

ENVIRONMENTAL AND SOCIAL REVIEW SUMMARY

Country: Dominica

Project Name: Dominica Geothermal Risk Mitigation Project

Project Number: P162149

Environmental Category: A – Full Assessment

Project Description

1. The Government of the Commonwealth of Dominica (GoCD) seeks financing for the Geothermal Risk Mitigation Project in Dominica. The project will be developed by the Dominica Geothermal Development Company Ltd (DGDC), which was legally established by the GoCD in the last quarter of 2016 to develop and operate the Wotten Waven geothermal field. DGDC is founded under the Companies Act (1994) and is a private entity in all respects. As such, it is intended to serve as a special purpose vehicle to eventually attract a private partner for the further development of the geothermal field. DGDC will be responsible for the proposed project investments, including construction, testing, commissioning, operation and ownership of all infrastructure financed under the project. DGDC will sell electricity to the national utility – the Dominica Electricity Services Limited (DOMLEC) – under the regulatory framework established through the Electricity Supply Act 2006. DGDC will operate as a private company under the laws of the Commonwealth of Dominica and meets all the criteria envisaged under Operational Policy 4.03 Performance Standards for Private Sector Activities for application of the Performance Standards.
2. The financing plan for the proposed Project, amounts to US\$51.5 million and includes a combination of concessional financing and grants from development partners as well as equity from the GoCD. The project comprises the construction, completion, testing, commissioning, ownership and operation of geothermal wells, steam gathering and reinjection system, a two-unit geothermal power plant with a gross capacity of 7 MW to feed domestic demand.¹
3. The project will be developed in the existing Wotten Waven-Laudat geothermal field in the Roseau Valley, where the GoCD conducted exploratory works. The geothermal field is located in the southwestern part of Dominica, in the Roseau Valley, about 5 to 6 km east of the capital, Roseau. The valley lies inland from the coast and is mainly covered by forest with rich vegetation. Mountains surround the valley on three sides and the narrow cliffs mark the entrance to the valley. The mountains located farthest to the west belong to the Mornes Trois Pitons National Park (MTPNP), which was established in 1975 under the National Parks and Protected Areas Act. In 1997, MTPNP was declared a UNESCO World Heritage Site. This is a main tourist attraction and is close to the Wotten Waven-Laudat field. Other touristic attractions in or close to the Roseau Valley include: the hot springs at Wotten Waven; the Trafalgar Falls; the Boiling Lake; the Titou Gorge; the Valley of Desolation; and the Freshwater Lake. The assessment of the geothermal resource at Wotten Waven-Laudat was based on the results of geoscientific investigations carried out from 1997-2008 and an exploration drilling program conducted by the Government. Three slim holes were drilled from three separate well pads in 2011 and 2012 (WW-01 located along the Trafalgar-WW link road; and WW-02 and WW-03 located in the Laudat area). In 2013/14, a production well was also drilled (WW-

¹ Thereafter, depending on resource availability, a large geothermal power plant (LGPP) with a capacity of 40-100 MW could be developed for supplying electricity exports to Guadeloupe and/or Martinique through undersea cables.

P1) in the same pad as WW-03 and a re-injection well (WW-R1) was drilled in the south-western boundary of the resource.

4. About 1,800 total people live in the Roseau Valley, of which nearly 1,000 are located in Trafalgar and Shawford, and the remaining in the hamlets of Wotten Waven/Casseau, Copthall, and Laudat. The project is located in close vicinity (less than 200 m in certain cases) to some villages in the Roseau Valley - Laudat (the closest), Trafalgar, Fond Cani, and Wotten Waven (See Figure 1, Annex 1).
5. The climate of Dominica is tropical all year round, with high temperatures, high humidity and heavy rainfall (average annual rainfall can reach 9,000 mm over the most exposed mountains). As Dominica is a volcanic island, there are natural sources of atmospheric emissions, including steam, carbon dioxide, and hydrogen sulphide, via natural geothermal features such as vents and fumaroles. In some areas of the Roseau Valley, the smell of hydrogen sulphide is noticeable².
6. The key components² of the proposed 7 MW power plant include: a) Two-unit power plant comprising 2 x 3.5 MW units, adjacent to existing wells; estimated land requirement for the power plant and steam condensing plant is approximately 13,400 m² (1.34 ha); b) production well WW-P1 (the existing geothermal production well at Laudat, which will be the sole production well for the project); c) reinjection wells: the used geothermal fluid (brine and possibly some steam condensate) produced from the production well will be disposed of into reinjection wells WW-R1 (located in Trafalgar) and WW-01 (located in Wotten Waven) via reinjection pipeline of up to 3.5 km in length. The land required for the well pads and associated equipment is approximately 2,000 m². A corridor of approximately 4 m wide will be required for the pipeline (likely to be limited to a diameter of 12 inches), totaling close to 13,000 m² (1.3 ha); d) steamfield infrastructure, including piping, steam separator, atmospheric flash tank, brine and condensate collection and disposal systems, pressure relief system, storage sump and rock muffler; and e) supporting infrastructure including existing well pads, turbine building, primary and ancillary equipment, cooling system, and water supply. A single Engineer-Procure-Construct (EPC) contract will be used for civil works and the construction of the geothermal power plant and associated steam gathering system.
7. The interface between the geothermal power plant and the national transmission system will be provided by DOMLEC, based on an interconnection agreement to be negotiated with DGDC. It is expected that the output from Laudat hydropower station (right next to the geothermal site) will be taken via underground cable to the geothermal plant, where a switchboard will marshal the 11 kV output from both plants and return the combined power to Laudat substation via double circuit underground cables. These will traverse DOMLEC-owned land. They will be rated for 33 kV, which will allow the option in the future to install a step-up transformer at the geothermal plant and dispatch all or part of the power at the higher, 33 kV, voltage. At Laudat, the output will be connected to the existing overhead line running to New Trafalgar hydro station and from there via Padu hydro plant to Fond Colé.
8. Ancillary facilities and infrastructure include an existing port and existing access roads. All equipment will be transported by sea to the island through Dominica's main port at Woodbridge Bay, about 2 km north of Roseau. The berth at Woodbridge Bay is used by both

² In the existing geothermal field where the project will be built, five wells have already been drilled as part of the exploratory phase: three exploration / production wells (WW-01, WW-02 and WW-03), one production well (WW-P1) and one injection well (WW-R1).

cargo and cruise vessels and was used to transport the equipment during the exploratory phase. The existing road network was used to transport the drilling rig and equipment during the exploratory phase but is currently undergoing repair after the recent storms in 2015, 2016 and 2017. Following the completion of these works, the road will be suitable for the transport of equipment to the project site. At the project site, a paved road runs along the Laudat platform of WW-P1 and WW-03 and enables access to the forest from the village of Laudat, as well as being the access road for two tourist sites (Titou Gorge and walking track to the Boiling Lake). At the injection site (WW-01) near Wotten Waven, an existing road gives access to the site and to several vendors and tourism attractions (hot pools).

9. It is likely that 40 to 50 workers will be required for the power plant construction at the peak of construction and a team of 10 to 15 workers for the pipeline. Approximately 50% of these workers are likely to be sourced from outside of Dominica. Most of employment during construction is likely to be short-term and significant employment opportunities for local communities will likely be limited. The unskilled and semi-skilled workforce is anticipated to generally come from the local area, but accommodation in the form of a worker's camp will be developed on the site to house mainly expatriate and out of town workers for the duration of construction to minimize traffic trips to the site from Roseau. There is the potential for women to be disproportionately affected as many of the construction jobs will be geared towards men. The construction of the power plant is anticipated to last 18 months to two years, and includes standard construction equipment, such as small drilling rigs, excavators, trucks, rollers, compactors, cranes, portable welders and generators, etc. It is not envisaged that a concrete batching plant will be required, as concrete will likely be supplied by local plants. However, it will be a decision for the EPC Contractor. Site preparation will involve levelling for buildings, internal accesses, lay-down spaces, workers' accommodations and management offices. Prior to the commencement of construction, sediment and erosion control measures shall be put in place in accordance with the sediment and erosion control plan and any local regulatory requirements. It is assumed that most workers will be based in the worker's camp located in the same area of the power plant; however, it is possible that some workers will be based in Roseau City as this is the most populated area in Roseau Valley. During operation, a workforce of up to 12 workers is expected.

Key Issues

Environmental and Social Categorization

10. The Project risk category is Category A on the basis of the screening criteria defined under the World Bank's Operational Policy 4.03. The development of geothermal resources for power generation is normally beneficial as it may displace more polluting and harmful fossil-based alternatives for baseload power generation, contributing to protect the environment locally and to reduce global GHG emissions. This is the case of this project. In addition, a small geothermal power plant, as the one to be built under the project has a limited environmental footprint. Nonetheless, the A categorization is recommended based on the locations of the reinjection lines as well as that of the power plant, which are on the periphery of the MTPNP, a UNESCO World Heritage Site. In addition, the Project's direct area of influence could expand to high value biodiversity areas.

Identified Applicable WB Performance Standards

11. The DGDC meets the criteria for a *private entity*, as set out in paragraph 3 of the Operational Policy 4.03 Performance Standards for Private Activities (OP 4.03). Specifically, DGDC: (a) carries out a business purpose, which is that of constructing and operating the geothermal

power plant, and does so on commercial basis; (b) will make profits through the sale of geothermal electricity to DOMLEC and therefore will be financially autonomous; and (c) has an independent Board and a competitively selected Project Manager, which make the company managerially autonomous and not controlled by the GoCD in its day-to-day management. In light of its private entity nature, the Bank has approved that Performance Standards (PSs) be applied to the DGDC.

12. The applicable Performance Standards (PSs) for the project are:

WB PS1: Assessment and Management of Environmental and Social Risks and Impacts

WB PS2: Labor and Working Conditions

WB PS3: Resource Efficiency and Pollution Prevention

WB PS4: Community Health, Safety and Security

WB PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

WB PS7: Indigenous Peoples

WB PS8: Cultural Heritage

13. The Government of the Commonwealth of Dominica will undertake land acquisition through the requirements of OP/BP 4.12 on involuntary resettlement, the details of which are presented in the ISDS and summarized in paragraph 68.
14. WBG Environmental Health & Safety (EHS) Guidelines that are expected to be applicable to this project include: General EHS Guidelines; EHS Guidelines for Geothermal Power Plants; and EHS Guidelines for Electric Power Transmission and Distribution.

Key Information Sources

15. The WB review of the Project's environmental, social, and health and safety impacts and risks was based on the various environmental and social studies data collected for environmental assessments for exploration and drilling phase between 2009 and 2013, including the Regulatory Impact Assessment on the Initial Environment - Environmental Feasibility Study (2009); the Stage 1: Exploration Drilling Process Environmental Impact Assessment (2011); the Stage 2: Preliminary Environmental Impact Assessment of Geothermal Production and Re-Injection Drilling Wells in Dominica Environmental Impact Assessment (2011). An Environmental and Social Impact Assessment (ESIA) for the project was commissioned and included additional baseline surveys of the social, physical and biological environment within the Roseau Valley, all completed between October 2013 and April 2015. A review of these studies has been carried out, and additional baseline surveys were performed as part of the ESIA. The ESIA was originally submitted to the WB for comment in early September 2017. However, a category 5 storm (Hurricane Maria) struck and devastated the island, fundamentally changing the environmental and social baseline. As such, a revision of the ESIA in the 'Post-Maria' scenario was required and was undertaken in March 2018. The DGDC submitted the final version of the ESIA to the Bank in July 2018. The draft document was also disclosed on the DGDC's website in June 2018.³
16. In summary, the key documents reviewed by the Bank team included:
- DGDC's Land Acquisition Review, dated June 2017, prepared by Jacobs New Zealand Limited;

³ <https://www.geodominica.dm/#download>

- DGDC’s draft Environmental and Social Impact Assessment (ESIA), with its technical annexes, dated April 2018 and prepared by Jacobs New Zealand Limited;
 - DGDC’s draft Abbreviated Resettlement Action Plan, dated April 2018, prepared by Jacobs New Zealand Limited;
 - DGDC’s draft Environmental and Social Management Plan (ESMP), dated April 2018, prepared by Jacobs New Zealand Limited;
 - DGDC’s Framework Environmental and Social Management System (ESMS), dated April 2018, prepared by Jacobs New Zealand Limited;
 - DGDC’s Stakeholder Engagement Plan including Community Grievance Mechanism, dated April 2018, prepared by Jacobs New Zealand Limited;
 - DGDC’s Environmental and Social Action Plan (ESAP), dated July 2018, prepared by Jacobs New Zealand Limited;
17. As part of the due diligence process, the Bank’s social and environmental specialists visited the proposed project and probable land acquisition sites in 2016, 2017 and March 2018. Based on this review and due diligence, the project is expected to comply with Bank Performance Standards and relevant WBG Environmental, Health, and Safety Guidelines (EHSGs).

Environmental and Social Mitigation Measures

18. DGDC has commissioned E&S impact assessments, identified E&S impacts and risks and proposed proportional measures to mitigate the negative impacts and risks. The impact assessments, along with the various plans and measures, ensure that the project will comply with: (a) the host country legislation; (b) the applicable WB Performance Standards; and (c) the applicable WBG environmental, health and safety guidelines.

PS1: Assessment and Management of Environmental and Social Risks and Impacts

19. Environmental and Social Assessment and Management System. DGDC commissioned an ESIA consistent with the WB requirements. The ESIA includes adequate criteria to assess the significance of the adverse impacts, including the issues identified in WB Performance Standards 2 through 8; and applicable national laws and regulations. It contains an Environmental and Social Management Plan (ESMP), a Monitoring Plan, a Stakeholder Engagement Plan, a Grievance Redress Mechanism, and an Abbreviated Resettlement Action Plan (RAP). It also includes the Framework Environmental and Social Management System (ESMS) developed for the project. The ESMS includes the proposed environmental and social policy and is consistent with the requirements in WB PS 1. The Company is committed to protect the environment and the health and safety of its workers and those who live in areas where they operate, to conduct their business with respect and care for both the local and global environment and systematically manage to eliminate any injury, occupational illness, unsafe practices and incidents of environmental harm from their activities. To support these broad commitments, the company will implement specific policies and commitments regarding environmental and occupational health and safety, as well as social commitments to support the long-term development of the communities in the area the company serves, thus facilitating the maintenance of the “license to operate”.
20. During construction of the power plant, the principal impacts include increased noise, dust, air emissions and community risks in villages close to the project and project accesses; erosion and sedimentation; increased risks of accidents in access roads; and potential impacts to tourism and habitats in high sensitive areas. For the construction of the

reinjection pipelines, impacts to water quality and ecology are the principal impacts originated from the earthworks and stream crossings required.

21. During operation, the principal impacts originate from increased erosion, runoff, and sedimentation; increased release in H₂S air emissions; workers' health and safety risks; and potential accidental releases, or well blowout.
22. Management Programs. An Environmental and Social Management Plan (ESMP) which sets out the proposed mitigation and monitoring measures to be implemented by DGDC and the EPC Contractor is described in Volume 4 of the ESIA to ensure that environmental and social impacts and risks are managed to an acceptable level in accordance with applicable WB Performance Standards and the applicable WBG environmental, health and safety guidelines. DGDC is the project operator and is ultimately responsible for the management and supervision of all project activities. The ESMP summarizes the DGDC's commitments to address, mitigate and monitor risks and impacts identified as part of the ESIA, through avoidance, minimization and compensation/offset that will be applied to the construction and operation of the power plant and reinjection pipelines and wells. Management of environmental and social risks and impacts during construction will primarily be the responsibility of the EPC Contractor through the EPC contract. DGDC will be responsible for reviewing, approving and supervising implementation of the detailed plans and procedures, consistent with the mitigation and monitoring measures in the ESMP, that will be developed and implemented by the EPC contractor. DGDC will ensure that the construction management plans are in place in advance of the EPC starting construction. As indicated in the ESIA, the Contractor's ESMS will consist of a set of plans and procedures, which include, but are not limited to, Occupational Health and Safety Management, Traffic Management, Subsidence Risk Management, Soil and Erosion Management, Pest and Weed Management, Waste Management, Biodiversity Restoration, Emergency Preparedness and Response Plan, Grievance Mechanism, Stakeholder Engagement Plan, Chance Find Procedure, and Worker's Code of Conduct (with a section on Cultural Heritage). DGDC will review and monitor EPC contractor's performance in accordance with their ESMP and related management plans/procedures to ensure alignment with the overarching project requirements and will report to the Bank every 6 months in the Biannual Environmental and Social Report.
23. The DGDC Project Manager and the EPC Contractor Site Manager will be responsible for ensuring good environmental practice on site during construction. Staff will be trained in environmental management, auditing and monitoring procedures as per the framework that has been outlined in the Framework Environmental and Social Management System.
24. Organizational Capacity and Competency. DGDC will be responsible for the proposed project investments, including construction, testing, commissioning, operation and ownership of all infrastructure financed under the project. It will operate autonomously on a commercial basis, with the day-to-day management entrusted to a management team within the company. The nascent nature of DGDC and the limited geothermal development expertise available in Dominica to undertake the proposed project make it necessary to strengthen the capacity of DGDC. The company has a clear and dedicated mandate to develop the proposed project and its strategy calls for significantly augmenting its capacity through internationally reputable consultancies with extensive experience in designing and overseeing geothermal investments, as well as through local/regional specialists. With support from the Government of New Zealand (GoNZ), DGDC has acquired the services of Jacobs Engineering Group (Jacobs), who will assist the company throughout preparation and implementation of

the project. Jacobs is a global consultancy firm with international experience in geothermal development and familiar with the application of performance standards. The GoNZ is also funding the position of a Project Manager/Chief Operating Officer recruited internationally, who will have in-depth, applied experience related to all aspects of geothermal development, including safeguards compliance. DGDC safeguards team includes a Safeguards Officer, a Community Liaison Officer and a Site and Office Attendant. Throughout project preparation, while supporting ESIA development, Jacobs has provided capacity building on safeguards to DGDC. The GoNZ is closely coordinating its support with the World Bank, to ensure compliance with good industry practices and the requirements under the Performance Standards.

25. Additional support for environmental and social management will be provided by French Development Agency (AFD) which will contract an external expert who will be seconded to the DGDC. This support will include assisting the DGDC to prepare and implement its Environmental and Social Management System (ESMS) as well as training its safeguards team.
26. The Framework Environmental and Social Management System (ESMS) proposed for the project is presented in the Volume 4, Section 3 of the ESIA. It provides the key elements for developing and implementing an overarching ESMS which establishes a methodological approach to managing environmental and social risks and impacts in a structured way, on a continuous basis. DGDC will be responsible for implementing the ESMS and ensuring compliance with national regulatory and Project Sponsor requirements for the life of the project. The ESMS will ensure that there are appropriate environmental and social policies and procedures in place and that these are followed consistently. The ESMS is consistent with the provisions of WB PS 1, thus structured around the proposed DGDC's environmental, social, health and safety policies and including structure procedures for the identification of impacts and risks, management programs, emergency preparedness/response, monitoring/review, stakeholder engagement, communications/grievance, reporting to affected communities.
27. During construction and operation of the project there will be ongoing monitoring of environmental and social aspects, reviews of compliance with the ESMS and an evaluation of the effectiveness of the ESMS. These monitoring events and reviews will provide opportunities to review the environmental and social aspects of the project, determine whether the appropriate controls are working or need to be improved. In addition, they will help to identify any new aspects. All relevant project environmental and social aspects will be captured in the Aspect Registers: an example of this is provided in ESIA Volume 5: Technical Appendices. Any new aspects that are identified can then be assessed and rated in accordance with the risk rating systems described in ESIA Volume 5: Technical Appendices and added to the Aspect Registers.
28. Routine auditing will be carried out, following established procedures, to determine the project's level of compliance with the ESMP, country regulations, WB requirements, and to evaluate the effectiveness of the ESMS. Reviews of the ESMS will be conducted throughout construction and operation of the project and where necessary changes should be made to the documentation to ensure that it remains relevant. These reviews as a minimum should be undertaken every six months during construction and annually for the operation phase.
29. DGDC's structure to implement the ESMS relies on the project manager, environment control

supervisor, HSE manager, operations manager and the community liaison officer. DGDC's human resources (HR) policies and procedures will provide a description of functions/positions and requirements. DGDC shall identify the knowledge and skills necessary for implementation of the ESMS and identify training requirements for its personnel and contractors engaged during the construction and operation of the Project. All persons responsible for undertaking work during the life of the project will be trained on the contents of the ESMS. All training information, records and certificates should be properly documented and filed, as the audits of the ESMS will seek verification that all project personnel have been given the appropriate training.

30. Emergency Preparedness and Response. The Operations Manager has overall responsibility for the construction of the Project and associated infrastructure, and specifically for reviewing and approving the site's Emergency Preparedness and Response Plan. Emergency Response Procedures will form an integral part of the OHS Plans. As part of these, an Emergency Response Plan shall be prepared to address emergencies of all scales.
31. Monitoring and Review. The ESIA includes a set of proposed monitoring to be conducted to ensure control measures are effective and impacts are minimized. In addition, the proposed ESMS includes procedures for monitoring and measuring effectiveness of the management programs, including compliance with legal/contractual and regulatory requirements. Monitoring proposals were developed for both the construction and the operation phase. For example, during construction, to determine the effectiveness of dust mitigation measures used during construction, the EPC Contractor will ensure that ambient air monitoring is undertaken on the site boundary; visual dust inspection of the site on a daily basis during the dry season to gauge the effectiveness of dust mitigation measures will occur at least 400 m from construction works; visual inspections of cleaning truck tires and road watering activities will also be monitored and recorded. The results will be reported monthly and included in publicly available reports. DGDC will monitor the performance of the EPC contractor. Noise monitoring to confirm the actual construction noise levels at representative sensitive receiver locations will be undertaken, for example, adjacent to the power plant site. This monitoring will be carried out at the start of the construction of the project and on a quarterly basis. DGDC will monitor the performance of the EPC contractor.
32. DGDC will develop a MTPNP monitoring program for the five key species considered threatened by IUCN - giant ditch frog, imperial parrot, red-necked parrot, forest thrush, and a species of tree frog (*Eleutherodactylus amplinympha*) - recommended to be at every six months from pre-construction until the completion of one year of construction, and annually thereafter for a minimum of five years of operation. The program should also include the ongoing monitoring in the Laudat and Trafalgar area for any other potential impacts on the Outstanding Universal Value (OUV) of the WHS. The MTPNP monitoring program will be agreed with input from the MTPNP managing authorities (National Parks Unit of the Division of Forestry, Wildlife and National Parks), and implemented prior to construction where appropriate. The monitoring program outlined will enhance understanding of the ecology of the MTPNP and surrounding ensure that if any adverse effects on OUV were to occur, these would be detected in a timely manner and properly mitigated.

From the MTPNP Impact assessment section of Volume 2 of the ESIA the Noise levels at the MTPNP are predicted to be inaudible (less than 20 dB(A)) under all 10 operational scenarios, with one exception, which is 21 dB(A) at the Valley of Desolation, during steam pressure releases. Noise level changes of 3 dB(A) are imperceptible to human receptors and a change

of 1dB(A) is therefore negligible, even for sensitive animals". Steam pressure releases including commissioning and well testing which are of short durations and based on the noise modelling conducted, the project does not anticipate that these species will be unduly impacted by noise during breeding and nesting season in MTPNP. During operation, testing will be carried out during daytime only and screening provided to reduce noise by up to 6dB(A) as (this is described in 8.1.2 of Appendix F of the ESIA); this mitigation will further reduce the noise impact of steam pressure releases at the Valley of Desolation and elsewhere.

33. A Reservoir Monitoring Procedure (RMP) will be developed by DGDC and monitoring undertaken by DGDC staff. The RMP will consider all possible changes that may occur to the deep reservoir and the surface thermal activity. DGDC will ensure that a baseline monitoring program is undertaken at selected natural geothermal features before the power plant is commissioned, to establish the natural seasonal variability of surface spring activity including flowrate, temperature and fluid chemistry. Springs can change over time, so the baseline data is needed for objective assessment, post commissioning.
34. During operations, responsibility for monitoring is on the contractor (possibly more than one) to be recruited to ensure operation and maintenance (O&M) of the power plant as well as of reservoir management. Among others, the following monitoring will be performed: ambient monitoring for H₂S at sensitive locations (e.g. nearby residential areas) using low-level ambient H₂S monitors such as Odalog, which can be deployed at multiple locations for up to two months at a time; safety monitoring systems with warning alarms for high emissions of potentially hazardous gases, including H₂S, incorporated at the well sites (e.g. the power plant and reinjection sites), as well as providing direct safety measures in the event of a blowout, will highlight potential H₂S emissions issues which could arise during well commissioning and operation (all personnel and local residents will be made aware of the procedure should an alarm be activated); for the Organic Rankine Cycle option, there will be infrared heat detectors and pentane vapor monitors installed at the power plant site around the working fluid condenser/equipment and cooling tower, for early detection of any leaks of pentane or heat sources; all heat and pentane sensors if an ORC plant is selected will be checked and calibrated on an annual basis or as per the manufacturer's specifications. DGDC will monitor the performance of the O&M Contractor.
35. **Labor influx and gender issues.** The Project will require approximately 50-60 workers (goal is 50% from Dominica), who will be housed in a workers' camp during the construction stage. The camp will be located close to the proposed work sites to minimize traffic impacts on the local communities due to workers travelling daily to and from the site along the narrow Roseau Valley roads. Labor influx could potentially increase the incidence of gender-based violence, unintended pregnancy, and sexually transmitted infections (STIs), including HIV/AIDS, on the local communities. To address these risks, the social, health and safety procurement clauses covering labor recruitment, safety, and HIV/AIDS will be incorporated into all works contracts.

PS2: Labor and Working Conditions

36. Human Resources Policies and Procedures. As established in the ESMS, DGDC's human resources (HR) policies and procedures will be consistent with the requirements of World Bank Performance Standards and Dominica national labor laws. The HR manual will include: prohibition of any type of child and/or forced labor; implementation of equal opportunity and non-discriminatory hiring and promotion policies; description and full disclosure of the

worker's/employees' rights and duties, including freedom of association and collective bargaining; and a non-retaliatory grievance mechanism to receive and process any complaints from employees on work related conflicts or issues. Compliance with these policies and procedures will also be mandatory to all contractors, suppliers, and sub-contractors.

37. Working conditions and occupational safety and health procedures framework has been outlined in ESIA Volume 5: Appendices, Technical Report – Working Conditions and Occupational Health. It is anticipated that detailed labor, health and safety documents will be prepared by the EPC Contractor prior to commencement of project construction works and by Dominica Geothermal Development Company (DGDC) prior to commissioning the plant. These would cover hazard identification, safe work practices, emergency response plans, incident/accident management, auditing and review etc.
38. The EPC Contractor will issue all project staff with an individual contract of employment detailing their rights and conditions in accordance with the national law and WBG requirements related to hours of work, wages, overtime, compensation and benefits such as maternity or annual leave, and update the contract when material changes occur. A Worker's Grievance Mechanism has been prepared and will be implemented for the construction and operation phases. This is contained in Volume 5 of the ESIA. Decommissioning consultation events with affected workers and communities are considered as part of the Stakeholder Engagement plans for the project
39. During operations, workers' occupational monitoring, such as hearing and vision, will be undertaken on an annual basis. All heat and pentane sensors of an ORC plant is selected will be checked and calibrated on an annual basis or as per the manufacturer's specifications. DGDC, as principals, will undertake independent audits of the O&M Contractor Health and Safety performance to ensure that the health and safety practices as set out in their health and safety plans are being complied with. The audits will also check that no unsafe practices are being carried out at site. If unsafe practices are identified during the audits, work at the site should cease. The audits should be carried out once every two months.
40. A security procedure shall be included within the OHS Plan covering areas of security control, working hours, areas of security control, prohibited articles / activities on the site, duties of security staff, entry and exit from the site, and application, issue and display of security passes (including vehicle passes), among others. It will be implemented by the EPC contractor to control access to all construction sites to avoid risks related to unauthorized access from local communities. Visitors to the site shall also attend a visitor orientation and control program to ensure they do not enter hazardous areas unescorted. The security guards will be trained on human rights issues and will not be armed. They will coordinate with local government security forces in case of need and will ensure that security and human rights of local communities' members are respected. For the reinjection line, access restriction and safety measures of the public will be implemented along the right of way (RoW) during pipeline construction.
41. Occupational Health and Safety. Consistent with its E&S policies, DGDC will develop an Occupational Health Safety (OHS) Plan for the construction activities at the Project site, which will apply to all personnel involved in the Project, including EPC contractor, subcontractors and part-time workers. The primary health and safety objectives will be to ensure effective measures and management of occupational health and safety to minimize workplace accidents and injuries. The health and safety procedures within the OHS Plan will comprise a

comprehensive Health and Safety Management System - HSMS. They will meet the requirements specified in the WBG EHS Environmental, Health and Safety Guidelines pertaining to occupational safety and health. In addition, any subcontractors appointed by the EPC Contractor will be required to submit their own OHS Plans/Health and Safety Management System.

42. The O&M Contractor will be required to develop an Occupational Health and Safety (OHS) Plans for the operation and maintenance of the project, which will apply to all personnel involved in the project, including subcontractors and part-time workers. The health and safety procedures within the OSH Plans will comprise a comprehensive Health and Safety Management System. They will meet the requirements specified in the WBG Environmental, Health and Safety Guidelines pertaining to occupational safety and health. DGDC will be responsible for auditing and reviewing the document. Each Safety Management System will have a procedure for identifying all hazards associated with the activity in question.
43. The EPC Contractor will develop an Occupational Health Safety Management System which covers their staff and sets out the safety performance standards which the EPC contractor and its subcontractors will meet. The EPC Contractor will actively monitor and audit the safety performance of its subcontractors. The EPC Contractor and subcontractors' performance will be evaluated through standard HSE statistics, including lagging indicators (such as total recordable injury rate and loss time injuries frequency) and leading indicators.
44. DGDC and the EPC Contractor will establish a hierarchy of responsibility with regards for the provision of health and safety. The precise titles and roles of each member will be determined by DGDC and the EPC contractor prior to work on the site. A Health and Safety Management Committee comprised of DGDC and EPC contractor's HSE Managers will be appointed to evaluate health and safety at the site and to assess and recommend changes to equipment, policy and/or procedures where required by health and safety issues. Staff will be trained in safety procedures and provided with Personal Protective Equipment (PPE). As well as a site induction for new workers, ongoing health and safety training shall be provided by the DGDC or EPC contractor. This will be sufficient to ensure that staff have the appropriate technical skills and safety awareness to perform their assigned jobs properly and safely. Staff involved in potentially hazardous tasks, e.g. working in hazardous areas, working at heights, working in confined spaces etc., where additional skills are needed, will be given specialized training as per the job requirement. A proportion of employees will be required to attend additional training courses, such as basic industrial first aid or firefighting. An example of the type and frequency of safety training is provided in Table 3-2 of Volume 5 of the SIA, Appendix I. The DGDC or EPC Contractor may also provide further training as part of their internal requirements.

PS3: Resource Efficiency and Pollution Prevention

45. Resource Efficiency: The energy contained within geothermal steam is converted to electrical energy using a turbine that is mechanically coupled to a generator. The electrical power from the generator will be transmitted from the power plant using insulated cables, at 11 kV, allowing connection to the existing DOMLEC 11 kV network without adding a step-up transformer. The output from Laudat hydropower station (right next to the geothermal site) will be taken via underground cable to the geothermal plant, where a switchboard will marshal the 11 kV output from both plants and return the combined power to Laudat substation via double circuit underground cables. These will be rated for 33 kV, which will allow the option in the future to install a step-up transformer and dispatch all or part of the

power at the higher, 33 kV, voltage. At Laudat, the output will be connected to the existing overhead line running to New Trafalgar hydro station and from there via Padu hydro plant to Fond Colé. DOMLEC is also proposing to disconnect an additional existing transmission line which runs from New Trafalgar directly to Fond Colé and extend this up to Laudat, hence providing a second circuit connecting Laudat and the geothermal plant to Fond Colé. The existing portions of this second line was destroyed by Hurricane Maria and in rebuilding it, DOMLEC intends to extend it to Laudat and install upgraded insulators to permit subsequent operation at 33 kV rather than the current 11 kV. The provisions made at the geothermal power plant and on the restored second line will allow the entire valley system down to Fond Colé to be upgraded to operate at 33 kV, thus reducing transmission losses from what will become the major power source for the south of the island.

46. Water: During construction, there will be a water demand for an estimate of 10 to 50 workers (potable and toiletry), equipment wash-down and potentially a reserve for fire-fighting (minimum of 500 m³). Water will be sourced from an unnamed stream immediately to the north of the power plant site. Impact of abstraction for these activities is considered to be of minor significance. Concrete mixing has been assumed to be undertaken off site (brought in via trucks).
47. During operations, the quantities of water required will be small as only a small work force (2 or 3 staff) will be involved. Options for water sources include taking water from local streams or rivers, rain water or deliveries of bottled water. Water taken from local streams will require filtration and biological treatment. The most likely solution is: Drinking water delivered; Rainwater collection for showers (if permitted) and cleaning. In addition, potential exists for the need of stimulation of well WW-R1 by pumping cold water from the Roseau River to increase well injection capacity. This would require 51,840 m³ of water to be pumped into WW-R1 at a rate of 20 liters/s over a 1-month period. This is 0.6% of the dry base flow in the Roseau River at the point of take, thus unlikely to produce negative impacts on the water biota and fishing or agriculture downstream
48. GHG Emissions: By displacing high polluting diesel-based generation with clean, renewable geothermal sources, the project will result in a significant net reduction of CO₂ emissions. GHG emission savings have been estimated by assessing and comparing emissions under two scenarios: (i) a 'baseline scenario', which entails a business-as-usual situation, namely that the same amount of electricity is produced from diesel-based generation; and (ii) a 'project scenario', which entails that 51.2 GWh of electricity will be generated from geothermal instead of diesel every year. Emissions associated with the geothermal power plant are calculated assuming a net emission factor of 0.109 t CO₂/MWh, as estimated based on production well test results. Emissions associated with the baseline scenario are calculated using an emission factor of 0.856 t CO₂/MWh, as estimated based on the performance of the existing diesel generators. The analysis shows that the project will earn GHG emission savings in the range of 38,223 tons of CO₂ per year or a total of 955,578 tons of CO₂ over a 25-year lifetime.
49. Pollution Prevention: The construction and operation of the GPS will produce a wide range of wastes, air emissions and liquid discharges.
50. Air Emissions and Ambient Air Quality: Hydrogen sulfide and mercury are the main potential air pollutants associated with geothermal power generation employing flash or dry steam technologies. Safety monitoring systems with warning alarms for high emissions of potentially hazardous gases will be incorporated as part of the drilling and power plant set

up. Dust will also be of concern, particularly for the well pad and the reinjection line due to proximity to receptors but will be managed according to the Air quality/dust management included in the Construction environmental management plan. It is possible that the operation of the power plant could result in a discernible increase in odor from H₂S discharges at residences nearest to the Project area. However, given the active geothermal nature of the area and the existing baseline levels of H₂S in this area, it is unlikely that these would reach nuisance levels and the likeliness of health and ecosystem impacts is low. The highest measured background concentration of H₂S measured as part of the baseline assessment is 19 µg/m³, which if added to the model predictions results in concentrations that remain well below the lowest-observable-adverse-effect level (LOAEL) of 15,000 µg/m³ and the 24-hour average guideline of 150 µg/m³ at all receptors. This is therefore considered to have a negligible level of potential impact on the surrounding environment.

51. The technical report on the noise impact assessment is presented in Volume 5 of the ESIA. The seven nearest and most representative affected villages in the surroundings of the project have been considered in this assessment, including the closet (Laudat, Trafalgar, and Wotten Wagen), as well as following natural locations: Boiling Lake; Valley of Desolation; and Fresh Water Lake (2.5km north east of Laudat). The main sources of noise in the area surrounding the project are local fauna, residential noise, low traffic on local roads, wind and water courses. Ambient noise levels are generally louder during night time hours due to local fauna such as insects and nocturnal wildlife. Near schools, hotels and tourist attractions, noise levels were somewhat higher. The construction of the project is expected to last for at least two years during which time the construction and commissioning of the geothermal plant will be completed. This report has considered potential construction impacts from the following project construction phases: Power plant; Reinjection pipelines; Suspension bridge and Tramway Carpark. It should be noted that for the development of the power plant no additional well drilling will be required,
52. Wastewater Treatment: During construction, it is expected that the sewage and site amenity wastewater from a workforce of approximately 50 workers will be treated onsite by package plant then discharged to land via soak-away. On start-up, it is possible for the wells to discharge debris such as stones and drilling residues as well as two phase fluids. The initial clearing will be discharged to the local silencer (rock muffler), then the well will discharge to the local flash tank and brine will be captured in the well pad sump. The injection pipe line will be flushed after construction and as part of a hydro-test. The probable location for a suitable discharge of the hydro-test one of the sumps at the injection well pads. Cooling water pipes will be flushed, and the water will be circulated. No chemicals will be added during this process. Water used during the cleaning will be obtained from the site raw water supply and likely discharged to the storm water system. This water is then typically discharged to ground, upon environmental approval. Strainers will collect the minimal (handfuls) amount of debris expected to be generated and the debris will be taken to landfill. Storm water discharges from the buildings at the GPS roofs and well pads will discharge to adjacent waterbodies. It is proposed that all storm water from site hard standing areas, roofs and well pads will be captured and disposed to surface watercourses through detailed design. These areas are considered to be of low risk of contamination as they do not contain oily waste processes or condensate/brine discharges. During operation the power plant has a small number of operators (~3) and as such site traffic and use would present low risks for contamination. The ESMP recommends additional controls of the storm water discharges that includes their capture into sumps or settling ponds to mitigate flow effects and provide

for capture and treatment of floatable and suspended contaminants in the storm water. Protection of outlets to reduce erosion risk is also proposed.

53. Solid Waste Management: Geothermal technologies do not produce a substantial amount of solid waste. Sulfur, silica, and carbonate precipitates are typically collected from cooling towers, air scrubber systems, turbines, and steam separators. This sludge may be classified as hazardous depending on the concentration and potential for leaching of silica compounds, chlorides, arsenic, mercury, vanadium, nickel, and other heavy metals. Solid wastes will include non-hazardous waste (paper, packaging material, organic waste, building rubble, non-hydrocarbon filters, etc.); salvageable/recyclable material (scrap metal, pipes, used tires, empty drums and scrap wood, etc.) and hazardous waste (used hydrocarbons, expired chemicals, paints, batteries etc.); waste water. All waste will be managed according to the ESMP proposed in the ESIA, mainly the Waste management plan; Hazardous substance management; Recycling plan; and Emergency preparedness and response for well blowout and pipeline rupture, including measures for containment of geothermal fluid spills. The EPC Contractor will develop a Waste Management Procedure that they and all subcontractors will implement during all project construction works. DGDC will be responsible for checking and reviewing the document. Attention should be given to the use and re-use of materials to minimize waste and using materials and products from sustainable sources.
54. Pesticide Use and Management: During the construction phase, DGDC will review and monitor EPC contractor's performance and related management plans/procedures to ensure alignment with the overarching Project ESMS. Management of environmental and social aspects associated with the project will be carried out in accordance with the ESMP, which will include a set of plans and procedures, including a Construction environmental management plan and a Pest and Weed Management Procedure that the EPC contractor and all subcontractors will implement during all project construction works. DGDC will be responsible for checking and reviewing the document. Plants used in any landscape planted will be local and nursery grown and checked for insect infestations. Any replanting / landscaping will use native or endemic species to prevent the incursion of opportunistic invasive species.
55. Visual Impacts: For the power plant the geothermal separator and the Atmospheric Flash Tank (AFT/Silencer) will be approximately 7-10 m high. This will likely be a prominent visual impact to be addressed with surrounding terrain and landscaping. Any lighting requirements will be designed to ensure light spill is directed into the construction site.

PS4: Community Health, Safety, and Security

56. The project and the reinjection lines are located in close proximity to the villages of Laudat, Trafalgar and Wotten Waven. As such potential impacts and risk may include a) increased risk of traffic hazards and incidents associated with the construction routes; b) exposure to hydrogen sulphide gas, leakage, and well blow outs; c) major accidents associated with the storage, use of working fluid (typically n-pentane) for Binary Plant; d) exposure to project-related hazards associated with construction and operational activities; e) Community health impacts related to dust emission during construction that will exacerbate existing or cause new conditions (e.g. respiratory, eye, skin diseases); and f) health and safety risks associated with ponds, confined spaces and risk of fire. Mitigation measures have been recommended to reduce impacts on communities to a minor/acceptable significance level, including controlling access, developing community emergency response procedures, and implementing disease prevention measures.

57. Dust and noise related nuisance from construction are anticipated to be short-term (2 years duration of construction). H₂S concentrations during operations are predicted to be well below World Health Organization (WHO) thresholds of observed adverse effect levels. Overall health impacts of the project are therefore considered to be manageable.
58. Infrastructure and Equipment Design and Safety: Health and safety impacts arising from the construction, operations and decommissioning of the Project are likely to include increased risk of traffic hazards and incidents associated with the construction routes. A Traffic Management Plan (TMP) will be developed for the construction and the operation and distributed to staff to inform them of the best ways to travel to the sites of the project. Staff should be encouraged to take public transport, car pool or that the contractor provides transport for them. A range of mitigation measures have been recommended to reduce impacts on communities to a Minor (acceptable) significance level, including controlling access, developing emergency response procedures, and implementing disease prevention measures. The EPC Contractor will undertake monitoring of construction traffic and traffic management measures to ensure compliance with the traffic management requirements outlined within the TMP. Activities to be monitored include a) construction traffic movements to ensure truck drivers use the designated routes; b) traffic incidents/complaints from the public or officials to ensure that unpredicted changes in travel time due to incidents such as, for example traffic accidents, emergencies, natural disasters can be managed by specially trained personnel; and c) public roads to ensure that the roads in the vicinity of the site are clean at all times of clay, slurry or materials from the site. DGDC will monitor the performance of the EPC Contractor.
59. Hazardous Materials Management and Safety: For the construction phase, the EPC contractor will develop a Hazardous Substances Management Procedure that they and all subcontractors will implement during all project construction works. DGDC will be responsible for checking and reviewing the document, and for supervising and auditing its implementation. Under the Hazardous Substances Management Procedure, the EPC contractor will induct the workforce to be made aware of hazardous substances, with reference to the applicable Safety Data Sheets (SDS). They will also attend mandatory safety training in the correct way to use and handle the hazardous substances. Training must be adjusted to be compliant with the laws of Dominica and any other relevant regulations prescribed by the competent authorities. Workers will be provided with the appropriate Personal Protective Equipment (PPE) for the handling and use of hazardous substances. Emergency facilities, first aid points, clinics, eye wash fountains, emergency showers will be identified/provided where required. Other facilities that will be available include fire extinguishers, first aid, communication equipment, emergency doors and alarms. Storage areas will be identified, and unauthorized entry will be controlled by use of barriers warning signs and close supervision. All hazardous substances
60. During operation, uncontrolled discharges of geothermal fluids (brine and condensate) can be harmful to the environment. Brine can contain dangerous metals (such as arsenic) as well as other harmful substances (such as boron). These substances can leach into soils and accumulate if not remediated. Brine is also hot and could damage or kill flora and fauna in the vicinity of any discharge. While geothermal condensate will contain far fewer quantities of hazardous materials, it can be rich in boron which will tend to accumulate in the cooling tower sludge. All geothermal fluids will be captured and sent to injection wells during the operation phase via the reinjection pipeline Leakage of hydrocarbon working fluids and

ancillary plant fluids, such as oil, presents a fire risk. These risks are mitigated with a fire fighting system integrated into the project design.

61. The O&M Contractor will ensure that heat and pentane sensors will be fitted around the storage tank and the plant to detect any leaks and heat changes; a deluge fire extinguishment system is supplied which when activated will quickly extinguish any fire.
62. Ecosystem Services: The proposed geothermal development is located approximately 450 m from the MTPNP boundary at the closest point. A separate report to address the specific impacts in this World Heritage Site (WHS) was developed (ESIA, Volume 5: Technical Appendices - MTPNP Impact Assessment). A range of measures have been incorporated in the project design, mitigation and monitoring to promote sustainable management of living resources, including minimizing habitat destruction through site and route identification; design and implementation of control procedures for sediment, dust and noise impacts; and the design of a MTPNP monitoring program to be implemented for the five key species considered Threatened by IUCN: giant ditch frog, imperial parrot, red-necked parrot, forest thrush, and a species of tree frog (*Eleutherodactylus amplinympha*). DGDC will develop a MTPNP monitoring program will be implemented for the 5 key species considered Threatened by IUCN: giant ditch frog, imperial parrot, red-necked parrot, forest thrush, and a species of tree frog (*Eleutherodactylus amplinympha*), recommended to be at every six months from pre-construction until the completion of one year of construction, and annually thereafter for a minimum of five years of operation. The program should also include the ongoing monitoring in the Laudat and Trafalgar area for any other potential impacts on the OUV of the WHS. The MTPNP monitoring program will be agreed with input from the MTPNP managing authorities (National Parks Unit of the Division of Forestry, Wildlife and National Parks), and implemented prior to construction where appropriate. The monitoring program outlined will enhance understanding of the ecology of the MTPNP and surrounding areas. Independent third-party auditing of the implementation of the ESMP will be undertaken at regular intervals. The budget for this auditing and its frequency will be specified in the ESMP and verified by the relevant regulators.
63. Community Exposure to Disease: The workforce during construction is estimated at 50-60 workers at peak, and for operations estimates to be approximately 12. Approximately 50% of the workforce is expected to come from Roseau, which will help minimize community conflicts, misunderstandings and exposure to communicable diseases. Nevertheless, mitigation measures such as a worker code of conduct, health screening, HIV/AIDS awareness program and cultural education program will be implemented to ensure that health, safety, and security risks from Project workers remain low.
64. Emergency Preparedness and Response: Communities have expressed concerns about accidents. In the event of a spill during construction, spill containment and clean up equipment will be located onsite. This will include equipment for containing and cleaning any spill such as a shovel, broom, drain covers, sandbags, booms and absorbent material, storing and disposing of spilled material such as safe containers, bags, and drums, protecting the safety of staff through the use of PPE. Any spills will be contained and cleaned up immediately and disposed of at an approved facility. Incidents will be recorded and reported following the accident reporting system as detailed in the HSE Plan. This includes the preparation of an Accident/Incident Report. The EPC Contractor will develop an Emergency Response Plan that they and all Subcontractors will implement during all project construction works. DGDC will be responsible for checking and reviewing the document. The EPC

Contractor, alongside DGDC will communicate the plan with the local community.

65. During operations, accidental leakages and explosions, though extremely rare, could lead to fire outbreaks that may result in the loss of human lives, loss of wildlife, damaged properties and other serious health implications. Accidental release of fumes and other toxic emissions emanating from the power generation process implicate respiratory infections to workers as well as residents around the Project site. In the event of any explosions or leakages, local livelihoods could also be affected.
66. Both plant options will require substantial fire detection and protection to prevent damage to components and buildings such as the cooling towers and oil containing equipment including the turbine-generators. For both options, this would likely comprise a fire ring main and spray system that covers the physical plant, and an inert gas (CO₂, "inergen", or similar) discharge system for the control room and building annex. A fire-fighting water tank will be required and sized in accordance with NFPA 850 (Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations).
67. Security Personnel: Site security issues include public access to the power plant, the reinjection route pipeline and potential traffic accidents with the pipeline. Under the recommended mitigation measures, Security Guards will be trained on human rights issues, and the project will coordinate with local government security forces on human rights and security matters. DGDC will adhere to the Voluntary Principles on Security and Human Rights (Voluntary Principles) through its ESMS guidance for Security.

PS5: Land Acquisition and Involuntary Resettlement

68. This PS is not applicable to this project. Involuntary resettlement is addressed through the requirements of OP4.12. Under OP4.12 requirements, the Project will require land from 13 landowners for the construction of the power plant and the reinjection pipeline. For the reinjection line, a corridor of up to 10 m is required and DGDC will determine the exact land to be acquired based on technical and financial considerations. The ARAP sets out land acquisition guidelines and procedures (for negotiation and compensations). Twelve PAPs have requested cash compensations while one has opted for replacement land. The GoCD will negotiate with the landowner, acquire the needed land by paying the agreed compensation and transfer the land to DGDC. Grievance redress related to land acquisition would be addressed by the Department of Lands and Surveys of the Ministry of Housing and Lands. If the DGDC receives any land acquisition-related complaints, complainants will be directed to the Ministry of Housing and Lands. DGDC will coordinate with the Ministry to report on land acquisition related grievances. The DGDC will be responsible for all other project- related grievance redress including monitoring and evaluation. Further details on resettlement issues are available in the [ISDS](#).

PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

69. Protection and Conservation of Biodiversity. An initial baseline survey for flora and fauna and subsequent analysis was carried out in 2008 with the aim to provide an introduction to the biodiversity of the Roseau Valley, and also the legal context related to forest clearing and protected natural spaces. Three areas were initially selected in 2011 for detailed flora and fauna assessment and then a fourth was added in 2015. At each area the dominant habitat and flora and fauna species were described and matched to vegetation type descriptions. The general description of the biodiversity and flora and fauna in the Roseau Valley was informative and based on expert knowledge of the island biodiversity (using the International

Union for Conservation of Nature (IUCN) Red Lists). The area was classified as High sensitivity areas containing a high number of protected species inside (IUCN, French and Dominican legislation); an area with very few anthropic influences; a high number of endemic species (Dominican and Caribbean); or the presence of species poorly represented elsewhere. Baseline surveys of the biological environment within the Roseau Valley were completed between October 2013 and April 2015 to support the preparation of the ESIA.

70. Type of Habitat: The major vegetation type in all areas surveyed is secondary rain forest at varying stages of succession. Some agricultural habitats were also present, both those currently under cultivation and those apparently abandoned. No rare or threatened plant species were identified in any of the transects or plot-based surveys. The proposed location for the power plant site and laydown area includes an abandoned dwelling, and agricultural land with low-growing ground cover and some trees. The primary remaining crop was citrus fruits. The site originally selected for exploratory drilling and one of the proposed reinjection wells is adjacent to the Wotten Waven to Trafalgar main road, approximately 140 m from the Wotten Waven Sulphur Springs tourist site. The area is characterized by a high-water table, and there is a wetland/marsh area, with patches of fumarolic vegetation and hot water pools. To the southwest and the north lies secondary rainforest and agricultural land, where crops such as banana, coconut, mango and breadfruit are cultivated.
71. Protected or Recognized Areas: The protected area of principal relevance to the project is Morne Trois Pitons National Park, a World Heritage Site (WHS) which lies approximately 600 m north-west, and upstream, of the proposed Project infrastructure. The MTPNP, along with three other sites on the island, is also designated by BirdLife International as an Important Bird Area (IBA). The MTPNP covers nearly 7,000 ha area of the volcanic island, comprising rugged mountain landscape and deep canyons. It supports at least five species considered Threatened by IUCN: two amphibians, two parrots and one passerine bird. There are five live volcanic centers within the park, the highest of which reaches 1342 m. The landscape is scenically striking and features natural hot springs, bubbling mud ponds, lakes and magnificent waterfalls. Within the park are the sources of the southern part of the island's major watercourses. Two small coastal/island IBAs are located on the south and south-east coasts, and the Morne Diablotin National Park in the north of the island, is the other. The designation also renders all four sites Key Biodiversity Areas (KBA). In addition, an Endemic Bird Area (EBA) extends across the whole of the Lesser Antilles and supports seven endemic bird genera. Dominica has two endemic bird species of its own, and also supports 18 restricted-range bird species. Nationally, Dominica recognizes 10 protected areas, covering 22% of the terrestrial habitat, and 0.01% of the marine area. No other established or proposed protected areas have been identified.
72. Alien Invasive Species: The area adjacent to an access road which leads to the geothermal reinjection line supports savannah-like species, with some secondary rainforest vegetation, including some areas which have been cleared. In this area invasive *Mimosa* spp. were noted to be dominant. The transport of significant quantities of soil on or off site is not expected. Spread of invasive species which may outcompete native species is possible, although based on the scale of the construction area, is unlikely to be significant.
73. Management of Ecosystem Services: The important species and habitats identified in the assessment were red-necked parrot, tink frog, Dominican ground lizard, Dominica anole, blue-headed hummingbird, and plumbeous warbler, and their habitats. No likely significant (greater than minor) negative impacts have been identified through the assessment process,

and thus to minimize adverse impacts, standard good practice measures will be implemented during construction and operation, such as: a) implement dust-suppression measures such as covering vehicles transporting materials, ensuring vehicles use wheel wash facilities at site, and use of water spray dust suppression systems; b) inductions/tool-box talks for staff will include reference to measures required to protect biodiversity; c) vegetation clearance activities should commence outside the breeding season for red-necked parrot (breeding is between February and June). Where possible it should avoid the primary amphibian breeding season between May and August also; d) habitat cleared should be the minimum possible, with any way-leave area required of the minimum width necessary; e) temporary fencing to prevent inadvertent damage outside designated construction areas; f) avoid piling of clear-felled vegetation on standing live vegetation which would hinder movement of wildlife; g) any replanting / landscaping will use native or endemic species to prevent the incursion of opportunistic invasive species; h) Machinery and vehicles should be cleaned upon entry/exit, and any soil brought on or off site screened for invasive species or plant pathogens; i) minimize potential for sedimentation impacts by ensuring good construction site practices are implemented, among others.

74. The environmental damage following Hurricane Maria is estimated to be *'very high, with 80-90 percent of environmental resources significantly affected'* according to the GoCD Post Disaster Needs Assessment (PDNA) Report (2017). Hurricane force wind and intense rainfall produced widespread damage to forests on Dominica and much of the pre-Maria forest was stripped of leaves and damaged, with downed trees were widespread throughout the island. (GoCD, 2017). Ecological services relating to water production, erosion control and land stabilizations will likely be affected for a time after Hurricane Maria (although it is not yet known for how long) and *'may require interventions'* to remedy according to the PDNA Report (GoCD, 2017). First hand observations mention forest defoliation of between 80 to 90%, ultimately leading to tree deaths with Dominica's wildlife having been severely hit. Conservation efforts associated with the island's rare bird species (Imperial Parrot and Red-necked parrot) ensured that a number kept in captivity were held safe (American Bird Conservancy, 2018). Populations in the wild have fared less well. Rainforest ecosystems such as those found on Dominica have been through previous hurricane events and vegetation cover and habitat integrity has returned rapidly (within 2 years; DominicaVibes, 2017) reaching semi-maturity or maturity. Also, due to the level of deforestation and soil erosion that has occurred as a result of Hurricane Maria the soils are less stable and as such minimizing soil and erosion, and in particular sediment discharges during construction works via mitigation measures as set out in the ESMP need to be carefully adhered to in order to minimize impacts from the development on rivers, and slope stability.

PS 7 – Indigenous Peoples

75. There are no indigenous people in the project area.

PS 8 – Cultural Heritage

76. The ESIA assesses the impact of the Project on cultural heritage. No direct impacts on physical cultural heritage are anticipated, as all known cultural heritage are located outside the Project boundaries. According to a 2015 report by Caraïbes Environnement Développement & Coll, there are no known significant archaeological sites in the Roseau Valley. The complex and ancient history of human occupation of the island has led to numerous influences on current and past architecture in the Roseau Valley – including an 18th century mill located in Wotten Waven.

The MTPNP, which in 1997 was declared UNESCO World Heritage Site, is not linked to archaeological, historic or religious/spiritual sites. It has been inscribed on the World Heritage List under **criterion viii**- “To be outstanding examples representing major stages of the earth’s history, including the record of life, significant on-going geological processes in the development of landforms or significant geomorphic or physiographic features” and **criterion x**. “To contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation

77. Community members and project stakeholders did not raise concerns linked to cultural heritage during the consultation meetings. If any archaeological, or other cultural heritage is encountered during project construction, the EPC Contractor and all subcontractors will implement the Chance Find Procedure outlined in the ESIA to address this risk. The Chance Finds Procedure requires the Contractor to contact the relevant institutions – specifically the Ministry of Youth, Sports, Culture and Constituency Empowerment and the Dominica Museum. The EPC contractor will also develop a Code of Conduct for workers in which they will be required to pay attention to any cultural heritage that may be encountered during civil works.

Stakeholder Engagement

78. Project stakeholders include landowners in the project area, communities within the Roseau Valley, local businesses including the tourism industry, regulatory agencies, community groups and local and central authorities. These parties were all consulted, in addition to civil society and agencies interested in the environmental and social impacts of the project.
79. DGDC prepared a Stakeholder Engagement Plan that establishes the ground rules for continuous engagement and dialogue with various stakeholders during preparation, construction and operational phases. It clearly outlines the responsibilities of the DGDC’s executive and management for stakeholder engagement. It is expected that the stakeholder engagement plan will be reviewed throughout the construction phase and annually during the operational phase.
80. A fairly robust process of stakeholder consultations and dialogue was carried out, beginning in 2013 and continued for the Environmental and Social Impact Assessment (ESIA), as part of the Stakeholder Engagement. The consultations documented community concerns about potential risks associated with the geothermal plant; the potential impacts (which can be both positive and negative) on ecotourism that is a key economic activity in the valley, among others; expectations about job creation were also mentioned.
81. Consultations held as part of project preparation include: three public meetings between December 2016 and August 2017. A total of 15 focus group meetings were held as part of the ESIA baseline data collection. Together, all the consultation meetings provided the opportunity for representatives of local hotels and resorts, handicraft vendors, hot springs businesses, and unemployed parties in the area to express their concerns concerning the project.
82. Following Hurricane Maria in September 2017, five focus group meetings were held in Laudat, Wotten Waven and Trafalgar to identify the impacts of Hurricane Maria on the community and to understand how conditions in the Project area have changed since the ESIA baseline data was collected pre-Hurricane Maria. During this round of consultations, communities expressed additional concerns coming out of the hurricane experience. A

summary of the feedback received from the consultations and project design responses are presented in the table below. Volume 2 of the ESIA presents a summary of the consultation comments and how these are responded to all through the ESIA.

Comment	Project design response
Noise level of the project and effect on the community	Noise control measures will be put in place to minimize noise pollution during construction.
Will the re-injection pipeline pass through villages?	Re-injection route pipeline selected with the intent of avoiding settlements.
Potential negative impacts on tourism	The thermal resource is not likely to be reduced as a result of the Project and the Project could become an educational tourist destination. The presence of construction employees could result in a minor increase in local businesses.
Traffic impacts on the community and local businesses	Establishment of a worker's camp close to the construction site to minimize traffic movement that could disrupt local activities
Resettlement and land acquisition impacts and plans for the community and businesses	All persons affected by involuntary land acquisition will be consulted and compensated in accordance with the ARAP. All compensation will be paid before any construction begins
What happens if the reinjection pipe has a leak and dangerous fluids are flowing on the surface?	DGDC will develop and implement an Emergency Response and Disaster Management Plan in line with best practice.

83. Focus group meetings will continue throughout the Project lifecycle and be conducted by DGDC and its Community Liaison Officer (CLO) as required to address topical issues and issues of interest / concern to local community groups.
84. Community Engagement and Grievance Mechanism: DGDC's safeguards staff will handle project-related grievances. The Community Liaison Officer (CLO) will be responsible for logging all grievances in the grievance register. Comments or complaints can be made directly to DGDC or the contractor, through the CLO or through a community representative (e.g. through the village elders).
85. The CLO will log the receipt of a comment, formally acknowledge it, track progress on its investigation and resolution, and respond in writing with feedback to the aggrieved party. The CLO will provide a response to the complainant within ten working days, unless there are exceptional circumstances. If the Project receives a large number of unsubstantiated grievances, the process will be reviewed to define instances when no response is needed.
86. Where investigations are required, Project staff and outside authorities as appropriate will assist with the process. The DGDC will identify an appropriate investigation team with the correct skills to review the issue raised and to decide whether it is Project related or whether it is more appropriately addressed by a relevant authority outside the Project.

Information Disclosure

87. DGDC presented the ESIA non-technical summary (NTS) of findings to Roseau valley communities at three public meetings held in the first week of July 2018 in Laudat, Wotten Waven and Trafalgar. Community were given the opportunity to express concerns and ask questions about the project and ESIA findings. Concerns generally included community health and safety issues, natural hazards, employment and construction impacts. The draft document was also disclosed on the DGDC's website in June 2018.⁴ The finalized version of the NTS and volumes I and II of the ESIA were disclosed in country on August 10, 2018. The remaining ESIA components and notably the ARAP were disclosed in country on October 18,

⁴ <https://www.geodominica.dm/#download>

2018. The full ESIA was disclosed internationally by the Bank on October 24, 2018.

ANNEX 1

FIGURES

Figure 1 – Map of Dominica and Caribbean Islands



Figure 1. 1 - Project location

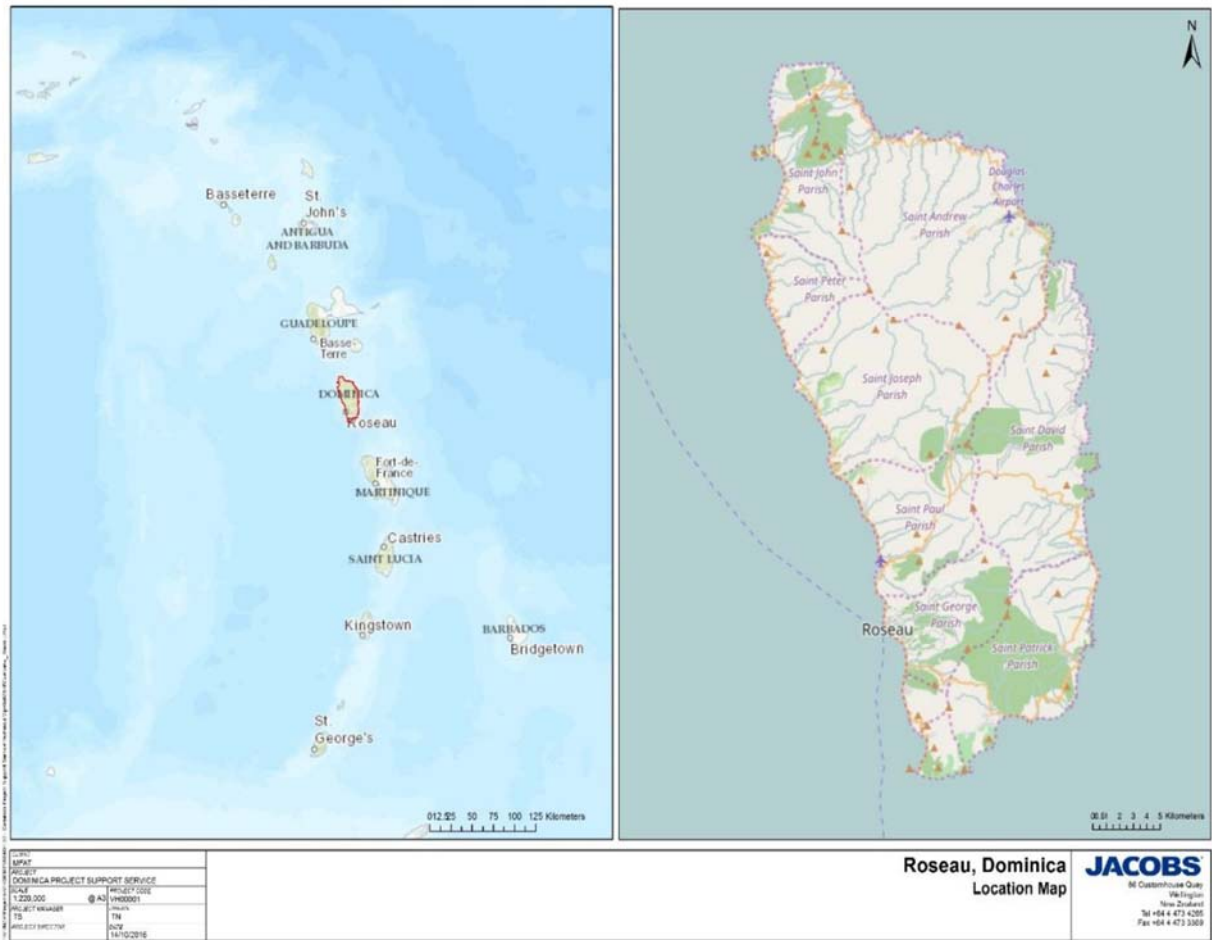


Figure 2 – Location of Roseau Valley (Site of the proposed geothermal power plant)

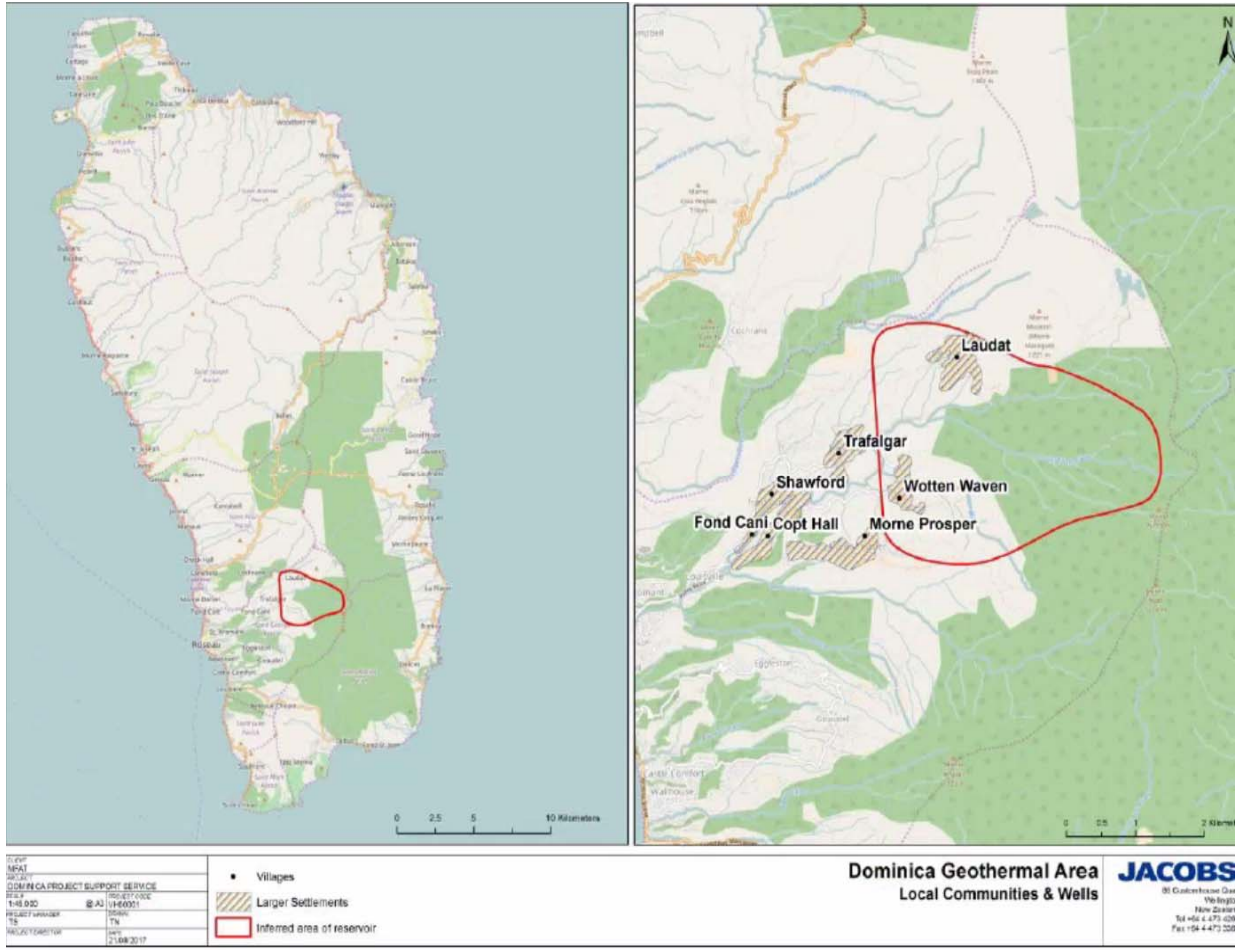


Figure 3 – Project overview/location in the Roseau Valley

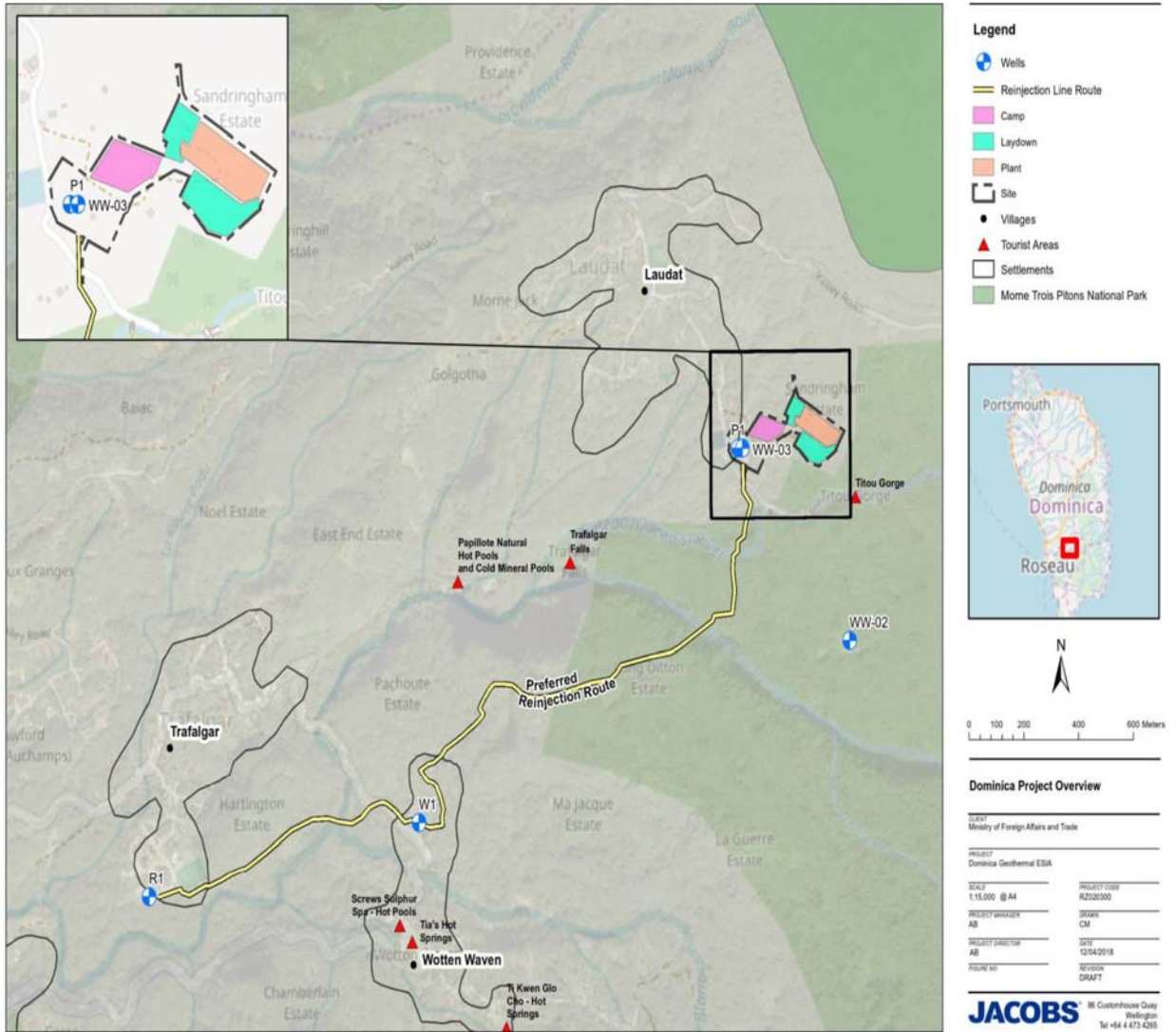


Figure 4 – Settlements within the Roseau Valley and close to the project area

