of Saint Lucia (GoSL) proposes to conduct the Saint Lucia Geothermal Resource Exploration Project (project) within the Soufrière, Choiseul, and Laborie regions of Saint Lucia to assess the feasibility of commercial development of geothermal resources in Saint Lucia. This purpose of this Environmental and Social Management Plan (ESMP) is to detail:

1. The measures to be taken during the implementation and closure of the project to eliminate or offset adverse environmental and social impacts, or to reduce them to acceptable levels
2. The actions needed to implement these measures during the construction, operation and closure of the proposed project.

This ESMP has been prepared consistent with World Bank guidance specified in the draft *World Bank Environmental and Social Framework* (World Bank 2017).

## 1.2 BACKGROUND

The GoSL has obtained financial assistance and technical support from a number of development partners in support of the project. To date, the World Bank has assisted Saint Lucia in accessing grant financing from the Global Environmental Facility and the SIDS DOCK Support Program for the project. Technical assistance has also been received from the Government of New Zealand and the Clinton Climate Initiative. This ESMP has been prepared to address World Bank requirements for mitigation implementation including monitoring and reporting during implementation of the project.

## 1.3 ESMP CONTENTS

The ESMP includes the following:

- Mitigation measures from the ESIA
- Roles and responsibilities for implementation of the mitigation measures by the GoSL, civil works contractor, and drilling contractor
- Procedures for implementing mitigation measures, including the required timing of mitigation implementation
- Procedures for routinely verifying, documenting, and reporting implementation of the ESMP
- Capacity building requirements
- Costs for implementing mitigation measures and the ESMP

## 1.4 PROJECT SUMMARY

### 1.4.1 Project Location

The project is located in the Soufrière, Choiseul, and Laborie districts of Saint Lucia. The project includes geothermal exploration drilling on well pads in the following areas shown on **Error! Reference source not found.**:

- Belle Plaine
- Mondesir-Saltibus (MS-1, MS-2, MS-3, and MS-4)
- Fond St. Jacques (east and west)

### 1.4.2 Project Activities

The proposed project includes drilling slim-hole wells and potentially full-size geothermal exploration wells to evaluate the feasibility of commercial geothermal development in Saint Lucia. Slim-hole wells would be drilled first. Slim-hole wells (3.78-inch bottom hole diameter) typically require less capital investment and cause less environmental and social impact than deep full-sized wells because they are drilled with smaller drill rigs on smaller well pads, drilling takes less time, and less fluid is produced. An exploratory drilling program using slim-hole wells is a cost-effective method for geothermal exploration.

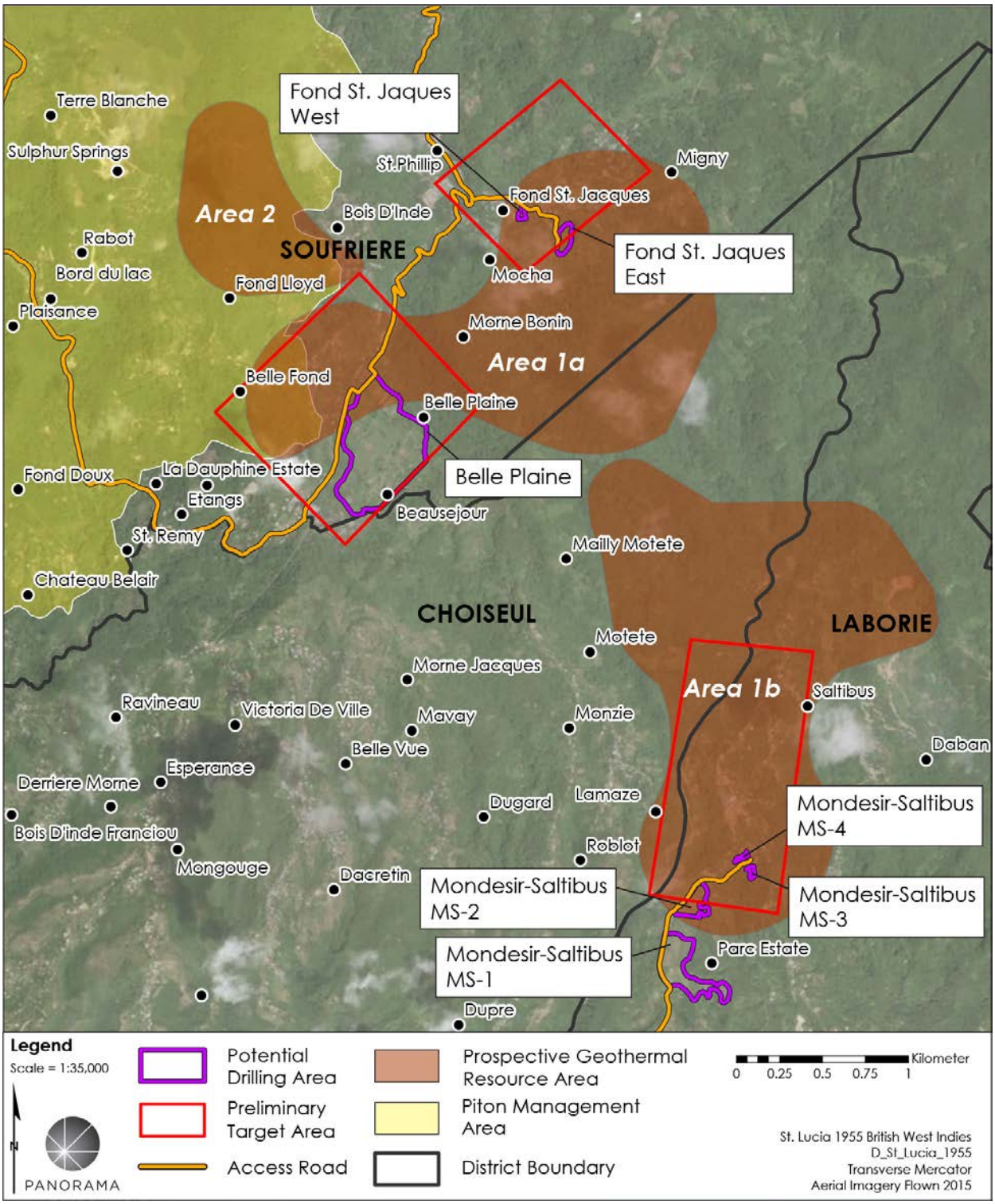
Full-sized (7-inch+ bottom hole diameter) geothermal exploration wells may be drilled in Belle Plaine or Mondesir-Saltibus (MS-1 or MS-2) if the slim-hole drilling results suggest the presence of a commercial geothermal resource.

The project address the possibility of drilling full-sized wells in addition to slim-hole wells to provide a range of options for the exploratory drilling program. The feasibility of drilling full-sized wells would depend on the results of slim-hole drilling, access to funds, access to sufficient workspace, and the presence or absence of environmental resources and receptors that may be impacted.

The project would include the following activities and components:

- Civil works and site development at three potential drilling areas
- Drilling up to four slim-holes and up to two full-size wells
- Well testing
- Well abandonment and site reclamation

## Figure 1.4-1 Potential Drilling Areas




*Sources: (Jacobs New Zealand Limited 2016, GeothermEx and Power Engineers 2017)*

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# 2 MITIGATION MANAGEMENT AND MONITORING PLAN

## 2.1 OVERVIEW

The purpose of the Mitigation Management and Monitoring Plan is to identify mitigation measures to reduce impacts from the project, describe the roles of participating parties and key personnel responsible for implementation the mitigation measures, and identify procedures to ensure that the mitigation measures are implemented adequately during all phases of construction.

Mitigation measures for the project are identified in **Error! Reference source not found.**. Parties responsible for implementing or overseeing implementation of mitigation measures, as well as their roles and responsibilities, are described in Section 3. Implementation and verification procedures are described in Section 4.

## 2.2 MITIGATION MEASURES

### 2.2.1 Detailed Mitigation Measures with Responsibilities

Table 2.2-1 lists the detailed mitigation measures, the impact that the mitigation measure is addressing, the party that is responsible for implementing the measures, and the timing of implementation. These parties include the civil contractor, drilling contractor, GoSL, and GCC.

## Table 2.2-1 Detailed Mitigation Measures with Responsibilities

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| **Environmental Mitigation Measures - Water Resources** | | | |
| • Water Quality<br>• Erosion and Topsoil Loss<br>• Landslides and Mudflows | **Water-1: Stormwater, Erosion, and Sediment Control**<br>Stormwater runoff and drainage shall be properly managed at all work areas using best management practices (BMPs) (e.g., procedural actions and/or material installations). BMPs and drainage systems shall be designed to accommodate rapid rainfall events that can be expected in the region.<br>The following procedures shall be implemented to prevent soil loss, erosion, and sediment transport in project areas:<br>• Project activities shall be scheduled to avoid the heaviest rain season, to the extent possible.<br>• Soil disturbance shall be limited to the minimum amount necessary.<br>• All disturbed areas shall be stabilized as soon as possible (i.e., covered, compacted, or secured with BMP materials).<br>• Project traffic shall be restricted to designated areas.<br>• Pipelines shall be monitored for leaks and any leaks shall be repaired immediately.<br>• Sediment shall be controlled and prevented from leaving disturbed project areas.<br>All BMPs shall be properly inspected and maintained on a frequent basis to ensure they are functioning properly. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| • Water Quality | **Water-2: Water Quality Monitoring Program**<br>The drilling contractor shall implement a water quality monitoring program to ensure the project does not cause or substantially contribute to a condition that exceeds acceptable water quality standards. Water quality sampling shall occur prior to the start of project activities to determine the baseline contaminant levels, and then every few weeks during project activities in the area, in order to determine if the project is reducing water quality. Samples shall be taken upstream and downstream in potentially affected waterways. If it is determined that the project is reducing water quality, the drilling contractor shall make the appropriate adjustments to the construction activities to correct the problem. If the water supply becomes unsafe to drink, safe water shall be supplied to the affected communities and workers. Water Quality monitoring and any necessary supplemental water supply shall continue until the water conditions are safe and | • Drilling Contractor | • Before Construction<br>• During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | returned to pre-project conditions. A Draft Water Quality Monitoring Program is provided in Appendix F of the Scoping Studies Report.<br>In the unlikely event that water quality is impacted for a long-term basis (longer than project activities are occurring), long-term water treatment and/or supply systems shall be installed that provide safe water to those affected at pre-project constituent and flow levels, while also considering seasonal fluctuations. | | |
| • Water Quality<br>• Hazardous Materials | **Water-3: Drilling Waste and Effluent Management**<br>The drilling contractor shall incorporate specific procedures for managing drilling waste and effluent into the Hazardous Materials Management Plan and the Waste Management Plan.<br>All drilling muds, fluids, and cuttings shall be tested for water quality parameters before discharging such fluids into the environment or disposing the materials into landfills, to ensure contaminant levels in waste water do not exceed acceptable standards and are disposed of properly in accordance with the Waste Management Plan. Water quality parameters that may be sampled include: pH, Temperature, Boron, Bicarbonate, Calcium, Chloride, Sulfide, Iron*, Fluoride, Copper, Cadmium, Mercury, Lead, Chromium (hexavalent* and total), Nickel, Arsenic, Vanadium, and Silver. Geothermal fluid shall also be tested for the following radiological elements: Radium 226/228 (combined), gross alpha (adjusted), and uranium. Fluid that exceeds acceptable standards shall be contained and/or disposed of in accordance with applicable laws and policies. Note: Elements marked with an asterisk (*) require testing within 24 hours due to short hold times. If it is not feasible to transport the samples to a certified lab within the specified hold times, testing shall be conducted on site.<br>Reserve pits for drilling materials shall be maintained in proper functioning order with a minimum of 0.5 meter (1.6 feet) of freeboard at all times. If foams are applied to the drilling fluid, the drilling contractor shall cover any reserve pits containing drilling cuttings or line the downwind perimeter of the reserve pits with hay bales or equivalent to prevent the foam from being transported offsite via wind. Drilling fluids, mud, and spoils shall be stored in either storage tanks or reserve pits adjacent to the wells. Drilling fluids shall be reused to the extent feasible to conserve freshwater. | • Drilling Contractor | • During Construction |
| • Water Quality<br>• Geothermal Emissions | **Water-4: Blowout Prevention** | • GoSL<br>• Drilling Contractor | • During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| • Hazards | All drill rigs used during the exploration program shall be equipped with blowout prevention (BOP) equipment to prevent blowout if the geothermal resource is encountered.<br>The GoSL shall require that the drilling contractor or the drilling supervisor have experience in geothermal drilling. Drillers shall receive proper training for response to blowouts, should one occur.<br>The drilling contractor shall prepare and implement a Well Blowout Prevention and Containment Plan. At a minimum, the plan shall address the following:<br>• Proper use of BOP equipment that meets industry standards<br>• Specific procedures for preventing and controlling an incidental blowout, such as using a blowout preventer stack and stocking material for quelling the blowout<br>• Training requirements for all workers that may be exposed to a well blowout<br>• Staffing requirements to ensure qualified individual(s) who are certified in well control and blowout response are present during all drilling operations<br>• Blowout documentation and cleanup procedures | | |
| • Water Supply | **Water-5: Water Supply System Protection**<br>Public and private water supply systems (i.e., pipes, intakes, tanks, and ditches) shall be identified and marked for avoidance prior to initiating project activities that could damage such systems. If water supply systems are inadvertently damaged, they shall be repaired immediately. Water shall be supplied to the affected community members if the water supply is interrupted.<br>The GoSL will consider the community benefit of leaving water supply systems that are developed for the project (i.e., pipes, intakes, tanks, and wells) after exploration drilling is complete. | • GoSL<br>• Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction<br>• After Construction |
| • Water Supply | **Water-6: Water Extraction Strategy**<br>The drilling contractor, in conjunction with the GoSL, shall develop a strategy for obtaining water that does not disrupt the water supply for domestic and agricultural users. Water extraction for the project, including the locations of water pipelines and tanks, shall not deplete water reserves below levels that are required to supply the community. The PCU and drilling contractor shall consult with Water and Sewerage Company of Saint Lucia (WASCO) and Water Resource Management Agency (WRMA) of St. Lucia to ensure communities are supplied with adequate water during extraction. | • GoSL<br>• Drilling Contractor | • Before Construction<br>• During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | Where water is extracted from rivers, the project intake systems shall be designed to limit impacts on sensitive aquatic habitat and wildlife, and screen barriers shall be installed to prevent impingement and entrapment of wildlife. Intake areas and potential hazards where pipelines cross roadways shall be clearly marked with signs and/or flagging. | | |
| **Environmental Mitigation Measures - Air Quality** | | | |
| • Air Quality | **Air-1: Fugitive Dust Management**<br>The following procedures shall be implemented where dry exposed soils are located in project areas:<br>• Water shall be applied to active construction areas to prevent visible dust, to the extent that water is readily available. Water shall not be over applied so that it creates runoff that leaves the site. As an alternative to water, chemical stabilizers or surfactants may be applied to disturbed areas, being careful to not allow overspray on nearby vegetation.<br>• Vehicle speeds shall not exceed 25 kilometers (15 miles) per hour on unpaved surfaces.<br>• Inactive areas shall be covered or otherwise stabilized to reduce the potential for wind transporting dust.<br>Disturbed areas shall be stabilized and restored once project activities are completed. | • Civil Works Contractor<br>• Drilling Contractor | • During Construction |
| • Air Quality | **Air-2: Construction Emissions Controls**<br>The construction contractors shall be responsible for ensuring all vehicles and equipment are properly operated and maintained according the manufacturer's specifications, and equipped with appropriate emission control devices (i.e., catalytic converters, etc.). Malfunctioning equipment shall be repaired immediately or removed from the site. | • Civil Works Contractor<br>• Drilling Contractor | • During Construction |
| • Worker Health and Safety<br>• Community Health and Safety | **Air-3: Air Quality Monitoring and Noxious Gas Management**<br>The drilling contractor shall be responsible for managing risks to workers and local communities from potentially harmful geothermal gas emissions (e.g., hydrogen sulphide, carbon dioxide, boron, arsenic, mercury, and bicarbonate) during well drilling and testing. At a minimum, the following procedures shall be implemented during drilling and testing activities: | • Drilling Contractor | • During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | • Well drilling or testing that could cause the release of potentially harmful geothermal gases shall not occur where the public could be put at undue risk. An appropriate geothermal gas hazard zone shall be established around well sites based on the risk of gas release from the drilling and testing activities that would occur. The hazard zone shall be marked with signs and communicated to the local community members. If occupied structures would be located within a hazard zone, the drilling site must be relocated or drilling activities shall be limited to techniques that would not release unsafe levels of geothermal gases, such as surface coring.<br>• Minimize the potential for gas release by using properly weighted drilling mud to keep the well from flowing or by implementing other well head abatement measures.<br>• Install gas detection and monitoring devices during well drilling and testing activities, that are equipped with alarms that would be trigged if gas concentrations reach unsafe levels.<br>• Autonomous respiratory equipment shall be provided in enclosed areas of the drill rig.<br>• The Health and Safety Plan shall specify safety procedures for potential exposure to geothermal gases and emergency response.<br>The drilling contractor shall implement an air quality monitoring program to monitor air quality during well drilling and testing for signs of unsafe levels of potentially harmful geothermal gases using automated detection and alarm systems. If unsafe gas levels are detected, the area shall be evacuated and properly trained workers wearing appropriate PPE shall attempt to stop the release by injecting hydrogen peroxide, capping the well, or another suitable method. | | |
| **Environmental Mitigation Measures - Geology and Soils** | | | |
| • Topsoil Loss | **Soils-1: Topsoil Preservation and Restoration**<br>Where grading occurs within farmland, topsoil shall be separated and stockpiled during the construction period. The topsoil stockpile shall be secured with plastic and BMP materials. Following construction, the topsoil shall be applied evenly to the site during the restoration process. The topsoil shall be properly compacted and stabilized to prevent erosion and sediment transport. | • Civil Works Contractor | • Before Construction<br>• During Construction |
| • Unstable Slopes and Saturated Soils | **Soils-2: Geotechnical Investigation**<br>The civil works contractor shall complete a geotechnical investigation prior to initiating civil works activities for access road expansion or well pad construction in | • Civil Works Contractor | • Before Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | Fond St. Jacques. The contractor shall implement all recommendations contained in the geotechnical investigation. | | • During Construction |
| **Environmental Mitigation Measures - Noise** | | | |
| • Noise | **Noise-1: Noise Abatement and Community Coordination**<br>Construction noise and the associated effects shall be reduced or minimized, to the extent possible, by implementing the following procedures:<br>• Select quieter equipment and construction activities, whenever feasible;<br>• Ensure motorized vehicles and equipment are equipped with the greatest possible noise reduction parts, such as mufflers, silencers, insulators, and enclosures;<br>• Locate access roads and well pads as far from sensitive receptors as feasible;<br>• Limit civil work activities to daytime hours (7:00 to 18:00), to the extent feasible;<br>• Avoid civil works during sensitive morning, evening, and nighttime periods, to the extent feasible;<br>• Notify and coordinate with residents adjacent to project areas prior to construction to inform them of the possibility of temporary noise disruption, and how to report noise complaints;<br>• Install acoustic barriers between stationary equipment and sensitive receptors located within 300 meters (1,000 feet);<br>• Use a rock muffler or other effective, industry standard silencer during well testing;<br>• Notify community members at least 24 hours prior to conducting well tests; and<br>• Implement a Noise Complaint Program to record and respond to noise complaints during construction. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| **Environmental Mitigation Measures - Natural Habitats and Biodiversity** | | | |
| • Biodiversity | **Biodiversity-1: Pre-Construction Surveys in MS-3 and MS-4**<br>The GoSL shall conduct surveys for rare plants and priority or endemic wildlife species prior to civil work activities in MS-3 and MS-4. If any rare plants or sensitive wildlife species occur in the drilling area, the sensitive resource shall be fenced, and no activities will be allowed within 15 meters (50 feet) of the resource. | • GoSL | • Before Construction |
| • Natural Habitats | **Biodiversity-2: Invasive Weed Control** | • Civil Works Contractor | • During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | All equipment shall arrive at the work site clean and free of caked mud and plant material. | • Drilling Contractor | |
| • Nesting Birds | **Biodiversity-3: Nesting Bird Avoidance and Impact Minimization**<br>Well drilling activities shall be scheduled outside of the prime bird nesting season (April to June) to the extent feasible. If well drilling occurs during the prime nesting bird season, well pads shall be positioned at least 75 meters (250 feet) from the forested areas where suitable nesting habitat for priority bird species may be located.<br>Prior to well drilling during the nesting season, a qualified biologist shall survey potentially suitable nesting habitat for priority species birds. If active nests are identified, a qualified biologist shall monitor the nesting birds' responses to the loudest level of construction noise for an appropriate duration. If the nesting birds show signs of disturbance that could result in nest failure, all work activities that disturb the birds shall be temporarily halted and visual and acoustic barriers shall be erected between the nesting location and work areas. Installation of any visual and acoustic barriers shall be overseen and approved by the qualified biologist. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction |
| **Environmental Mitigation Measures - Archaeological and Cultural Resources** | | | |
| • Archeological and Cultural Resources | **Cultural-1: Archaeological Testing or Monitoring**<br>The contractor shall either conduct subsurface archaeological testing prior to grading and earthwork. If the results of the subsurface testing indicate the presence of subsurface archaeological resources, archaeological monitoring shall be conducted during grading and earthwork in the drilling area.<br>*Archaeological Testing*. Prior to ground disturbing activities in Belle Plaine and Mondesir-Saltibus, a qualified archeologist shall conduct subsurface archaeological testing, site recording, and artifact recovery in previously undisturbed areas that would be significant impacted by project activities (e.g., grading deeper than 6 inches and drilling). The testing shall include a series of 50 cm shovel test pits at 10-meter (30-foot) intervals within the immediate areas that would be affected.<br>*Archaeological Monitoring.* During grading activities in Belle Plaine and Mondesir-Saltibus that are greater than 6 inches in depth, a qualified archeological monitor shall be present. The archeological monitor shall observe grading activities and collect any artifacts that may be unsurfaced. If the archeological monitor determines that a sensitive archeological site may be present, work shall be redirected until the site can be evaluated for its significance. | • Civil Works Contractor | • Before Construction<br>• During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | If the site is determined to be significant or if the site evaluation efforts would be extensive, project areas that pose a risk to the site may be relocated away from the site to avoid potential delays to project activities. Alternatively, special protection measures may be implemented to continue project activities while preserving possible site features, as determined appropriate by the archeological monitor. | | |
| • Archeological and Cultural Resources | **Cultural-2: Pre-Construction Surveys in MS-3 and MS-4**<br>The GoSL shall conduct surveys for archeological and cultural resources prior to civil work activities in MS-3 and MS-4. If any sensitive resources are identified, the resources shall be evaluated to determine appropriate treatment or avoidance procedures. If the sites contain resources or if inadvertent discoveries are made during construction, the testing and monitoring provisions detailed in Cultural-1 shall be implemented, as determined necessary by the archeologist and GoSL. | • GoSL | • Before Construction |
| • Archeological and Cultural Resources | **Cultural-3: Worker Cultural Resource Sensitivity Training**<br>Workers shall be properly trained on identifying potential archeological and cultural resources that could be uncovered during construction, including procedures for reporting potential discoveries to the archeological monitor. If potential resources are discovered, they must be left in place or turned over to the archeological monitor for proper record keeping and cataloging. | • GoSL | • Before Construction<br>• During Construction |
| **Environmental Mitigation Measures - Landscape and Visual Character** | | | |
| • Landscape and Visual Character<br>• Waste | **Landscape-1: Site Reclamation and Restoration**<br>The following reclamation and restoration activities shall be completed following construction:<br>• Prior to construction the contractor shall take photos of the well pad and access roads to document pre-construction conditions<br>• The contractor shall restore grades on site to match pre-construction conditions<br>• The proper restoration of the site shall be documented by the contractor in a post-construction report containing pre- and post-construction photos<br>• The drilling mud treatment facilities and water intake and/or drilling fluid disposal pipes shall be dismantled upon completion of the exploration phase and removed from the project site.<br>• Where applicable, the temporary treatment facilities and pipes for disposal of geothermal fluids produced during the well tests shall be dismantled after | • Drilling Contractor | • After Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | completion of the tests and the temporary treatment facilities and pipes shall be removed from the project site.<br>• The drilling fluid and mud reserve pits, and any water supply sumps shall be filled in, and graded to match the surrounding area.<br>• The worker camp and storage area, including all aggregate and materials and any latrines, shall be dismantled and removed from the site. The worker camp and storage area shall be resurfaced as necessary to match the surrounding area.<br>• Heavily compacted areas should be appropriately de-compacted to facility quicker vegetation regrowth. | | |
| **Environmental Mitigation Measures - Traffic Circulation and Safety** | | | |
| • Traffic Circulation<br>• Community Health and Safety | **Traffic-1: Traffic Control**<br>Informational signs shall be posted where lane and road closures could substantially disrupt traffic circulation at least 7 days prior to the closure. Proper traffic controls shall be in place during closures to minimize impacts on traffic circulation and for traffic safety, such as signs, flaggers, and temporary barriers.<br>Local traffic laws and speed limits shall be followed at all times. Appropriate safety precautions shall be taken when transporting large equipment on public roadways, such as using a pilot car. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| • Community Health and Safety | **Traffic-2: Road Hazard Avoidance**<br>If road work occurs on public roadways, the civil works contractor shall design the modifications in accordance with applicable road and traffic safety laws. The project shall not degrade road safety or create a new road hazard. The designs for any road modifications shall be submitted to the GoSL for review and approval prior to conducting the work. | • Civil Works Contractor | • Before Construction<br>• During Construction |
| **Environmental Mitigation Measures - Utilities and Communication Systems** | | | |
| • Utilities and Communication Systems | **Utilities-1: Protect Overhead Utility Lines**<br>The construction contractors shall identify and mark any overhead utility and communication lines that hang over access roads and work areas to ensure the lines are not inadvertently damaged during construction. A minimum of 5 feet of clearance shall be maintained between construction equipment and low-hanging lines. If the minimum clearance cannot be maintained, the | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | construction contractors shall work with the applicable system providers to temporarily disconnect or reposition the lines for the duration of construction. | | |
| **Environmental Mitigation Measures - Hazards and Hazardous Materials** | | | |
| • Water Quality<br>• Hazardous Materials<br>• Worker Health and Safety<br>• Community Health and Safety | **Hazards-1: Hazardous Materials Management Plan**<br>The construction contractors shall prepare and implement a Hazardous Materials Management Plan. The Hazardous Materials Management shall identify proper management procedures for all hazardous materials and wastes that may be encountered during construction, including handling, labeling, transporting, and storing procedures. In addition, the Hazardous Materials Management Plan shall address the following:<br>• Non-toxic and biodegradable produces will be used whenever possible.<br>• Hazardous materials shall be transported and stored in appropriate containers with clearly visible labels. Hazardous materials shall be stored at least 100 feet from any downgradient drainage or within secondary containment cable of containing its entire volume.<br>• Stormwater flows shall be directed away from hazardous material storage areas.<br>• Equipment and work areas shall be regularly inspected for signs of leaks and spills. Spill containment and cleanup kits shall be available wherever hazardous materials are being used or stored. Any incidental spills or leaks shall be contained and cleaned up as soon as it is safe to do so. Any contaminated soil shall be collected and disposed of in an appropriate land fill.<br>• Equipment refueling and maintenance shall be limited to designated areas at least 30 meters (100 feet) from any downgradient drainage.<br>All workers shall receive training on proper handling and storage of hazardous materials, as well as spill response and cleanup procedures, prior to working on the project site. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| **Environmental Mitigation Measures - Fires** | | | |
| • Wildfire Ignition | **Fires-1: Fire Prevention and Response**<br>The risk of fires shall be evaluated for each project site based on the activities that would occur, environmental conditions, and presence of ignitable or combustible materials in the area. If the activities pose a risk of igniting a wildfire, appropriate fire prevention and response equipment shall be available at each active site, | • Civil Works Contractor<br>• Drilling Contractor | • During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | such as shovels, axes, fire extinguishers, and dedicated water tanks. All workers shall be trained on proper fire prevention and response procedures prior to working on the site.<br>Any smoking on site shall be restricted to barren areas away from ignitable or combustible material. Smoking waste shall be fully extinguished and disposed of appropriately. | | |
| **Environmental Mitigation Measures - Solid Waste** | | | |
| • Water Quality<br>• Hazardous Materials<br>• Waste | **Waste-1: Waste Management Plan**<br>The construction contractors shall prepare and implement a Waste Management Plan. At a minimum, the plan shall address the sources of waste; waste minimization, reuse, and recycling opportunities; and waste collection, storage, and disposal procedures. The Waste Management Plan should distinguish between solid and liquid waste, as applicable, and include procedures for addressing waste that may be hazardous to health and the environment. In addition, the Waste Management Plan shall address the following:<br>• All food waste shall be contained in covered bins and disposed of on a frequent basis to avoid attracting wildlife.<br>• Trash bins shall be accessible at all locations where waste is generated.<br>• The project area shall be kept clean and free of litter and no litter shall be allowed to disperse to the surrounding area.<br>• Solid waste shall be removed from the site and transported to a municipal landfill.<br>• Waste shall not be dumped or buried in unauthorized areas or burned.<br>• Human waste associated with the worker camp and latrines shall be properly contained and disposed of.<br>The construction contractors shall ensure all workers receive training on proper disposal of all waste prior to working on the project site. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| **Social Mitigation Measures** | | | |
| • Livelihoods | **Social-1: Agriculture Production**<br>Impacts to active farmland should be avoided to the extent possible. The locations of access roads and well pads should be positioned away from active agricultural areas, as feasible. The limits of all access roads and well pads shall be clearly | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• After Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | identified and marked, if necessary, to ensure impacts from ground disturbance are limited to approved properties and work areas.<br>If active farmland cannot be avoided, crops with long maturing periods (i.e., bananas, coconuts, cocoa, avocados, mangoes, and citrus) should be avoided to the greatest extent possible. Where farmland and crops are impacted by the project, farm owners and farmworkers should be compensated for the loss in pay and agriculture production for affected growing seasons in accordance with the Resettlement Action Plan and Resettlement Policy Framework. Male and female farm owners and farmworkers shall be compensated for impacts to agriculture production equally | | |
| • Working Conditions and Equality | **Social-2: Working Conditions and Equality**<br>Employment opportunities created by the project shall be equally available to men and women. If locals are hired for construction jobs, job postings and/or notices shall be disseminated that foster participation from women and men. The GoSL shall include a preference for hiring from the project region in the civil works contract<br>The construction contractors shall provide safe and equal working conditions and comply with the World Bank's social policies regarding age, gender, ethnicity, and religious equality. Workers shall be provided with:<br>• Information on their rights regarding safety and payment prior to working on the site<br>• Gender-specific latrines at each project area that are maintained in a sanitary condition with adequate capacity<br>• Gender-specific sleeping quarters at the worker camp<br>• Clean drinking water at all times<br>• Adequate training for their position<br>Violence, sexual harassment, discrimination, and drug abuse shall not be tolerated. Workers engaging in such activities shall be dismissed immediately. Any concerns and complaints regarding workplace or community harassment shall be addressed with respect and due diligence by a grievance and redress committee designated by the GoSL; women shall be appointed to the grievance and redress committee. Workers and community members who issue concerns or complaints shall be protected from retaliation. | • Civil Works Contractor<br>• Drilling Contractor | • During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | Prior to working on the project site, all workers shall receive equality and harassment awareness training, for both workplace and community relations, in conjunction with other social trainings for the project. | | |
| • Working Conditions and Equality<br>• Noise<br>• Community Health and Safety | **Social-3: Community Engagement and Sensitivity**<br>**Pre-construction Meeting.** Prior to the start of construction activities, the PCU shall hold a public meeting for the affected communities to explain the project activities, schedule, possible inconveniences that may be experienced during construction, and safety considerations associated with drilling operations (refer to Health and Safety-4). The affected communities shall be informed of how they can submit complaints about the project should they arise.<br>**Informational Signs.** The PCU shall install an informational sign at the entrance of each project area to inform the public about the project, construction schedule, and important information about health and safety related to project activities, such as evacuation areas in the event of an emergency. The sign shall include procedures and contact information for submitting complaints about the project to the community liaison officer (CLO).<br>**Community Complaints.** Complaints that relate to the requirements set forth in the ESIA shall be recorded and addressed as set forth in the Stakeholder Engagement Plan, and the underlying issue shall be corrected, to the extent feasible.<br>**Worker Sensitivity Training.** The PCU shall prepare a social and community sensitivity training that would be provided to all workers. The training shall be designed to inform all workers of the local customs, traditions, and community considerations for each area affected by the project. The construction contractors shall be responsible for providing the social and community sensitivity training to all workers prior to initiating work. | • GoSL<br>• Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| • Recreation | **Social-4: Recreation**<br>Avoid project activities (i.e., drilling, staging, or storing material) in recreational areas such as playing fields where feasible to minimize disruption to the communities in the drilling areas. | • Civil Works Contractor<br>• Drilling Contractor | • During Construction |
| **Health and Safety Mitigation Measures** | | | |
| • Fires<br>• Worker Health and Safety | **Safety-1: Health and Safety Plan**<br>The construction contractors shall prepare and implement a Health and Safety Plan that addresses the applicable risks and prevention procedures applicable to | • Civil Works Contractor | • Before Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| Community Health and Safety | each contractor's work. At a minimum, the Health and Safety Plan shall address hazards that may be encountered during construction, including prevention and response procedures, for the following topics:<br>• General occupational hazards that may be encountered (e.g., moving machinery and motorized equipment, working at heights or in confined spaces, repetitive motions, falling objects, exposure to heat, loud noises, and hazardous materials, protective clothing);<br>• Unique occupational hazards associated with drilling activities (e.g., exposure to potentially harmful geothermal gases, hot geothermal fluids and drilling materials, and hazards associated with a potential well blowout);<br>• Minimum training requirements for operating vehicles, equipment, and machinery, in accordance with applicable laws and industry standards;<br>• Fire prevention and response procedures, including compliance with the with relevant policies in the GoSL's Wildfire Management Plan;<br>• Natural hazards that may be experienced during construction (e.g., hurricanes and tropical storms, landslides, earthquakes, volcanic eruptions, and flooding), including designated response procedures and evacuation areas for each project area that are consistent with the GoSL's natural hazards and emergency response plans;<br>• Biological hazards in the environment (e.g., dangerous or infectious insects, animals, and plants);<br>• Disease risk and prevention (i.e., HIV/AIDs, etc.);<br>• Community safety considerations (e.g., traffic, harmful geothermal gases, and unsafe areas);<br>• Emergency preparedness and response procedures, including the locations of hospitals and medical services in the region in the event of an injury or medical emergency.<br>The construction contractors shall provide all workers with training on the contents of the Health and Safety Plan prior to working on the site. Refresher trainings shall be given on an occasional basis and before beginning work in new project areas. | • Drilling Contractor | • During Construction |
| • Worker Health and Safety | **Safety-2: Personal Protective Equipment**<br>The construction contractors shall supply all workers with personal protective equipment (PPE), and ensure workers use the proper PPE during all work activities. At a minimum, PPE for workers shall include:<br>• Safety headgear | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |

| Issues/Potential Impacts | Mitigation Measure | Responsible for Implementing | Timing of Implementation |
|---|---|---|---|
| | • Steel toed boots<br>• Safety glasses or impact-resistant eye protection<br>• Ear protective devices<br>• Harnesses for workers operating at heights<br>• Respirators<br>• Gloves<br>• High visibility clothing or vests<br>• Other specialized protective equipment for the drilling, welding, etc.<br>All PPE shall be properly fitted for each worker, including body size and gender, and workers shall be trained in the proper use of PPE, prior to working on the project site. | | |
| • Worker Health and Safety | **Safety-3: First Aid and Emergency Response Equipment**<br>The construction contractors shall provide first aid training to all workers prior to working on the project. The construction contractors shall ensure all project sites are equipped with first aid and emergency response equipment.<br>The drilling contractor shall ensure that adequate safety equipment is located at drilling sites and maintained in good working order, such as firefighting equipment, protective suits, respirators, and other breathing apparatuses. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |
| • Community Health and Safety | **Safety-4: Community Safety**<br>Communities that may be exposed to hazards from drilling activities (communities within 500 meters of well pads) shall be informed of the risks and provided information regarding emergency preparedness and response. If and where necessary at drilling areas, alarms shall be installed for major emergencies that could require evacuation, such as a well blowout or geothermal gas emission. Evacuation procedures during an alarm shall be communicated to community members during the Pre-construction Information Meeting and on applicable display panels (refer to Social-3).<br>The construction contractors shall install temporary signs and fences around all unsafe areas to prevent members of the public from entering the areas. If installing fences is not feasible, the area shall be clearly identified as unsafe with signs and flagging. | • Civil Works Contractor<br>• Drilling Contractor | • Before Construction<br>• During Construction |

### 2.2.2 Mitigation Plans

Table 2.2-2 includes a list of the required mitigation plans described in the detailed mitigation measures listed in **Error! Reference source not found.**. The contractor responsible for preparing each plan is specified.

#### Table 2.2-2 Mitigation Plans

| Mitigation Plan | Mitigation Measure | Applicable to Contractor? | |
|---|---|---|---|
| | | Civil | Drilling |
| **EHS Plan** | Safety-1 Health and Safety Plan | Yes | Yes |
| | **Other measures with ESH requirements (to address in EHS Plan)** | | |
| | Water-4; Blowout Prevention | | Yes |
| | Air-3: Air Quality Monitoring and Noxious Gas Management | | Yes |
| | Hazards-1: Hazardous Materials Management Plan | Yes | Yes |
| | Fires-1: Fire Prevention and Response | Yes | Yes |
| | Waste-1: Waste Management Plan | Yes | Yes |
| | Safety-2: Personal Protection Equipment | Yes | Yes |
| | Safety-3: First Aid and Emergency Response Equipment | Yes | Yes |
| | Safety-4: Community Safety | Yes | Yes |
| **Water Quality Monitoring Program** | Water-2: Water Quality Monitoring Program | | Yes |
| **Water Extraction Strategy** | Water 6: Water Extraction Strategy | | Yes |
| **Hazardous Materials Management Plan** | Hazards-1: Hazardous Materials Management Plan | Yes | Yes |
| | Water-3: Drilling Waste and Effluent Management | | |
| **Waste Management Plan** | Waste-1: Waste Management Plan | Yes | Yes |
| | Water-3: Drilling Waste and Effluent Management | | |

### 2.2.3 ESMP Implementation Cost

**Error! Reference source not found.** defines the estimated costs for implementation of the mitigation measures included in this ESMP.

## Table 2.2-3 ESMP Implementation Costs

| Implementation Requirements | Requirements with Direct Costs | Assumptions[1] | GoSL | Civil Works Contractor | Drilling Contractor | Req. Total |
|---|---|---|---|---|---|---|
| **Mitigation Measures** | | | | | | |
| Water-1: Stormwater, Erosion, and Sediment Control | • Implement water quality procedures to prevent soil loss | • Install BMPs at start of civil works<br>• Quarterly maintenance<br>• Weekly inspection | $1,500 | $8,000 | $5,000 | **$14,500** |
| Water-2: Water Quality Monitoring Program | • Water quality testing and analysis before and during construction | • Assume monthly water quality testing and analysis in each area prior to and during drilling | | | $10,000 | **$10,000** |
| Water-3: Drilling Waste and Effluent Management | • Testing of drilling cuttings at each site | • Assumes analysis of up to 6 wells | | | $12,000 | **$12,000** |
| Water-4: Blowout Prevention | • Use blow-out preventers | • Blow-out preventers on each well ($2,000 per well) | | | $12,000 | **$12,000** |
| Water-5: Water Supply System Protection | • Repair water supply systems when damages are made | Not anticipated | | | | **$0** |
| Water-6: Water Extraction Strategy | • Water supply | • 50 units at $500/unit | | | $25,000 | **$25,000** |
| Air-1: Fugitive Dust Management | • Prevent fugitive dust through water application during ground disturbance and stabilizing disturbed areas | • Assume one water truck and locally sourced water would be used by the civil workers contractor for up to 90 days | | $18,000 | | **$18,000** |

[1] Standard procedures and tasks that would be included with contractor construction contracts are identified in project mitigation measures and this table. Costs associated with these tasks are considered to be a standard construction cost and would not require additional funds associated with mitigation implementation.

| Implementation Requirements | Requirements with Direct Costs | Assumptions[1] | GoSL | Civil Works Contractor | Drilling Contractor | Req. Total |
|---|---|---|---|---|---|---|
| Air-2: Construction Emissions Controls | • Maintain and repair equipment according the manufacturer's standard | • N/A – Standard procedure | | | | **$0** |
| Air-3: Air Quality Monitoring and Noxious Gas Management | • Install gas detection and monitoring devices during well drilling and testing activities | • Up to 30 air tubes and air analysis over course of project activities | | | $10,000 | **$10,000** |
| Soil-1: Topsoil Preservation and Restoration | • Plastic sheeting to secure topsoil; reapply topsoil | • Equipment used to reapply topsoil would be available locally | | $500 | | **$500** |
| Soil-2: Geotechnical Investigation | • Conduct geotechnical investigation prior to initiating civil works activities | • Geotechnical engineer | $10,000 | | | **$10,000** |
| Noise-1: Noise Abatement and Community Coordination | • Install acoustic barriers between stationary equipment and sensitive receptors | • Up to 4 noise blankets | | | $1,000 | **$1,000** |
| Biodiversity-1: Pre-Construction Surveys in MS-3 and MS-4 | • Conduct surveys for endemic species | • Cost of study in remaining area | $1,000 | | | **$1,000** |
| Biodiversity-2: Invasive Weed Control | • Clean work vehicles and equipment prior to entering the site | • N/A – Standard procedure | | | | **$0** |
| Biodiversity-3: Nesting Bird Avoidance and Impact Minimization | • Biologist survey and monitoring if necessary<br>• Possible implementation of visual and acoustic barriers | • Cost for survey | $2,000 | | | **$2,000** |
| Cultural-1: Archaeological Testing or Monitoring | • Conduct surveys for archeological and cultural | • Estimate includes testing and site visiting | $5,000 | | | **$5,000** |

| Implementation Requirements | Requirements with Direct Costs | Assumptions[1] | GoSL | Civil Works Contractor | Drilling Contractor | Req. Total |
|---|---|---|---|---|---|---|
| Cultureal-2: Pre-Construction Surveys in MS-3 and MS-4 | resources prior to civil work activities | | | | | |
| Cultural-3: Worker Cultural Resource Sensitivity Training | • Provide archeological and cultural resources training to workers | • N/A- No cost measure | | | | **$0** |
| Landscape-1: Site Reclamation and Restoration | • Dismantle temporary treatment facilities and worker camps | • One week to restore each drilling site | | | $10,000 | **$10,000** |
| Traffic-1: Traffic Control | • Provide information signs where land and road closures could substantially disrupt traffic circulation | • N/A – Standard procedure | | | | **$0** |
| Traffic-2: Road Hazard Avoidance | • No cost associated with the measure | • No cost measure | | | | **$0** |
| Utilities-1: Protect Overhead Utility Lines | • No cost associated with the measure | • No cost measure | | | | **$0** |
| Hazards-1: Hazardous Materials Management Plan | • Use non-toxic and biodegradable drilling mud where feasible | • N/A – Standard procedure | | | | **$0** |
| | • Embank reserve pits if drilling mud contains foams | • N/A – Standard procedure | | | | **$0** |
| | • Install containment berms and redirect stormwater flows around hazardous material storage sites | • N/A – Part of construction | | | | **$0** |
| | • Cap drilling mud determined to be toxic with clean fill materials | • Cost to import fill materials. Assumes 500 cubic meters of fill obtained from local quarry | | | $4,000 | **$4,000** |

| Implementation Requirements | Requirements with Direct Costs | Assumptions[1] | GoSL | Civil Works Contractor | Drilling Contractor | Req. Total |
|---|---|---|---|---|---|---|
| Fires-1: Fire Prevention and Response | • Provide fire prevention and response equipment at each work site, such as shovels, axes, fire extinguishers, and dedicated water tanks | • N/A – Standard procedure | | | | **$0** |
| Waste-1: Waste Management Plan | • Prepare a Waste Management Plan for solid waste; store and dispose of solid waste at an appropriate facility | • Waste disposed weekly at a municipal landfill | | $800 | $1,800 | **$2,600** |
| Social-1: Agriculture Production | • Provide compensation for farmers where farmland and crops are impacted by the project | • The loss of active agricultural production cannot be determined at this time (see RPF) | | | | **$0** |
| Social-2: Working Conditions and Equality | • Provide information to workers regarding their rights on safety and payment; and provide training to workers for their position | • N/A – Standard procedure | | | | **$0** |
| Social-3: Community Engagement and Sensitivity | • Hold public meetings with the affected communities and install an informational sign at the entrance of each project area | • Assume a two-hour public meeting will be held with affected communities before construction occurs | $3,000 | $1,000 | | **$4,000** |
| Social-4: Recreation | • No cost associated with the measure | • No cost measure | | | | **$0** |
| Safety-1: Health and Safety Plan | • Prepare and implement an EHS plan with all required elements | • Drilling contractor plan would include greater hazards, risk management strategies, and emergency response procedures | | $4,000 | $10,000 | **$14,000** |
| Safety-2: Personal Protective Equipment | • Provide personal protective equipment | • N/A – Standard procedure | | | | |

| Implementation Requirements | Requirements with Direct Costs | Assumptions[1] | GoSL | Civil Works Contractor | Drilling Contractor | Req. Total |
|---|---|---|---|---|---|---|
| Safety-3: First Aid and Emergency Response Equipment | • Provide First Aid and safety equipment | • N/A – Standard procedure | | | | **$0** |
| Safety-4: Community Safety | No cost measure | No cost measure | | | | **$0** |
| **Mitigation Measures Subtotal** | | | **$22,500** | **$32,300** | **$100,800** | **$155,600** |
| **Monitoring** | | | | | | |
| On-site Compliance Inspection and Monitoring | • GoSL Monitor – Inspect construction sites (approx. weekly) | • Weekly GoSL inspections during drilling and monthly during civil works<br>• Contractor inspections would be conducted by staff present on the site (no cost) | $25,000 | | | **$25,000** |
| Reporting and Documentation | • Prepare/review Pre- and Post-Construction Audit Reports, Monthly Compliance Reports, and Quarterly Monitoring Reports | • Prepare/review Pre-and Post-Construction Audit Reports, Monthly Compliance Reports, and Biannually Monitoring Reports | $15,000 | | | **$15,000** |
| Grievance and Redress Mechanisms | • Redress grievances from community members, if needed | • N/A – It is assumed that this will be within the duties of GoSL and addressing grievances will not have a direct cost. | | | | **$0** |
| Emergency Response/Cleanup<br>Environmental | • Respond to emergencies and clean up hazardous material spills, if needed | • No spills are anticipated | | | | **$0** |
| **Monitoring Subtotal** | | | **$40,000** | **$0** | **$0** | **$27,000** |
| **Project Total** | | | **$62,500** | **$32,300** | **$100,800** | **$195,600** |

# 3 ROLES AND RESPONSIBILITIES

This section outlines the roles and responsibilities of parties involved with direct implementation of mitigation measures or implementation oversight.

## 3.1 DEPARTMENT OF SUSTAINABLE DEVELOPMENT

The Department of Sustainable Development (DSD) is responsible for managing the overall project. The construction contractors and DSD will employ environmental and health and safety (EHS) professionals to oversee implementation of the ESMP.

### 3.1.1 Expert on Environment Health and Safety

The DSD will oversee the project during all construction phases and ensure that mitigation measures are implemented correctly. The DSD expert on EHS shall be responsible for verifying that the mitigation measures are implemented adequately. The EHS expert shall have relevant experience monitoring construction on projects that have World Bank funding and mitigation compliance components. The qualified candidate should also have experience with environmental compliance on projects involving drilling. The EHS expert shall become familiar with mitigation measure requirements and ESMP procedures for the project. The EHS expert shall serve as the monitor for the DSD and shall be the key contact person regarding compliance with mitigation measures. The EHS expert shall be responsible for:

- Acting as the key point of contact for contractors and oversight agencies regarding compliance with mitigation measures
- Verifying project compliance with mitigation measure requirements through auditing and field inspection
- Providing direction to contractors regarding mitigation measure interpretation and ESMP procedures
- Issuing notices of non-compliance (addressed in Section 4.5.2) to contractors if they do not comply with mitigation measures or environmental laws
- Overseeing any rehabilitation of environmental damage that may occur

### 3.1.2 Community Liaison Officer

The GoSL Community Liaison Officer (CLO) will be responsible for coordinating with the local community and verifying the socio-economic measures in the ESMP are properly implemented. The CLO shall have knowledge of the local community and shall have relevant experience addressing social issues and responding to grievances. The CLO expert shall serve as the point

of contact for the local community and for workers should a social issue arise during project implementation. The CLO shall be responsible for:

- Activating a project phone number and email address for local residents and community members to contact if they have grievances with the project (address in Section 4.7), and acting as the key point of contact to resolve project grievances
- Acting as the point of contact for filing of any worker grievances and responding to worker grievances
- Verifying project implementation of socio-economic mitigation measures

## 3.2 PROJECT STEERING COMMITTEE

The project is subject to oversight from agencies with stake in the project or who are responsible for enforcing environmental laws. The DSD will establish a Project Steering Committee (PSC) that will guide the project implementation. The PSC will be responsible for ensuring the smooth execution of project activities and for the successful accomplishment of project objectives. The PSC will meet monthly to review project implementation and performance. The PSC shall include representative from the following agencies (addressed in the Resettlement Policy Framework):

- Representatives of the Department of Sustainable Development:
  - Chief Technical Officer;
  - Legal Officer;
  - Technical Director – Geothermal Resource Development Project
- Representative of the PCU;
- Representatives of the Department of Physical Planning:
  - The Authorized Officer or his/her representative:
  - Commissioner of Crown lands or his/her representative;
  - Quantity Surveyor;
  - Valuation Surveyor.
- Social Transformation Officers for each of the affected communities;
- Member of a recognized community-based organization
- Representative of the Department of Agriculture, Fisheries, Natural Resources and Cooperatives.

## 3.3 CONTRACTORS

Project contractors are responsible for complying with all mitigation measure requirements and ESMP procedures, and for ensuring that contracts and construction plans for the project meet all design requirements identified in the mitigation measures.

### 3.3.1 Drilling Services Contractor

A drilling services contractor will be contracted to perform the physical drilling and sampling at well sites. The drilling services contractor shall be responsible for implementing applicable mitigation measures identified in Table 2.2-1. The drilling services contractor will be required to retain a qualified EHS Officer and comply with reporting requirements defined in this section.

### 3.3.2 Civil Works Contractor

A civil contractor will be contracted by DSD to prepare roads leading to the site and construct spur roads to the well pads, construct the well pads, construct worker housing, and construct the storage area. The civil contractor shall be responsible for implementing applicable mitigation measure requirements identified in Table 2.2-1. The civil contractor will need to retain a qualified EHS Officer and comply with reporting requirements defined in this section.

### 3.3.3 Construction Contractor EHS Officers

Each construction contractor is responsible for retaining an EHS Officer to oversee compliance with mitigation measures applicable to their scope of work. The construction contractors are responsible for selecting EHS Officers with the necessary skills, experience, and availability to perform their duties adequately. Necessary qualifications include previous experience monitoring the implementation of mitigation measures on a project of similar scope and scale. Experience complying with World Bank environmental requirements is preferred. Construction contractors shall ensure their EHS Officers have completed all necessary EHS training prior to the project. EHS Officers will be responsible for the day-to-day implementation of mitigation measure requirements identified in Table 2.2-1. EHS Officers will be responsible for:

- Acting as the key point of contact for the DSD EHS expert, as well as oversight agencies if applicable, regarding compliance with mitigation measures
- Ensuring that all personnel including subcontractors have received environmental training prior to work on the project site and have been informed of mitigation measures and their associated responsibilities when working
- Ensuring that all personnel comply with mitigation measures
- Inspecting active work sites on a daily basis, and documenting compliance through completion of a daily compliance checklist and photographs (addressed in Section 4.2)
- Preparing required reports and managing compliance documentation during all phases of construction (addressed in Section 4.2)
- Ensuring that compliance documentation is complete and available for PCU or oversight agency auditing
- Managing any rehabilitation of environmental damage that may have occurred

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# 4 IMPLEMENTATION AND VERIFICATION PROCEDURES

## 4.1 IMPLEMENTATION PHASES

Mitigation measure requirements, as well as implementation and verification procedures, are applicable during one or more of three construction phases. Implementation phases include:

- Prior to construction ("Pre-construction")
- During construction, drilling, and well testing ("Construction")
- Following construction ("Post-construction")

Implementation phases for mitigation measure requirements are identified in Table 2.2-1. Implementation phases for ESMP procedure requirements are identified in this section.

## 4.2 AUDITING

### 4.2.1 Pre-Construction Audit Report

The DSD EHS expert and Civil Works EHS Officer shall survey the project site prior to construction to document the condition of all work areas, identify sensitive areas to avoid, and select the location of the worker camp. The PCU EHS expert will prepare a pre-construction audit report that documents the detailed status of each project work area prior to project activities. The pre-construction audit report shall include:

- Description of each project work area that identifies and describes the locations of previously disturbed or undisturbed features
- Areas that should be avoided to the extent feasible (e.g., active farmland)
- Photographs of each work area and important feature from multiple angles if necessary

The pre-construction audit report and photographs will be compared to site conditions following construction and determine the adequacy of restoration.

### 4.2.2 Construction Audit Report

The DSD EHS expert shall visit the site monthly during civil works and weekly (or more frequently if needed) to verify compliance at the site. Oversight agencies may also visit the site on an as needed basis at any time. An audit report documenting compliance with all applicable construction mitigation measures shall be prepared at the completion of each site visit.

### 4.2.3 Post-Construction Audit Report

The DSD EHS expert shall visit the project site following construction to document the condition of all work areas and sensitive areas adjacent to work areas. The status of each location and any issues shall be documented in a post-construction audit report prepared by the DSD EHS expert. Any issues identified with the condition of the work sites shall be addressed by the responsible contractor to the satisfaction of the DSD.

## 4.3 MONITORING FREQUENCY

Contractor EHS Officers would be on site on a daily basis or otherwise defined in the mitigation measures to inspect active work sites and verify compliance with all applicable mitigation measures for the work phase. DSD EHS Offices shall monitor the site on a weekly basis during drilling and a monthly basis during civil works. More frequent monitoring may be conducted if needed to ensure compliance with the mitigation measures and resolution of any issues that are noted.

## 4.4 COMPLIANCE REPORTING

### 4.4.1 Weekly Compliance Checklists

Contractor EHS Officers shall complete a daily compliance checklist each day that work occurs in the field. Photographs will be attached to the checklist to document work activities.

A checklist form may be developed for use on mobile devices (i.e., smart phones and tablets). If so, access to digital copies of the checklists would made available to agencies upon request.

### 4.4.2 Monthly Compliance Reports

Contractor EHS Officers shall prepare and submit a monthly compliance report to GCC and the DSD EHS expert to document construction and compliance activities completed during the month, and to track the resolution of any issues that may have occurred. The reports should include the following information for the period:

- Summary of completed construction activities
- Estimate of remaining construction and schedule
- Summary of compliance activities
- Updated list of all EHS incidents that occurred during the project
- Follow up information from any past issues that are still being resolved
- Photographs of project activities

### 4.4.3 Biannual Compliance Reports

The DSD shall prepare and submit a biannual compliance report to the World Bank to document construction and compliance activities completed during the period, and to track the resolution of any issues that may have occurred. The DSD will use daily compliance checklists and monthly reports prepared by the construction contractors to develop the biannual report.

The DSD EHS expert shall be responsible for reviewing and submitting the biannual reports to applicable oversight agencies. The reports should include the following information for the period:

- Summary of completed construction activities
- Estimate of remaining construction and schedule
- Summary of compliance activities
- Contractor's implementation activities
- DSD's and agency oversight activities (i.e., site visits)
- Updated list of all EHS incidents that occurred during the project, including attached notices of non-compliance that were issued
- Follow up information from any past issues that are still being resolved
- Photographs of project activities

## 4.5 CONTRACTOR TRAINING

### 4.5.1 Environmental Responsibilities

Contractors are required to train workers on the environmental requirements for the project as a whole, as well as how to comply with applicable mitigation measure requirements when completing their work. In addition to general environmental awareness training, specific environmental training requirements are identified in Table 2.2-1.

### 4.5.2 Health, Safety, and Environmental Incidents and Non-Compliance

Contractors are required to ensure their workers are adequately trained prior to beginning work on the project. In addition to applicable worker safety laws, mitigation measures identify specific health and safety requirements that each contractor must comply with. Health and safety training requirements are identified in Table 2.2-1.

## 4.6 INCIDENTS

### 4.6.1 Incident Reports

Contractor EHS Officers are responsible for preparing and submitting incidents reports to the DSD EHS expert within 72 hours from discovery of the incident. EHS Officers shall maintain a complete project record of incidents associated with their contract scope of work. The record shall be regularly updated and included with monthly reports submitted to the DSD.

Examples of EHS incidents include:

- Fires
- Accidents or "near miss" events
- Hazardous material spills that contaminate soil or water resources
- Improvement orders or notices issued by oversight agencies
- Non-compliance with mitigation measures

At a minimum, EHS incident reports should include:

- Dates the incident occurred and was discovered, if different
- Description of the incident
- Mitigation measures or environmental laws that were violated
- Parties present during the event
- Corrective actions taken to remedy the issue and prevent it from recurring
- Any remaining actions that are required to correct the situation, such as rehabilitation

### 4.6.2 Notices of Non-Compliance

If any issues with compliance are discovered by the DSD EHS expert, the observing party shall submit a written notice of non-compliance to the alternate party and contractors that documents the issue and presents preliminary corrective actions, if applicable. Notices of non-compliance shall include the following information:

- Dates the issue occurred and was discovered, if different
- Description of the issue
- Mitigation measures or environmental laws that were violated
- Parties present during the event
- Description of corrective actions taken
- Description of any necessary follow up actions or longer-term rehabilitation requirements if environmental damage occurred

### 4.6.3 Corrective Actions

Contractors are responsible for responding to and addressing notices of non-compliance in a timely manner and to the satisfaction of the DSD EHS expert. Contractors will be responsible for the rehabilitation costs and work effort associated with any environmental damage that may occur due to non-compliance with mitigation measures and environmental laws.

## 4.7 GRIEVANCE AND REDRESS MECHANISM

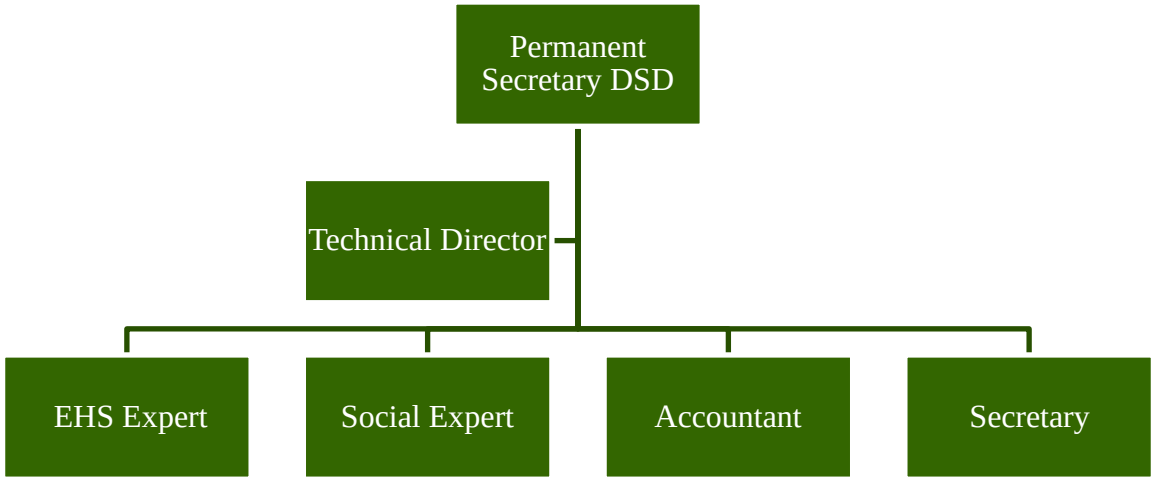
A Grievances Redress Committee (GRC) is addressed in the Stakeholder Engagement Plan to manage concerns and complaints raised by project affected persons (PAPs) within the communities affected by the project. The GoSL will appoint a community liaison officer (CLO) to conduct stakeholder outreach and respond to any grievances or complaints that may arise. The CLO will act as the key point of contact to resolve project grievances from construction workers, local residents, and community members. The CLO will be responsible for addressing project grievances and directing contractors to make any appropriate change to their work. The contractor shall take reasonable action to address grievances as required by local laws. Contractor EHS Officers will also act as points of contact for local residents or workers that express grievances at the project site. If grievances are expressed in the field, the receiving EHS Officer is responsible for notifying the GRC and DSD within 48 hours of receipt.

# 5 INSTITUTIONAL CAPACITY AND CAPACITY BUILDING

## 5.1 INSTITUTIONAL STRUCTURE

This Section outlines the institutional and management arrangements designed to effectively implement the mitigation measures for the project. The geothermal exploration project will be implemented by several contractor teams including the Civil Works contractor and Drilling contractor The management structure for implementation of the ESMP within DSD is illustrated in Figure 5.1-1.

**Figure 5.1-1 Project Management Structure**




## 5.2 INSTITUTIONAL CONSTRAINTS AND CONCERNS

### 5.2.1 Labor Capacity

Institutional constraints were defined through coordination with the DSD and stakeholders. The DSD has not currently staffed/assigned an EHS expert and CLO. This management expertise is critical to successful oversight of this ESMP.

### 5.2.2 Training

In office training is needed prior to well drilling. In the field training is required during implementation of the project. Training requirements include technical training in geothermal exploration for geologists and hydrologists and training for environmental monitoring and mitigation implementation.

### 5.2.3 Equipment

A full list of equipment required for implementation of the project and ESMP mitigation measures will be included in the Request for Proposals for civil works and drilling and testing. The selected contractors will be responsible for providing the necessary equipment to implement the mitigation measures. Equipment required to implement the well drilling and testing are specified in the *Pre-feasibility Study of a Proposed Geothermal Project in Saint Lucia Final Report* (GeothermEx and Power Engineers 2017)

## 5.3 KEY ACTIONS FOR CAPACITY BUILDING

### 5.3.1 Labor

DSD shall hire the necessary EHS experts and CLO. The qualified individuals shall meet the minimum qualifications defined in Section 1. The project will provide a technical knowledge base for geothermal drilling in Saint Lucia. This knowledge base is important for future development efforts in the country.

### 5.3.2 Trainings

The civil works and drilling contractors will prepare and implement worker training programs. The training programs will be specific to the project, incorporating information specific to geothermal exploration and mitigation measures in this ESMP. The mitigation measures in this ESMP require that all staff working on the project site receive health and safety training.

Technical experts at the DSD will receive in the field training by working side-by-side with drilling contractor experts during drilling. In the field training may be organized by topics, which include:

- Geothermal well design
- Geothermal well monitoring (using gages, software for logging the well, taking samples)
- Well testing (surface and belowground well testing instruments, short- and long-term testing, injectivity, interpretation methods)
- Geothermal reservoir modeling and software
- Power plant design

### 5.3.3 Equipment Procurement

Several pieces of equipment would need to be acquired prior to project initiation. In addition to the equipment needed to analyze water and soil samples and log the wells (listed above Section 5.2.3), the following pieces of equipment would be necessary for the project:

- Carbon dioxide and hydrogen sulfide measurement instruments
- Chemical analysis field kit
- Liquid and gas sampling devices
- Flame ionization detector for gas chromatography equipment

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# APPENDIX A

## Civil Works EHS Officer Daily Compliance Checklist

Project Title: _____ Site Location: _____

Construction Stage: _____

Inspection Date: _____ Inspection Time: _____

Inspected by: _____

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
|---|---|---|---|---|
| | | Y | N | |
| **Water Resources** | | | | |
| Water-1: Stormwater, Erosion, and Sediment Control | • Before Construction<br>• During Construction | | | |
| Water-5: Water Supply System Protection | • Before Construction<br>• During Construction<br>• After Construction | | | |
| **Air Quality** | | | | |
| Air-1: Fugitive Dust Management | • During Construction | | | |
| Air-2: Construction Emission Controls | • During Construction | | | |
| **Geology and Soils** | | | | |
| Soils-1: Topsoil Preservation and Restoration | • Before Construction<br>• During Construction | | | |
| Soils-2: Geotechnical Investigation | • Before Construction<br>• During Construction | | | |

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks |
|---|---|---|---|---|
| | | Y | N | (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
| **Noise** | | | | |
| Noise-1: Noise Abatement and Community Coordination | • Before Construction<br>• During Construction | | | |
| **Natural Habitats and Biodiversity** | | | | |
| Biodiversity-2: Invasive Weed Control | • During Construction | | | |
| Biodiversity-3 Nesting Bird Avoidance and Impact Minimization | • Before Construction | | | |
| **Archaeological and Cultural Resources** | | | | |
| Cultural-1: Archaeological Testing or Monitoring | • Before Construction<br>• During Construction | | | |
| **Traffic Circulation and Safety** | | | | |
| Traffic-1: Traffic Control | • Before Construction<br>• During Construction | | | |
| Traffic-2: Road Hazard Avoidance | • Before Construction<br>• During Construction | | | |
| **Utilities and Communication Systems** | | | | |
| Utilities-1: Protect Overhead Utilities Lines | • Before Construction | | | |
| **Hazards and Hazardous Materials** | | | | |
| Hazards-1: Hazardous Materials Management Plan | • Before Construction<br>• During Construction | | | |

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks |
|---|---|---|---|---|
| | | Y | N | (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
| **Fires** | | | | |
| Fires-1: Fire Prevention and Response | • During Construction | | | |
| **Solid Waste** | | | | |
| Waste-1: Waste Management Plan | • Before Construction | | | |
| **Social Mitigation Measures** | | | | |
| Social-1: Agriculture Production | • Before Construction<br>• After Construction | | | |
| Social-2: Working Conditions and Equality | • During Construction | | | |
| Social-3: Community Engagement and Sensitivity | • Before Construction<br>• During Construction | | | |
| Social-4: Recreation | • During Construction | | | |
| **Health and Safety Mitigation Measures** | | | | |
| Safety-1: Health and Safety Plan | • Before Construction<br>• During Construction | | | |
| Safety-2: Personal Protective Equipment | • Before Construction<br>• During Construction | | | |
| Safety-3: First Aid and Emergency Response Equipment | • Before Construction<br>• During Construction | | | |
| Safety-4: Community Safety | • Before Construction<br>• During Construction | | | |

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# APPENDIX B

## Drilling EHS Officer Daily Compliance Checklist

Project Title: _____ Site Location: _____

Construction Stage: _____

Inspection Date: _____ Inspection Time: _____

Inspected by: _____

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
|---|---|---|---|---|
| | | Y | N | |
| **Water Resources** | | | | |
| Water-1: Stormwater, Erosion, and Sediment Control | • Before Construction<br>• During Construction | | | |
| Water-2: Water Quality Monitoring Program | • Before Construction<br>• During Construction | | | |
| Water-3: Drilling Waste and Effluent Management | • During Construction | | | |
| Water-4: Blow Prevention | • During Construction | | | |
| Water-5: Water Supply System Protection | • Before Construction<br>• During Construction<br>• After Construction | | | |
| Water-6: Water Extraction Strategy | • Before Construction<br>• During Construction | | | |
| **Air Quality** | | | | |
| Air-1: Fugitive Dust Management | • During Construction | | | |

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks |
|---|---|---|---|---|
| | | Y | N | (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
| Air-2: Construction Emission Controls | • During Construction | | | |
| Air-3: Air Quality Monitoring and Management | • During Construction | | | |
| **Noise** | | | | |
| Noise-1: Noise Abatement and Community Coordination | • Before Construction<br>• During Construction | | | |
| **Natural Habitats and Biodiversity** | | | | |
| Biodiversity-2: Invasive Weed Control | • During Construction | | | |
| Biodiversity-3 Nesting Bird Avoidance and Impact Minimization | • Before Construction | | | |
| **Landscape and Visual Character** | | | | |
| Landscape-1: Site Reclamation and Restoration | • After Construction | | | |
| **Traffic Circulation and Safety** | | | | |
| Traffic-1: Traffic Control | • Before Construction<br>• During Construction | | | |
| **Utilities and Communication Systems** | | | | |
| Utilities-1: Protect Overhead Utilities Lines | • Before Construction | | | |

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks |
|---|---|---|---|---|
| | | Y | N | (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
| **Hazards and Hazardous Materials** | | | | |
| Hazards-1: Hazardous Materials Management Plan | • Before Construction<br>• During Construction | | | |
| **Fires** | | | | |
| Fires-1: Fire Prevention and Response | • During Construction | | | |
| **Solid Waste** | | | | |
| Waste-1: Waste Management Plan | • Before Construction<br>• During Construction | | | |
| **Social Mitigation Measures** | | | | |
| Social-1: Agriculture Production | • Before Construction<br>• After Construction | | | |
| Social-2: Working Conditions and Equality | • During Construction | | | |
| Social-3: Community Engagement and Sensitivity | • Before Construction<br>• During Construction | | | |
| Social-4: Recreation | • During Construction | | | |
| **Health and Safety Mitigation Measures** | | | | |
| Safety-1: Health and Safety Plan | • Before Construction<br>• During Construction | | | |
| Safety-2: Personal Protective Equipment | • Before Construction<br>• During Construction | | | |

| Mitigation Measures | Implementation Timing | Compliance Status | | Remarks |
|---|---|---|---|---|
| | | Y | N | (good practices, problem observed, possible cause of noncompliance and/or proposed corrective/preventive actions) |
| Safety-3: First Aid and Emergency Response Equipment | • Before Construction<br>• During Construction | | | |
| Safety-4: Community Safety | • Before Construction<br>• During Construction | | | |