Environmental and Social Impact Assessment (ESIA) addendum

Dominica Geothermal Development Project

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Ricardo Calvo, Ph.D.
Partner in Charge

Gabriela Morales
Project Manager

ERM, Inc
1776 I St. NW
Suite 725
Washington, D.C. 20006

T +1 202 466 9090

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ACRONYMS AND ABBREVIATIONS

Acronym	Description
ACC	Air Cool Condenser
AFD	*Agence Française de Développment*
ASTM	The American Society for Testing and Materials
BOP	Balance of Plant
CDB	Caribbean Development Bank
COD	Commercial Operations Date
CRO	Control Room Operator
DGDC	Dominica Geothermal Development Company Limited
DOMLEC	Dominica Electricity Services Limited
DOWASCO	Dominica's Water and Sewerage Company Ltd
DRMP	Disaster Risk Management and Adaptation Plan
E&S	Environmental and Social
EAP	Emergency Action Plan
EHS	Environmental, Health and Safety
EN	European Norms
EPC	Engineering, Procurement and Construction
ERM	Environmental Resources Management, Inc.
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESRP	Environmental and Social Review Procedures
EU	European Union
GAP	Gender Action Plan
GoCD	Government of the Commonwealth of Dominica
HAZWOPER	Hazardous Waste Operations and Emergency Response
HVAC	Heating, Ventilation, and Air Conditioning
IDB	InterAmerican Development Bank
IFC	International Finance Corporation
masl	meter above mean sea level
MW	Megawatts
O&M	Operation and Maintenance

Acronym	Description
OEC	ORMAT® Energy Converter
ORC	Organic Rankine Cycle
PPA	Power Purchase Agreement
PS	Performance Standards
QEHS	Quality, Environment, Health, and Safety
RAP	Resettlement Action Plan
SDG	Sustainable Development Goals
SEF	Sustainable Energy Facility
SGBVH	Sexual and Gender-based violence and harassment
STD	Sexually transmitted diseases
STI	Sexually transmitted infections
TBC	To Be Confirmed
TL	Transmission Line
US	United States
VEC	Valued Environmental and Social Components
WBG	World Bank Group

EXECUTIVE SUMMARY

Ormat Technologies Inc. through its subsidiary "Geothermal Power Company of Dominica (2023) LTD" (hereafter, Ormat) is the developer and will be the operator of a 10 megawatts (MW) binary-cycle Geothermal Power Plant, injection plant, and production wells WW-P1, WW-03 and RV-P2 (altogether, "the Project"). Ormat will develop the Project through a concession agreement that was signed in December 2023 (and became effective in January 2024) with the Government of the Commonwealth of Dominica (GoCD) as the "Grantor", and the Dominica Geothermal Development Company Limited (DGDC) —a Government Agency—as the Grantor's representative. Prior to Ormat's participation, it was the DGDC the original Project developer. Currently, even though Ormat will construct and operation the Project, the DGDC continues to lead community engagement including with Project Affected Peoples (PAP), from whom the GoCD acquired land intended for the Project. Land acquisition processes are led by the Lands and Surveys Division of the GoCD.

The Project prepared an Environmental and Social Impact Assessment (ESIA) with its Environmental and Social Management Plan (ESMP) in 2018; ERM prepared an ESIA Update in 2022[1]. Ormat became the developer in January 2024 and has refined some elements of the Project design, mainly around technology choices. Because of these changes, IDB and CDB's environmental and social policies require an update of the ESIA and ESMP, to reflect the new status and design of the project.

The scope of this 2024 ESIA and ESMP includes addressing the modifications made to the Project design by Ormat, updating of the applicable standards to reflect current requirements by lenders, updating of E&S management plans to include mitigation measures required by the CDB and the IDB policies, development of two new management plans (the Gender Action Plan and the Disaster Risk Management and Adaptation Plan), and a presentation of the 2024 ESIA addendum through a public consultation, which was held in Roseau Valley, Dominica on July 25, 2024. Additionally, an audit of the implementation of the Resettlement Action Plan (RAP) to evaluate how the processes of land acquisition and resettlement have been implemented.

The current Project components are:

- Production and Injection wells: All wells have been already constructed and tested. No changes to this component.
- Power plant main changes:
    - A single recuperator in the Organic Rankine Cycle (ORC) will be employed.
    - Turbines will be designed by Ormat.
    - Motive fluid employed will be Cyclo-pentane.
    - Design parameters based on the American Society for Testing and Materials (ASTM).
- The communications cable will be along the reinjection pipe path.

[1] The 2018 and 2022 ESIA are available here: https://www.geodominica.dm/publications222/

- Air Cool Condensers (ACC) fans are single speed and will be regulated for the most efficient cooling; low noise fan blades will be procured.
- There will be additional spare ACC fans for quick replacement.
  - Concrete blocks are expected to be used on every steam trap instead of a massive trap collection system prone to leaks.
  - Additional areas (i.e., offices, kitchen, workshop, storage, control room, among others) will not be part of the electrical building.
- Power Plant buildings: instead of one building, five buildings will be required for operations.
- Workforce: An estimated total of 90 to 100 workers will be required during construction (there will be 30 people at a time for each construction phase) and six workers during operations (three people per shift), plus clerical staff (total estimated personnel including off-site staff is 31). Around 95% of workers will be local during construction.
- Water usage: Raw water supply during construction is estimated as 1,500 liters per day and for operations 0.3 m^3/day, which is much less than the initial estimate on the 2022 ESIA. Raw water will be obtained from water trucks, which will be contracted by the EPC Contractor.

The 2024 ESIA and ESMP addendum is complaint with all the relevant National regulations, the International Finance Corporation (IFC) Performance Standards (PS), the applicable IFC Environmental, Health and Safety (EHS) Guidelines, the InterAmerican Development Bank (IDB) safeguard policies, the Green Climate Fund requirements, and the Caribbean Development Bank (CDB) standards.

Impacts identified are related to biodiversity, gender, workers influx, land acquisition, resettlement and livelihood restoration. The impacts evaluated in this addendum are anticipated to have no change in type or significance with respect to the last impact assessment in the ESIAs issued in 2018 or 2022. The new features integrated to the Project do not overall change the impact ratings evaluation, and none of the impacts were determined to be major and would all be reduced to minor or negligible with the implementation of appropriate mitigation measures. The table below summarizes potential direct impacts from the Project per the 2022 ESIA Update, and their residual significance. Please refer to the 2022 and 2018 ESIAs for a detailed description of the impacts and measures.

KEY DIRECT IMPACTS SUMMARY TABLE (ESIA UPDATE 2022)

Receptor	Impact description	Residual significance
Environmental/Soil	Increase runoff and sediment load due to deforestation and land clearing/levelling during construction	Minor
Environmental/Water quality	Decrease in Roseau River's water quality through increasing turbidity, reducing clarity and causing deposition of fine sediments	Minor
Environmental/Pollution	Potential for hazardous substances or waste to be accidentally discharged to the environment if inappropriately collected and stored on site.	Negligible

Receptor	Impact description	Residual significance
Environmental/Noise	During construction and commissioning works there will be noise impacts at Laudat (south), Trafalgar (east), Trafalgar (south) and Wotten Waven. Impacts will be short-term.	Minor
Environmental/Air quality	There is anticipated to be an increase release in H_2S because of the Project's activities. However, it is considered that there would be Negligible impact on receptors regarding odor, due to the low concentrations predicted at the main residential areas. Ormat will conduct ambient monitoring for H_2S during operations, at sensitive locations (e.g. nearby residential areas), using low-level ambient H_2S monitors which can be deployed at multiple locations for up to two months at a time.	Negligible
Environmental/GHG emissions	For GHG emissions, the total CO_2-e per year is significantly less than a fossil fuel derived energy source and therefore the Project is considered to have moderate beneficial impacts to the air quality.	Moderate beneficial
Environmental/Disaster Risk	The primary hydrological risk to the reinjection pipeline will be from flooding. Any pipe crossings (pipe bridges) over waterways will be at risk from potential flood impacts in terms of high-water levels and debris carried with these flows. With recommended detailed design mitigation measures in place to reduce the risk of flooding and debris strike, residual impacts for the reinjection pipeline are reduced to Moderate significance.	Moderate
Environmental/Disaster Risk	Potential impacts to the Project due to natural disasters, such as hurricanes.	Moderate
Biodiversity/General	Fragmentation of habitat and reduction of ecological connectivity.	Negligible
Biodiversity/Vegetation	Direct loss and disturbance of vegetation.	Minor
Biodiversity/Fauna	Mortality and Injury to fauna due to vegetation clearing and habitat loss.	Negligible
Biodiversity/Fauna	Habitat loss for wildlife due to construction within the road improvement/ expansion locations, reinjection and production well pads, reinjection pipeline, power plant area and immediate surrounding areas.	Minor
Biodiversity/Fauna	Mortality or injury to fauna due to open geothermal brine ponds.	Negligible
Socioeconomic	Gender.	Minor
Socioeconomic	Worker Influx.	Minor
Socioeconomic	Land Acquisition, Resettlement and Livelihood Restoration.	Minor

Receptor	Impact description	Residual significance
Cumulative impact/ VEC: Terrestrial and Aquatic Biota (flora and fauna)	The Project, other projects, and external drivers could have potential negative impacts on terrestrial flora and fauna. Effects and disturbances caused by the plant construction activities will be short-term and reversible. Further Valued Environmental and Social Components (VEC) conversion and/or degradation is not likely to occur.	Minor to Negligible
Cumulative impact/ VEC: Land Traffic	The Project and other projects could contribute to the potential negative impacts on this VEC by increasing land traffic. The external driver could exacerbate traffic due to potential damages to road infrastructure. Construction will be short-term. The impact is considered Minor for the short-term construction and then Negligible for operation.	Negligible to Minor
Cumulative impact/ VEC: Community Health and Safety	The Project, other projects, and external drivers could contribute to the potential negative impacts on this VEC: decreased quality of the air shed. However, the other projects are already in operation and therefore their impacts are already considered in the Project baseline and residual impact assessment. The Project could potentially contribute incrementally to the adverse impact, but further VEC conversion and/or degradation is not likely to occur, or the Project's contribution will be expected to be negligible.	Negligible
Landscape Aesthetics	The Project and other projects will contribute to the potential negative impacts on this VEC by reducing flora. Additionally, landscape aesthetics was identified as a highly valued VEC by stakeholders. The Project could potentially contribute incrementally to the adverse impacts that already exist, and some degree of VEC conversion and/or further degradation or perception of degradation is likely to occur. Actions will be implemented in the medium term to mitigate potential adverse cumulative impacts on the VEC.	Minor

Source: ESIA addendum (Jacobs, 2028 and ERM, 2022).

As part of this addendum, the ESMP has been updated where necessary and new management plans were developed to address specific topics including a Gender Action Plan (GAP) and a Disaster Risk Management and Adaptation Plan (DRMP). The following table shows the plans and programs included in the 2022 ESMP and which ones were updated or developed for this 2024 ESIA and ESMP addendum:

SUMMARY OF KEY UPDATES IN ESMP TABLE

ESMP 2022	ESMP 2024
• Biodiversity Management • Erosion and Sediment Control • Waste Management • Water Management • Air Emissions Management • Noise Management • Disaster Risk and Emergency Management • Well Blowout and Prevention • Emergency Response • Security Management • Labor Conditions and Workers Selection • Internal and External Grievance Mechanism • Community Health and Safety Management • Contractor Management • Stakeholder Engagement • Chance Find	No significant changes. Key considerations are: • Ormat is the implementing company for the ESMP. • Ormat will implement management plans and measures through their Environmental and Social Management System (ESMS), which is Project specific. • Ormat will implement its own policies, including a third-party platform to submit internal grievances or report breaches to the code of conduct • Ormat has an operational external grievance mechanism, which can be reached independently from the DGDC's • See specific changes for emergency response and disaster risk below
• Emergency Action Plan	The Plan is specific to operations and was prepared by Ormat. A project specific emergency preparedness and response plan is being prepared by the Engineering, Construction and Procurement (EPC) contractor.
• Transportation Management	The Plan is specific to construction and is to be developed by the EPC Contractor.
• COVID-19 Contingency Plan	The EPC Contractor will reflect the most up to date information generated on the topic, including measures to treat covid and other respiratory contagious diseases. The Plan will be attached as an addendum to the Operational Health and Safety Management Plan.
• Operational Health and Security Management	The Original Plan was prepared by the DGDC. Ormat will implement H&S Operational Measures from their own H&S Plan (to be prepared by Ormat before operations) and considering the risks identified in their ESMS.
• Non-existent as a standalone plan; there were gender considerations included as part of the Labor conditions and Workers' Selection Plan	Gender Action Plan. This plan was designed to prevent sexual and gender-based violence, raise awareness on sexually transmitted diseases and infections and measures to enhance gender equality.
• Disaster Risk and Emergency Management	Disaster Risk Management and Adaptation Plan. The plan has been developed using the IDB Methodology.

The proposed Project is anticipated to deliver benefits during the operation given that it would provide baseload renewable electricity to the island of Dominica and reduce the reliance on diesel fuel for power generation; however, it is acknowledged that the Project could also potentially lead to negative environmental and social impacts during its construction and operation. With the application of these mitigation measures, and the commitment to meet all the applicable standards and regulatory requirements, the Project will result in positive environmental and social outcomes, generating benefits to the population of Dominica.

1. INTRODUCTION

In 2023, the Caribbean Development Bank (CDB) received a request to finance a Geothermal Project in Roseau Valley, Dominica, using resources from the Sustainable Energy Facility[2] (SEF), through which Inter-American Development Bank (IDB) is also considering supporting. “The Project” consists of a 10 megawatts (MW) binary-cycle Geothermal Power and associated facilities that will be designed and constructed by the private company Ormat Technologies Inc, through its subsidiary Geothermal Power Company of Dominica (2023) LTD (Ormat), with support from the Dominica Geothermal Development Company Ltd. (DGDC), a special-purpose vehicle with its own board, created in 2017. The DGDC is 100% owned by the Government of the Commonwealth of Dominica (GoCD) and equity is transferred from GoCD to the DGDC under a subsidiary agreement. The GoCD (through the Lands and Surveys Division) acquired the land required to construct the current Project as well as land for prior drilling of exploratory and injection wells, activities that were concluded by another contractor in 2012-2013, followed by further testing in 2019. In December 2023, Ormat signed a concession agreement with the GoCD to construct and operate the power plant and associated facilities for a period of 25 years, making Ormat the developer and operator of the power plant. As the Project has had changes of developer and Project design and technology, the CDB and IDB retained Environmental Resources Management, Inc. (ERM) to update the Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP) to account for changes in the Project approach, scope, and design, as well as to validate that the critical assumptions and recommendations within the existing documentation remains relevant.

1.1 BACKGROUND

In 2018, Jacobs New Zealand Limited (Jacobs) prepared an Environmental and Social Impact Assessment (2018 ESIA[3]) for the construction and operation of the Dominica Geothermal Project. The Project included the construction and operation of geothermal wells, reinjection systems and a geothermal power plant with a capacity of 7 MW, and connection to the Dominica electrical grid and associated infrastructure. The World Bank approved the Jacobs ESIA in 2018.

Following an unsuccessful procurement in November 2019, carried out by GoCD using World Bank financing and procurements rules, there has been subsequent design modifications (e.g., increase in capacity from 7 MW to 10 MW, the addition of a production well pad and well, and the relocation of the reinjection well pad and well). In 2020, ECLIPSE, Inc., prepared an additional ESIA[4] that assessed the impacts of the relocation of the reinjection well, its pad, and reinjection pipeline.

To account for all changes, ERM prepared an ESIA and ESMP addendum issued in February 2022[5]. This 2022 ESIA update included the updates to the previous ESIAs and added management plans, including a Resettlement Action Plan (RAP) required due to land acquisition for the Project by the GoCD.

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[2] FP020: Sustainable Energy Facility for the Eastern Caribbean | Green Climate Fund
[3] Available at: ESIA – DGDC (geodominica.dm)
[4] *ibid*
[5] *ibid*

The DGDC is no longer the developer but Ormat, who indicated they made changes related to technology (i.e. the type of equipment employed such as turbine equipment, cable along the pipe path, motive fluid, ACC fans), the construction of five operation buildings instead of one, changes in design pipe layout, steam trap collection system, and changes in the standards used for testing and the implementation of other safety methods (See section 3). The Project footprint (i.e., coordinates, boundaries) did not change from the 2022 ESIA.

In addition, Dominica Electricity Services Limited (DOMLEC) who is Dominica's privately owned electricity generation and distribution company, continues to be the sole generator and distributor (apart from some small-scale solar installations) on the island. Ormat will sell the geothermal energy, generated by the Project, to DOMLEC, who will distribute it to residents on the national grid per their Power Purchase Agreement (PPA) signed in December 2023[6].

1.2 PURPOSE AND NEED FOR THIS UPDATE

This 2024 ESIA Addendum prepared by ERM updates the existing ESIAs, provides Project description updates, and summarizes the management measures issued to date in a consolidated table, for easy retrieval and to facilitate the implementation.

In addition, this update includes supplemental management measures required to align with the CDB and IDB's standards: Gender Action Plan (GAP) that includes actions to address Gender equality and Sexual and Gender-based violence (SGBV) and an updated Disaster Risk Management Plan (DRMP). ERM also conducted a Resettlement Action Plan (RAP) audit which assessed how the RAP was implemented, including how the land was acquired, livelihoods restored and how compensations were paid.

1.3 OBJECTIVES AND SCOPE

The objective of this Addendum to the ESIA is to complement the existing ESIA studies conducted by Jacobs (2018), ECLIPSE (2020) and ERM (2022). The specific objectives are:

- Updating the Project description with 2024 modifications by Ormat
- Updating the applicable standards, administrative and legal framework to reflect the requirements of current lenders
- Conducting a RAP audit to verify that the process was conducted according to the applicable standards and in alignment with the Project's RAP (2022)
- Adding management measures required by IDB and CDB's policies
- Summarize management measures for practical implementation
- Present the 2024 ESIA addendum through a public consultation

This ESIA addendum is focused primarily on the Geothermal Power Plant, which is the Project's component that has had modifications since the latest addendum in 2022. There are associated facilities which have had modifications (i.e., the replacement of segments of an existing 11 kV TL

[6] Ormat Technologies Inc. - Ormat Signed Historic 25-Year Power Purchase Agreement with Dominica Electricity Services Ltd.

and the addition of a 5 MW battery storage system) and some sections have required land acquisition. These components are described in Section 3 but are not part of CDB and IDB's financing scope and their impacts were not assessed.

2. SUPPLEMENTAL POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The Policy and Legal Framework have not changed since the latest ESIA addendum. Given that the *Agence Française de Développment* (AFD) is no longer a lender, the Project is not required to align with its standards. However, the Project will comply with the following:

- Dominica's National Legislation and International treaties where Dominica is a signatory (found in the 2018 ESIA)
- The Inter-American Development Bank Safeguards Policies[7]
- The Caribbean Development Bank Environmental and Social Review Procedures (ESRP) from December 1, 2014[8]
- The IFC Sustainability Framework (2012[9]), which includes the eight Performance Standards and the World Bank Group (WBG) Environmental, Health and Safety (EHS) General Guidelines (2007[10]) and the EHS for Geothermal Power generation (2007[11])

The standards listed above are considered altogether the applicable standards. There are no new policies or guidelines applicable to the Project in addition to those mentioned above, which are fully described in the 2022 ESIA.

2.1 ORMAT'S POLICIES

Ormat Technologies, Inc. has a series of internal policies which govern all their projects; these policies are endorsed and signed by the Board of Directors and are applicable to all Ormat's subsidiaries. Therefore, Ormat will apply the following in addition to the local legal and administrative requirements and lender's requirements.

- Code of conduct:
  - The code includes provisions to comply with applicable laws, including anti-money laundering, anti-trust and environmental laws and regulations, avoid conflicts of interest, unfair competition practices and insider trading, abide by US anti-corruption laws, and maintain confidentiality for non-public information.
  - The code has guidelines on record keeping, receiving gifts, gratuities and entertainment, acceptable and unacceptable employment practices (e.g., prohibition of the use of alcohol (while on duty) and drugs, any form of violence or weapons, discrimination, or

[7] IDB | Operational Policies (iadb.org) – See section 'Safeguards Policies' (For Operations Approved Before November 2021)
[8] Environmental and Social Review Procedures | Caribbean Development Bank (caribank.org)
[9] Performance Standards on Environmental and Social Sustainability | International Finance Corporation (IFC)
[10] World Bank Group Environmental, Health, and Safety Guidelines (ifc.org)
[11] Guide for Preparation of Draft Industry Sector EHS Guidelines (ifc.org)

harassment), and references other Ormat policies, such as the equal opportunity policy and the whistleblower policy.

- Human Rights and Labor Policy
- Ormat commits to respect human rights, to avoid any infringements of human rights and to address any relevant human rights impacts that Ormat may be directly or indirectly responsible for or involved.
- Equal Opportunity Policy
    - This policy states that Ormat is firmly committed to equal treatment of all applicants and employees regardless of race, color, national origin, ancestry, religion, gender, age, pregnancy, sexual orientation, gender identity, gender expression, disability, generic information, military service, marital status, veteran status, or any other protected status.
    - The policy applies to all terms and conditions of employment. Ormat's policies regarding harassment, discrimination and retaliation are intended to be stricter than applicable federal and state laws.
- Integrated Quality Environment Health and Safety (QEHS) Policy
    - The policy states that Ormat has an integrated management system and requires that they comply with international codes such as the International Organization for Standardization (ISO) 14001, ISO 9001, Pressure Equipment Directive (PED) 2014/68/European Union (EU) and the American Society of Mechanical Engineers (ASME)[12].
- Environment and Climate Change Policy
    - The policy outlines Ormat's commitment to the United Nations Sustainable Development Goals (SDGs) and to abide by environmental aspects of applicable laws and regulations.
    - Climate-related commitments include (1) encouraging low carbon energy generation and the efficient use of water, energy, and material resources; (2) developing innovative technologies for better performance; (3) applying best available technology for plant construction, operations, and decommissioning; (4) protecting biodiversity; (5) reducing waste and by-product generation; (6) tracking relevant data on the Company's environmental and climate change impacts and (7) Complying with the standards set out in relevant legislation and regulations.
- Whistleblower Policy
    - Establishes the procedures for making complaints and describes the procedure to treat and investigate complaints and allegations.
- Sexual and Gender-Based Violence (SGBV) is not tolerated and it is considered in multiple policies, including Human Rights and Labor, Equal Opportunity and Ormat's Code of Conduct.

[12] These are international standards related to different topics: ISO 14001 is for Environmental Management systems; ISO 9001 relates to Quality Management, and the Pressure Equipment Directive (PED) (2014/68/EU) applies to the design, manufacture and conformity assessment of stationary pressure equipment with a maximum allowable pressure greater than 0,5 bar.

The above and other Ormat policies are publicly available in the following link:
https://www.ormat.com/en/company/engagement/view/?ContentID=9199

3. PROJECT DESCRIPTION AND MODIFICATIONS SINCE THE 2022 ESIA ADDENDUM

This section provides an updated project description of the design modifications which have occurred since the 2022 ESIA addendum. Design modifications are listed in Table 3.1; only modifications were included; Project elements omitted from the table below remain the same from the 2022 ESIA. Section 3.1 provides a Project overview of current design and references the 2022 ESIA where applicable. Components marked with an asterisk (*) are considered additional facilities, **not part** of the "Project" as defined in this ESIA addendum.

TABLE 3.1 DESIGN CHANGES SINCE THE 2022 ESIA

Component	2022 ESIA	2024 update
Transmission lines*	The design assumed only 1 x 11 kV and 2 x 33kV underground cable interconnection to the DOMLEC electricity grid at the power plant.	There will be replacement of some sections of the existing 11 kV transmission line to 1 x 33 kV and 69 kV. Most of the TL will be underground and a portion of the 69 kV will be overhead. The TL will be constructed by the GoCD and will be operated and maintained by DOMLEC.
Buildings	Only one building was planned at the Plant site.	Ormat plans to construct five buildings for operations, all within the designated power plant's footprint area.
Storage*	No power storage was considered in the original design.	GoCD will construct a 5 MW Battery storage facility that will be operated by DOMLEC with the UAE-Caribbean Renewable Energy Fund and through a different developer.
Wells	Concrete slab around the well.	Concrete slabs were constructed for new wells drilled (2022 and 2023).
Power plant – Organic Rankine Cyle (ORC)	Use of two parallel recuperators.	Use of a single recuperator.
Power plant	Turbines from Atlas Copco.	Turbine will be from Ormat. The Organic Rankine Cycle (ORC) will continue to be the chosen technology for this Project.
Power plant	Motive fluids mentioned are Iso-pentane or N-pentane.	Motive fluid is Cyclo-pentane. According to Ormat, the designed motive fluid has been adapted for the thermodynamic character of the geothermal fluid. This fluid is already in operation, widely available and safe to operate. It has similar chemical features as the previously considered motive fluid.
Power plant	Design parameters based on European Norms (EN).	Design parameters based on the American Society for Testing and Materials (ASTM).

Component	2022 ESIA	2024 update
Power plant	Fiber optic cables path to injection lines.	Run cable along pipe path. Discreet cable above ground on the existing pipe path for quick installation, and reparation/replacement in case of malfunction.
Power plant	Air Cool Condensers (ACC) fans at variable speeds.	ACC fans are single speed. By design, ACC fans are single speed. The number of fans in operation will be regulated for the most efficient cooling Procurement and selection of low noise volume fan blades ensure noise mitigation.
Power plant	ACC fans wide protection screen.	Additional spare fans. Wide protection screens reduce fan efficiency and provide little additional protection. Additional spare fans are more efficient and can be quickly replaced.
Power plant	Steam trap collection system.	Independent gathering. Concrete blocks are expected to be used on every steam trap instead of a massive trap collection system prone to leaks. This ensures a localized and efficient water collection system.
Power Plant Facilities	The electrical building will include separate areas for offices, kitchen and meeting rooms, workshop and storage, a control room, and a machinery room.	The electrical building will not include additional areas.
Workforce	Estimated as a maximum of 50 people during construction and 4-6 people during the plant's operations.	There will be approximately 100 people required during construction and 31 during operations. Ormat will encourage and support hiring locals as much as possible (around 85%).
Water usage	Water intake estimated as 10,000 liters daily (200,000 liters monthly) during construction. During operations, potable water will be supplied by Dominica's Water and Sewerage Company Ltd. (DOWASCO). Demand estimates ranged between 8 and 10 m^3/hr.	Raw water during construction is estimated as 1,500 liters (396.26 gallons) a day, or 29,904.75 liters (7,900 gallons) per month. Water will be sourced from water trucks, and it is within the EPC Contractor's responsibility. Estimates during operations are 0.3 m^3/day. Ormat will use air-cooled condensers to cool down the motor fluid in the cycle, which doesn't use water and allows to have a reductio in the use of this resource.

* Outside the scope of funding and this ESIA.

3.1 PROJECT OVERVIEW

There are several components to the Project. Some of them have been carried out/constructed in previous years through other developers, while others are yet to be constructed. In addition, some elements will not be funded by the lenders. For description purposes, this chapter lists all components, specifying which ones are part of the funding scope and which ones are existing elements.

The Project will have the following components:

1. 10 MW binary-cycle power plant (2 turbines of 5 MW each)
2. Wells and pads (already drilled and outside the scope of this ESIA):
   a. Two production wells (already drilled and flow tested): WW-P1 and RV-P2.
   b. One injection well (already drilled and injection tested): RV-I2.
   c. Exploration well WW-03 will also be used for production
3. A 1.2 km reinjection pipeline to be constructed (no changes since the 2020 ESIA)
4. Additional facilities (all of which are outside of the scope of the funding scope but are not constructed yet):
   a. New Transmission Lines (TL) segments of 33 kV and 69 kV (to replace segments of the existing 11 kV TL. This will be done by a different developer for DOMLEC)
   b. A 5 MW battery storage system – (to be constructed for DOMLEC)
   c. Office building and material facilities

The Power Plant and new pipeline will be constructed and operated by Geothermal Power Company of Dominica (2023) Ltd, a Special-Purpose Vehicle created by Ormat International, Inc (Ormat)[13], who has a concession agreement with the GoCD to operate the plant for 25 years. Moreover, Ormat will also design (engineer), procure and construct the Project though its other subsidiary Ormat Nevada, Inc, who signed a contract as the EPC Contractor of the Project. The contract was executed in March 2024 between Ormat Nevada and Geothermal Power Company of Dominica (2023) Ltd (also Ormat).

Once the concession ends, the ownership and operations will be turned over to the government. The area where the Project will sit has been acquired by the GoCD, which totals 124,482 m^2 (see Table 3.3). The DGDC has a PPA with DOMLEC, who has the exclusive license to distribute and supply electricity to the Island. DOMLEC will purchase the electricity in a “take or pay” scheme, which is why they plan to include a battery storage.

Project activities include grading, civil works, mechanical and electrical works, and testing and commissioning activities.

3.1.1 MAJOR PERMITS

Ormat has obtained the necessary permits and authorizations for the construction of the power plant and is in the process of obtaining other permits and authorizations for later phases of the Project, including operations (Table 3.2).

[13] The legal name of the developer is Geothermal Power Company of Dominica (2023) Ltd.

TABLE 3.2 KEY PERMITS AND AUTHORIZATIONS FOR THE DOMINICA GEOTHERMAL PROJECT

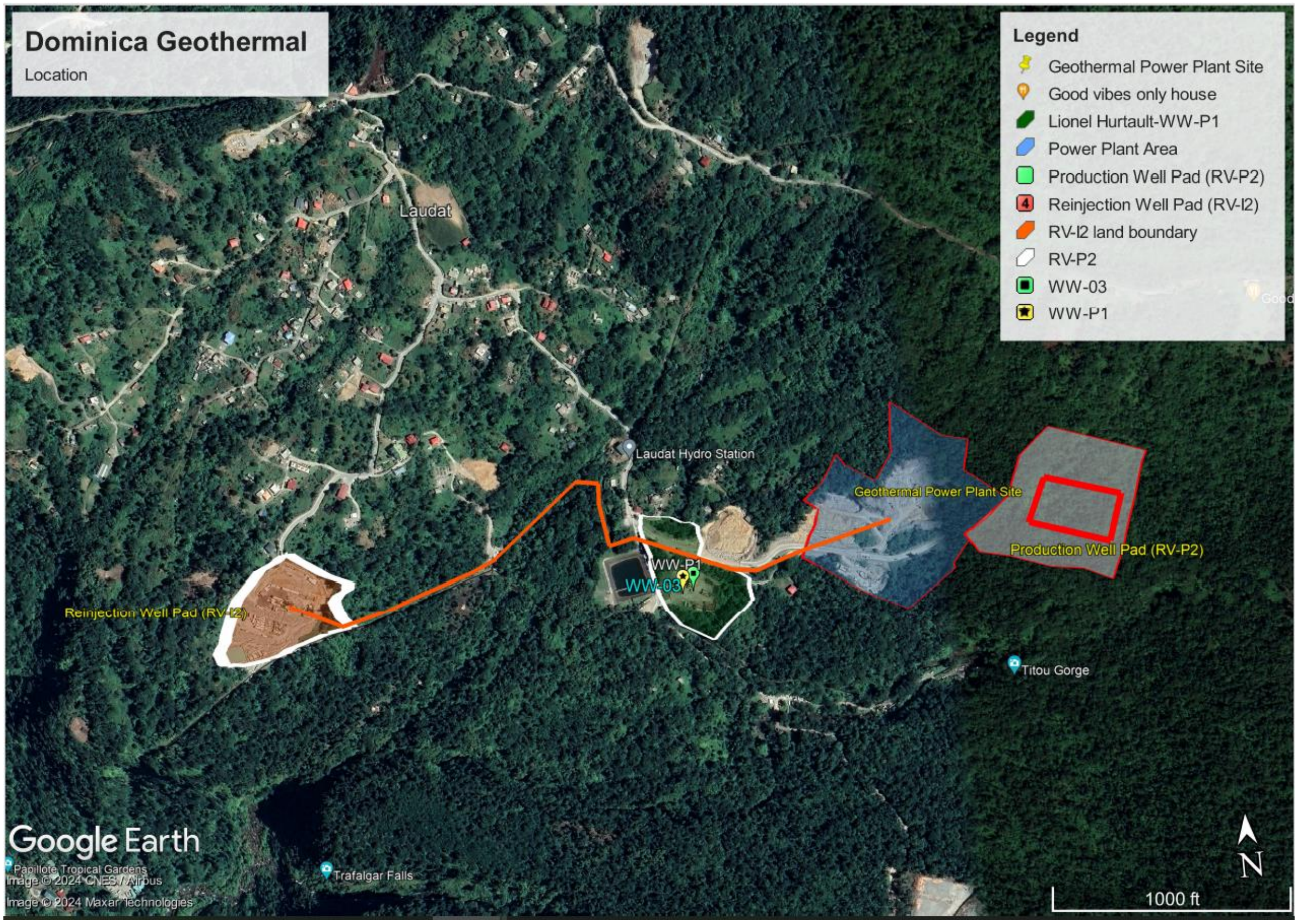
Permit/Authorization	Issuing Agency	Date obtained	Notes
Outline planning permission	Ministry of Housing & Urban Development – Physical Planning Division	28.May.2024	n/a
Vegetation clearing	Ministry of Environment, Rural modernization, Kalinago Upliftment and Constituency Empowerment. Forestry, Wildlife and Parks Division	25.June.2024	This authorization allows Ormat to clear 6,000 m^2 (1.48 acres) of vegetation for the construction of the geothermal power plant.
Approval of site for the disposal of soil for the Dominica Geothermal Plant	Ministry of Health, Wellness and Social Services – Environmental Health Department	26.July.2024	Non-objection letter for sites proposed by Ormat to dispose soil from grading works.
Generation license	Independent Regulatory Commission (IRC)	01.January.2021	Originally obtained by the DGDC, who transferred it to Ormat. The generation license is valid for 25 years, consistent with the concession agreement between Ormat and the GoCD.
Transfer of the generation license to Ormat	Independent Regulatory Commission (IRC)	21.December.2023	n/a

Source: Ormat, 2024

3.2 PROJECT LOCATION

The Project's location and footprint remains the same since the 2022 ESIA addendum: it is in the Roseau Valley, to the southeast of Laudat, at an estimated elevation of 550 meter above mean sea level (amsl) (Figure 3.1). The Project area and description of each Project component is detailed in section 3.3.

FIGURE 3.1 PROJECT APPROXIMATE LOCATION



Source: DGDC, 2023.

3.2.1 LAND ACQUISITION

All land has been acquired by the GoCD; no new land is envisioned for the Project. Ormat's agreement with the government includes a provision for acquiring more land if needed. If the Project required more land for future expansion or for other reasons, the GoCD would handle the transaction through the DGDC, and the ESIA would be updated. In case physical or economic resettlement occurred, a new RAP would take place.

Currently, all land for this Project has been acquired and compensation packages delivered. The assessment of the implementation of the current RAP was issued separately dur to confidentiality.

3.3 PROJECT COMPONENTS

Table 3.3 shows the Project footprint with a breakdown of each facility

TABLE 3.3 PROJECT FOOTPRINT

Project component	Land acquired (m²)	Construction area (m²)	Note
10 MW binary-cycle power plant	40,833	17,687	The "construction area" corresponds to the grading area. The Power plant itself will take 3.07 acres (12,423.85 m²). Most land was previously used for agriculture or was voided of vegetation. Ormat will clear 1.48 (6,000 m²) acres of vegetation, for which they obtained a permit by the Forestry, Wildlife and Parks Division on June 25, 2024.
Production well WW-P1	15,626	~3700	Both wells have been drilled and are within the same area.
Production well WW-03			
Production well RVP2	30,594	4,700	n/a
Injection well RVI2	17,874	~15,700	n/a
Injection pipeline	4,784	3,827	The pipeline will be 1,200 long and will require an 8 m Right of Way (Row) during construction and a 4 m wide corridor during operation.
Office Buildings	n/a	1,001.5	Combined area of five buildings is within the power plant's area (3.07 acres) described above.
Land adjacent to the power plant	14,771	TBD	It will accommodate part of the Steam Gathering System (SGS). No vegetation clearing will be required. The SGS will be installed within the existing access road.
Total estimated area (m²)	**124,482**	**46,616**	

Source: Ormat, 2024; DGDC, 2024. Note: TBD: To be determined.

3.3.1 PRODUCTION AND INJECTION WELLS

All production and injection wells for the Project have been drilled and tested. Their full description, its impacts and their mitigation measures can be found in the 2022 ESIA. Table 3.4 shows the physical parameters of the existing wells that will be used during the Project's operations.

TABLE 3.4 PHYSICAL PARAMETERS OF THE EXISTING PRODUCTION AND INJECTION WELLS

Parameter	WW-P1	WW-03	RV-I2	RV-P2
Wellhead, Easting (m)	679,461	n/a	678,887	680,000

Parameter	WW-P1	WW-03	RV-I2	RV-P2
Wellhead, Northing (m)	1,695,567	n/a	1,695,605	1,695,646
Wellhead Elevation m (masl)	552	543	517	612.5
Total Depth (mRKB)[14]	1,505	1,613	1,384	1,385
Azimuth (°)	190	-	210.5	155
Throw (m)	465	-	Not Available	Not Available
Casing Size (in)	9 5/8	7	9-5/8	9-5/8
Casing Shoe Depth (m)	726	590.6	746.2	781
Liner Size (in)	7	4.5	7	7
Liner Depth (m)	700-1,505	569-1,612	709-1375 (9m of fill)	753-1385

Source: Ormat, 2024.

3.3.2 POWER PLANT

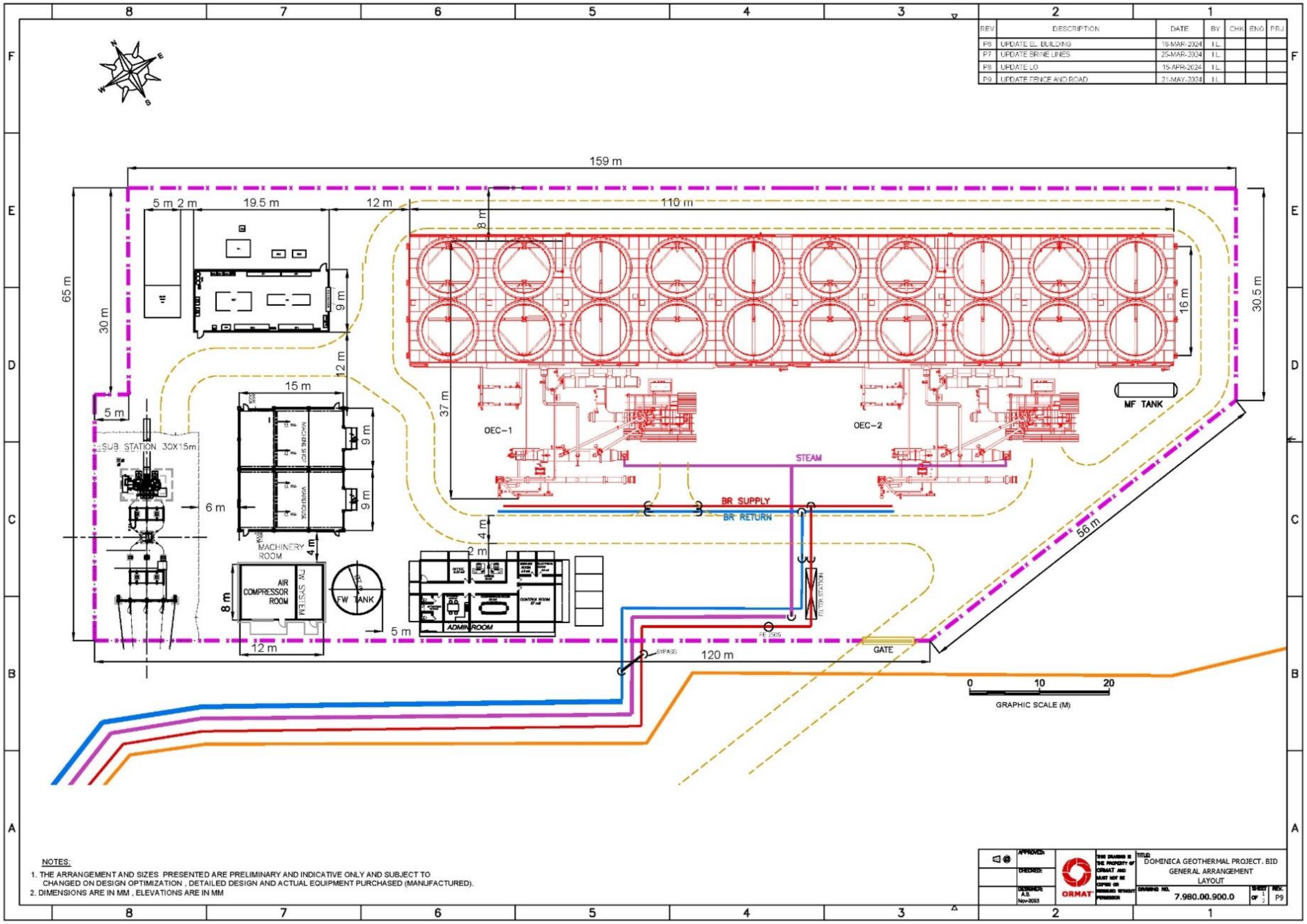
The Power Plant will maintain the same equipment as the 2022 ESIA: Turbine Generator, Heat Exchangers, Recuperators, Condensers, Pumps (feed, ponds, firefighting system), Storage Tanks, Transformers and other Substation components, Emergency Generator, Fire Fighting Tank and System, a Heating, Ventilation, and Air Conditioning (HVAC) System, Oil System, brine ponds, septic tank, and leach field.

Within the Power Plant's footprint, Ormat will also construct: (1) an electrical building, (2) a machine shop, (3) a warehouse, (4) a control building and (5) an air compression room, (6) security building and parking lot, (7) and a firefighting room.

The Power Plant's layout, including the areas for each building, is shown in Figure 3.2.

[14] mRKB - rotary kelly bushing depth, or the depth measured below the rotary table

FIGURE 3.2 POWER PLANT LAYOUT



Source: Ormat, 2024.

Though the final design is not available, the design life of the Plant is 30 years and the design life for all buildings shall be 50 years for the application of the structural design codes (Table 3.5).

TABLE 3.5 POWER PLANTS' TECHNICAL SPECIFICATIONS AND DESIGN PARAMETERS

Power Plant component	Description
Turbine	Manufacture standard (PARA-ASME)
Materials	ASTM (ASME for pressure vessels) / PED or equivalent
Pressure piping	ASME B 31.1 & B 31.3 / PED
Pressure vessels	ASME Sec VIII Div. 1 including U stamping (TEMA C for heat exchangers) / PED
Steel structure	AISC / EN10025
Feed pumps	Manufacture standard (PARA-API 610)
Valves	ANSI / API or DIN
Generator	NEMA MG1 / IEC 60034
Generator circuit breaker, MCC	MCC NEMA / IEC
Electric work, motors	NEMA / IEC
Control and Instrumentation	ISA / IEC
Instrument units	BU / SI
Classification of Hazardous Area for Electrical Equipment	U.S. National Electrical Code (NEC) Class I Div. 2, Group D or IEC classification Zone 2 Gas Group IIA or Atex Zone 2 Gas Group IIA
Hot dip galvanizing	Supplier standard
Painting system for un-insulated piping and equipment operating at temperatures lower than 120°C (250°F)	Supplier standard
Grid frequency and voltage control	Capability standard with BASLER DEC250

Source: Ormat, 2023. Concession agreement

The plant will have installed stormwater drainage systems, as described in the 2022 ESIA addendum. The EPC contractor, Ormat Nevada, Inc (hereafter, "Ormat Nevada") is preparing a Civil Plan that will detail Stormwater Management. Currently, Ormat has opened a temporary channel to divert water from the excavation area. Stormwater outfalls are still under design by the grading subcontractor. Ormat, through their subcontractor ECLIPSE, will conduct stormwater water quality monitoring every quarter; the frequency may increase as needed. Water quality sampling is discussed in Section 6.4.7

3.3.2.1 ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC)

For the construction of the Plant, Ormat Nevada will procure the following items:

- Two Ormat ® Energy Converter (OEC) Units: 2 x 5MW net Air-Cooled generating units
- Air cooled condenser including support structure
- Heat Exchangers (HeX) and Feed pumps (manufactured by Ormat)
- Electrical and control equipment
- Condensate system

Construction's main items are the following:

- Foundation & Buildings
- Electrical works Installation
- Utilities
- Commissioning and tests
- Transportation

Specifically for the Balance of Plant (BOP):

- Separation systems
- Geothermal pipe spools and supports
- Compressed air system
- Electrical equipment
- Firefighting system
- Fill & Drain
- Substation

The Plant will interface with a substation at the A Frame, the 33 kV transformer, and an 11 kV black start feeder.

3.3.3 PIPELINES

The pipeline route described in the 2022 ESIA addendum has not changed. There are no updates for that Project component.

Condensate produced in the steam pipelines will be collected via a condensate collection drain pot, found at local low points on the route. Condensate will either flow through a piped network to downhill storage sumps from where it can then be pumped to the injection well for disposal or will be discharged directly to the ground.

3.3.4 BRINE PONDS

Ormat will use the existing brine ponds to avoid unnecessary disturbance. The size and nature of the ponds is described in the 2022 ESIA addendum (P. 28; Section 3.9).

3.3.5 ADDITIONAL FACILITIES

As previously mentioned, the power plant will interface with additional facilities, which include a new line transmission network (with 11 kV, 33kV, and 69 kV sections) and a 5 MW storage battery system. DOMLEC has commenced preparation work for three new substations. All components will be constructed by DOMLEC and are not being funded by the lenders mentioned in this report.

There will not be additional access roads to the existing ones.

3.4 RESOURCES AND WASTE MANAGEMENT

3.4.1 WATER AND FUEL

3.4.1.1 CONSTRUCTION

Raw water consumption estimates are lower from the 2022 ESIA addendum; approximately 1,500 liters (396.26 gallons) a day, or 29,904.75 liters (7,900 gallons) per month. This estimate includes water for earthworks, wet trades, tools/materials washing, water for concrete, dust control and water required for workers' hygiene. Water trucks will be purchased by the EPC contractor for such activities; they will buy from authorized vendors.

Fuel consumption will be 115.5 liters per hour, as broken down in Table 3.6. Fuel consumption was estimated based on the equipment that will be used during construction.

TABLE 3.6 ESTIMATED FUEL CONSUMPTION DURING CONSTRUCTION

Equipment	**Fuel consumption (liters/hour)**	**Monthly fuel consumption (gal/month)**
Air compressor	22	31.00
Concrete mixer	2	2.82
Crane	12	16.91
Concrete pump	12	16.91
Welding set	4	5.64
Excavator	14	19.73
Forklift	5	7.05
Power generator	20	28.18
Trucks	6.5	9.16
Side boom	18	25.36
TOTAL	**115.5**	**162.75**

Source: Ormat, 2024.

3.4.1.2 OPERATIONS

The Project will not need to source water for operations, other than to supply bathrooms and providing potable water for workers of the plant. The Project will connect to Dominica's Water and Sewerage Company Ltd. (DOWASCO) for this.

Potable water will be purchased; if needed, Ormat may decide to obtain it from the Dominica Water and Sewerage Company Limited (DOWASCO); however, that is not the preferred choice at this moment. The estimated demand during operations is 0.3 m^3 (300 litters)/day.

No fuel will be required during operations as the power plant will self-generate energy.

3.4.2 HAZARDOUS MATERIALS

Hazardous materials remain as described in the 2022 ESIA (Section 3.11.2; page 28). Hazardous materials associated with the Project include the working fluid, oils and lubricants, and could include other chemicals such as sulfuric acid, sodium hydroxide, and hydrogen chloride that would be used to adjust the pH of the geothermal fluids and reduce scale build-up in the wells and heat exchangers. These materials would be stored in designated areas with impervious surfaces designed to contain potential spills.

The working fluid for the ORC will be kept in a 30 m^3 storage tank within the Power Plant. Hazardous Materials management measures will be included in a Hazardous Substances Management Procedure, which will be developed by the EPC Contractor Ormat Nevada.

Ormat will have a diesel storage tank (intended for the emergency generator). The tank will have secondary containment to prevent spills.

3.4.3 WASTE

3.4.3.1 NON-HAZARDOUS WASTE

Ormat estimates they will generate 20 cubic yards of non-hazardous waste (including concrete, cardboard containers, and burlap). Ormat and its EPC Contractor will retain an authorized supplier to transport, recycle or dispose waste during construction and operation. All waste will be finally disposed on Dominica Solid Waste Management Cooperation – Fond Cole Sanitary Landfill, which also takes recyclable waste. Ormat will not burn any waste, including cleared vegetation, despite being an acceptable practice under Dominican Law. They will also prohibit burning waste to their subcontractors.

3.4.3.2 HAZARDOUS WASTE

The Project will implement a Hazardous materials management plan to make sure the safe handling, storage, and disposal of these materials. Any hazardous waste generated during construction and operation will be handled in accordance with the Hazardous Waste Management Plan (2022 ESIA addendum). Hazardous waste estimates are in progress.

Ormat and its EPC Contractor will retain an authorized supplier to transport and dispose hazardous waste during construction and operation. They have identified options, but the final selection has not been completed. Final disposal site will also be the Fond Cole Landfill, which takes hazardous waste.

3.4.3.3 WASTEWATER

Domestic wastewater during construction consists of sanitary wastewater, which will be contained in portable toilets. These are handled by a specialized third party, who will treat and dispose them.

During operations there will be a single wastewater stream, consisting of sanitary facilities (domestic water). Ormat will use septic tanks during operations.

In addition, the existing brine ponds will collect geothermal fluids, which have been designed to be able to hold enough geothermal fluids during plant shut-down activities or emergency response. Any geothermal fluids collected in the brine ponds will also be re-injected into the reservoirs.

3.4.3.4 STORMWATER

During construction and operations, stormwater will be managed separately from industrial and sanitary wastewater to avoid contamination. It will be diverted from the construction areas in accordance with the Erosion and Sediment Control Plan and be collected in secondary containment areas will be checked for oil sheens and any signs of contamination before being discharged to the surrounding surface to allow for infiltration into the ground.

If there are signs of contamination, the stormwater will be pumped out of the secondary containment areas and collected, transported, treated or sent to disposal in compliance with local regulations (please refer to Section 4.4.3 of the 2022 ESIA).

3.5 WORKFORCE

3.5.1 CONSTRUCTION

Ormat will require approximately a total of 90-100 workers during construction, most of which are expected to be Dominican. It is anticipated that there will be around 30 people at a time for each construction phase (i.e., civil works, mechanical, electrical, etc.). Table 3.7 provides an estimate during construction:

TABLE 3.7 WORKERS' INFLUX DURING CONSTRUCTION

Estimated workers influx on construction phase	
Contractors/subcontractors (local workers)	
Discipline	Number of workers
Civil	30
Mechanical	35
Electrical	20
Ormat personnel (Foreign)	
Site manager	1

Estimated workers influx on construction phase	
Warehouse	1
Engineering	2-3

Source: Ormat, 2024.

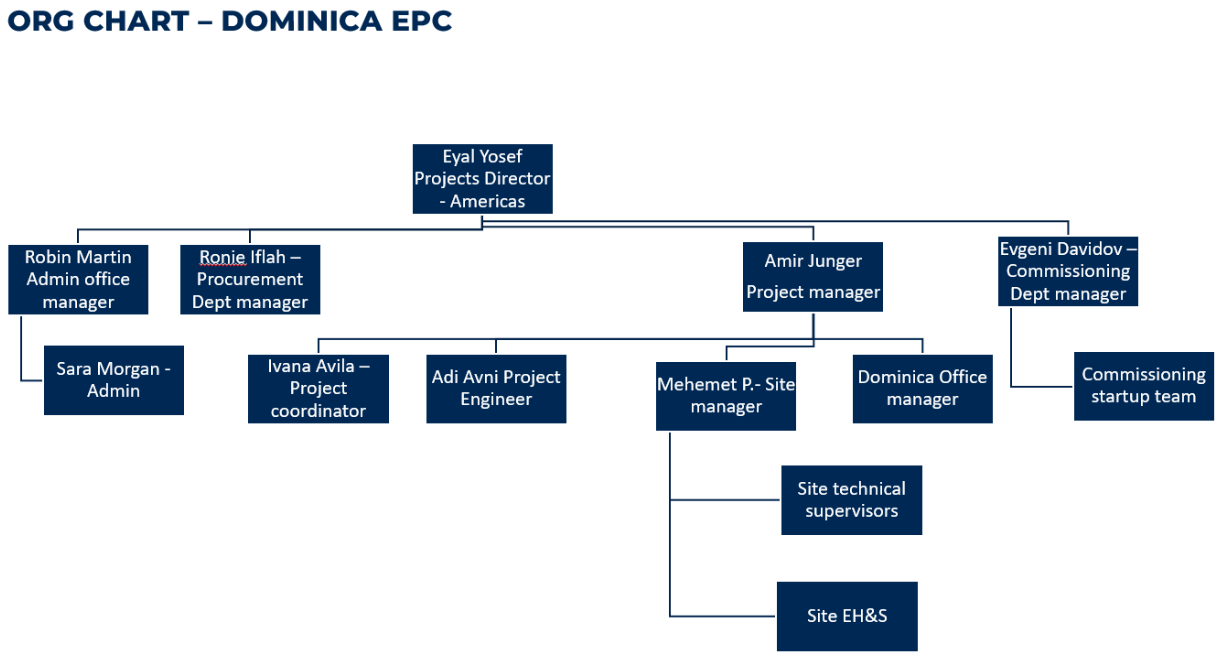
Women will be encouraged to apply for a job; however, Ormat will not hire directly local workers; rather, it will hire local subcontractors which may in turn hire locals for the job. Ormat will train local workers as needed. The training curriculum will include technical aspects of construction but also HSE obligations, including:

- Ormat's Policies on human rights, equal opportunity, environment and climate change, human resources
- Ormat's Environmental and Social Management System (ESMS) for the Dominica Geothermal Project
- The IFC Performance Standards, IDB and CDB's framework
- Workers Code of Conduct
- Whistleblower Policy and workers' grievance mechanism
- Health and Safety Practices
- Emergency Preparedness and Response
- Sexual and Gender based violence prevention measures
- Biodiversity, Environmental, Social and H&S Management Measures of Ormat's ESMS

Ormat's organizational chart during construction is below. Table 6.1 displays the roles and responsibilities for the ESMS implementation; the HSE coordinator (also known as "Site EH&S" in the organizational chart) oversees ESMS implementation, including management measures of this ESIA and the ESMP. There are two technical supervisors, and soon Ormat will add a third one.

If needed, Ormat will retain additional staff to support the implementation of HSE and ESIA measures (e.g., gender-related measures and the grievance mechanism).

FIGURE 3.3 ORMAT'S ORGANIZATIONAL CHART DURING CONSTRUCTION



Source: Ormat's ESMS, 2024.

3.5.1.1 WORKERS' TRANSPORTATION

There will be no camps; workers hired from abroad will be accommodated on the island. Their accommodations will be coordinated by Ormat; however, they are expected to be 4-5 people during construction, while the rest are planned to be locals.

Based on the above, workers influx will not be significant for this Project.

3.5.2 OPERATIONS

During operations, Ormat will require a workforce of 31 people (inclusive of administrative staff), with the following positions (Table 3.8). Staff working at the plant will be 6 in total (three per shift). Figure 3.4 displays the proposed organizational chart during operations.

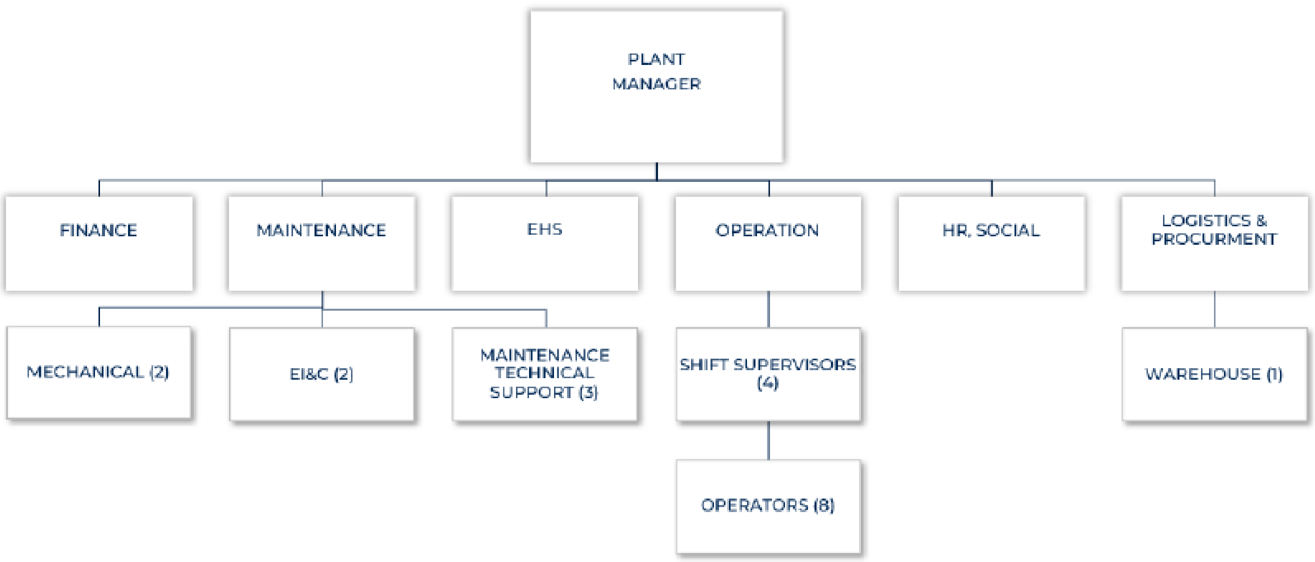
TABLE 3.8 WORKERS DURING OPERATIONS

Position	Estimated number of employees
Plant manager	1
Human resources	1
Procurement	2
Health, Safety, & Environment (including social performance)	2
IT	1
Wellfield	1

Position	Estimated number of employees
Operations (three people per shift)	6
Cleaning	2
Driver	1
Equipment operators (manlift, truck crane...)	2
Accounting/Legal	2
Maintenance (Mechanical, Electrical, Instrumentation & Control)	7
Security	3

Source: Ormat, 2024.

FIGURE 3.4 PROPOSED ORGANIZATIONAL CHART AND PERSONNEL DURING OPERATIONS



Source: Ormat, 2024.

3.6 SCHEDULE

Construction will take 18 to 27 months, with site clearing and grubbing starting in July 2024. The scheduled Commercial Operations Date (COD) will take place 24-33 months from the "effective date"[15] (January 4, 2024) and it is expected to be commissioned by the end of 2025. The below are key Project milestones planned per the concession agreement[16]:

[15] Established 30 days after the signing of the concession agreement, which took place on December 5, 2023.
[16] Milestones marked with an asterisk (*) were sourced from consultation presentations and other documents different from the concession agreement. Such milestones were added to provide a more detailed description of the Project's schedule.

- Grading and civil works – From July to September 2024
- Civil foundations – From Early September 2024 to Mid-March 2025*
- Mechanical construction – From Late September 2024 to Early May 2025*
- Order main equipment – February 2024
- Start of manufacturing main equipment – September 2024
- Power block construction start – February 2025
- Gathering system – From Early March 2025 to late July 2025*
- Buildings – From Mid-January to Mid-March 2025*
- Firefighting system – From Late December 2024 to Early March 2025*
- Electrical construction – From Mid-September 2024 to Mid-September 2025*
- Start of commissioning activities (including tests) – November 2025
- Commercial Operations Date – January 2026
- Longstop COD date – October 2026
- Extended longstop operations date – January 2027

As part of the agreement, the GoCD may request future expansions for the Power Plant; the date and nature (i.e., capacity) of the expansion—if there is one—will be determined solely by the GoCD. The requirements for such expansion (e.g., costs, land requirements, E&S impacts) would be evaluated separately through another ESIA. Potential expansions cannot occur before the third year from the COD.

The Operation and Maintenance (O&M) phase will be 25 years (with the possibility of expanding this phase); during this time, Ormat will be the sole operator of the plant. After such period the ownership of the power plant and other assets acquired during the life of the agreement will be transferred to the GoCD.

4. ASSESSMENT OF PROJECT IMPLEMENTATION TO DATE

Ormat started as the EPC in January 2024. Since then, they have been updating their environmental and social management plans, refining the project design, contracting with suppliers and local contractors (including contracting ECLIPSE, a local HSE services provider to support with environmental, H&S, and biodiversity commitments), and started grading activities on site. ERM verified that Ormat is adopting the ESMP from the 2022 ESIA Update into their project plans.

During the site visit on the week of July 22, 2024, we observed a well-managed project site and appropriate H&S practices. We made a few recommendations as the grading activities ramp up, including the following:

- Ensure that the grading contractor provide all workers with all necessary personal protection equipment (EPP) including steel-toe safety footwear (workers expressed they had to buy their own footwear).
- Clearly mark pedestrian-only areas on site to minimize human-equipment interactions.

- Set up one or more hydration and rest areas (this was in progress).
- Ensure that water quality is sampled after rain events (in progress); see section 6.4.7 for further details on water quality sampling.

Ormat is also pursuing the necessary permits, developing the site-specific protocols, and implementing the hiring and contracting strategy necessary to support the project as construction progresses.

5. IMPACT ASSESSMENT

5.1 GENERAL

The changes Ormat has made to the project are technical and within the same project footprint from the 2022 ESIA Update. Therefore, we identified no significant new or changed impacts for the project. The following table summarizes the impacts and their significance:

KEY DIRECT IMPACTS SUMMARY TABLE

Receptor	Impact description	Residual significance
Environmental/Soil	Increase runoff and sediment load due to deforestation and land clearing/levelling during construction	Minor
Environmental/Water quality	Decrease in Roseau River's water quality through increasing turbidity, reducing clarity and causing deposition of fine sediments	Minor
Environmental/Pollution	Potential for hazardous substances or waste to be accidentally discharged to the environment if inappropriately collected and stored on site.	Negligible
Environmental/Noise	During construction and commissioning works there will be noise impacts at Laudat (south), Trafalgar (east), Trafalgar (south) and Wotten Waven. Impacts will be short-term.	Minor
Environmental/Air quality	There is anticipated to be an increase release in H_2S because of the Project's activities. However, it is considered that there would be Negligible impact on receptors regarding odor, due to the low concentrations predicted at the main residential areas and a likely desensitized local population. Ormat will conduct ambient monitoring for H_2S during operations, at sensitive locations (e.g. nearby residential areas), using low-level ambient H_2S monitors which can be deployed at multiple locations for up to two months at a time.	Negligible
Environmental/GHG emissions	For GHG emissions, the total CO_2-e per year is significantly less than a fossil fuel derived energy source and therefore the Project is considered to have moderate beneficial impacts to the air quality.	Moderate beneficial

Receptor	Impact description	Residual significance
Environmental/Disaster Risk	The primary hydrological risk to the reinjection pipeline will be from flooding. Any pipe crossings (pipe bridges) over waterways will be at risk from potential flood impacts in terms of high-water levels and debris carried with these flows. With recommended detailed design mitigation measures in place to reduce the risk of flooding and debris strike, residual impacts for the reinjection pipeline are reduced to Moderate significance.	Moderate
Environmental/Disaster Risk	Potential impacts to the Project due to natural disasters, such as hurricanes.	Moderate
Biodiversity/General	Fragmentation of habitat and reduction of ecological connectivity.	Negligible
Biodiversity/Vegetation	Direct loss and disturbance of vegetation.	Minor
Biodiversity/Fauna	Mortality and Injury to fauna due vegetation clearing and habitat loss.	Negligible
Biodiversity/Fauna	Habitat loss for wildlife due to construction within the road improvement/ expansion locations, reinjection and production well pads, reinjection pipeline, power plant area and immediate surrounding areas.	Minor
Biodiversity/Fauna	Mortality or injury to fauna due to open geothermal brine ponds.	Negligible
Socioeconomic	Gender.	Minor
Socioeconomic	Worker Influx.	Minor
Socioeconomic	Land Acquisition, Resettlement and Livelihood Restoration.	Minor
Cumulative impact/ VEC: Terrestrial and Aquatic Biota (flora and fauna)	The Project, other projects, and external drivers could have potential negative impacts on terrestrial flora and fauna. Effects and disturbances caused by the plant construction activities will be Medium-term and reversible. Further Valued Environmental and Social Components (VEC) conversion and/or degradation is not likely to occur.	Minor to Negligible
Cumulative impact/ VEC: Land Traffic	The Project and other projects could contribute to the potential negative impacts on this VEC by increasing land traffic. The external driver could exacerbate traffic due to potential damages to road infrastructure. Construction will be short-term. The impact is considered Minor as traffic of heavy equipment will occur twice during the entire construction phase and then Negligible for operation.	Negligible
Cumulative impact/ VEC: Community Health and Safety	The Project, other projects, and external drivers could contribute to the potential negative impacts on this VEC: decreased quality of the	Negligible

Receptor	Impact description	Residual significance
	air shed. However, the other projects are already in operation and therefore their impacts are already considered in the Project baseline and residual impact assessment. The Project could potentially contribute incrementally to the adverse impact, but further VEC conversion and/or degradation is not likely to occur, or the Project's contribution will be expected to be negligible.	
Landscape Aesthetics	The Project and other projects will contribute to the potential negative impacts on this VEC by reducing flora. Additionally, landscape aesthetics was identified as a highly valued VEC by stakeholders. The Project could potentially contribute incrementally to the adverse impacts that already exist, and some degree of VEC conversion and/or further degradation or perception of degradation is likely to occur. Actions will be implemented in the medium term to mitigate potential adverse cumulative impacts on the VEC.	Minor

Source: ESIA addendum (Jacobs, 2028 and ERM, 2022; unchanged in 2024).

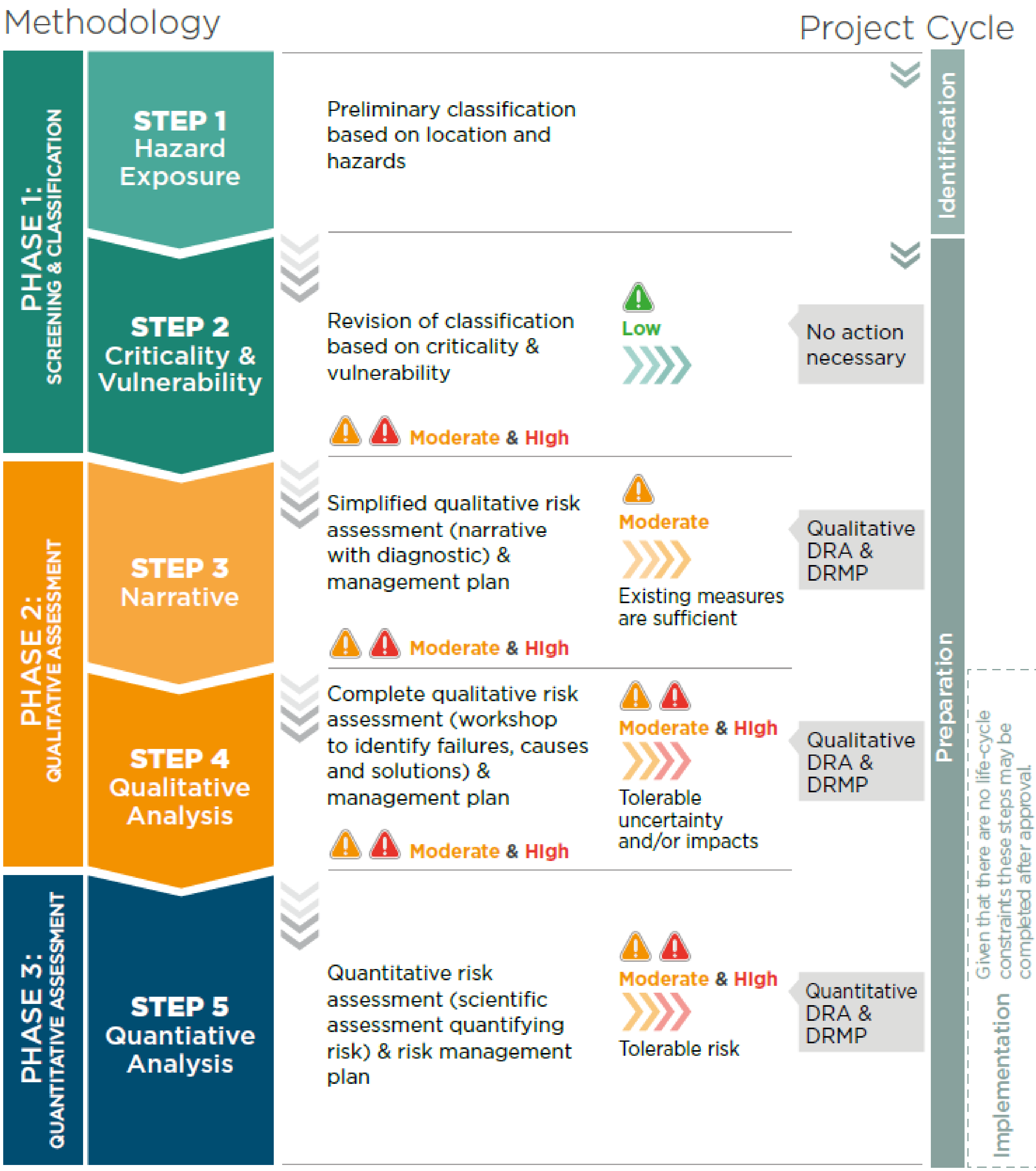
5.2 DISASTER AND CLIMATE CHANGE VULNERABILITY RISK

The 2022 ESIA and previous assessments only described disaster risk based on high-level natural disasters reported in the country, without considering any changes due to climate change in the future years. This addendum includes a Disaster and Climate Change Vulnerability Risk Assessment (DCCVRA) that includes:

- Screening and Classification from multiple databases of the Project's geophysical hazards for the baseline and future climate change projections of 2030, 2050, and 2080 excluding earthquake and volcanic hazards.
- Qualitative and Qualitative analysis of the criticality and current adaptation and management measures. The qualitative analysis was conducted based on previous ESIA studies and publicly available regional reports. The quantitative analysis was conducted through a participatory workshop with the Project design team.
- Preparation of a Disaster Risk Management Plan

This section summarizes the assessment; Appendix A includes the full assessment report. This update to the DRMP included a reevaluation of the hazard risks using the methodology presented in IDB's *Disaster and Climate Change Risk Assessment Methodology for IDB Projects*. This included a screening and classification of the hazard risks to the project area, a quantitative assessment of the proposed and implemented mitigation measures, and the development of updated DRMPs for the various hazards determined. An overview of the methodology is shown in Figure 5.1. Each of the considered hazards was evaluated for the risk presented to the project through four different time frames and two climate scenarios. The two climate scenarios considered were SSP1-2.6 and SSP5-8.5 and the four timeframes were: baseline, 2030, 2050, and 2080.

FIGURE 5.1 IDB DISASTER AND CLIMATE CHANGE RISK ASSESSMENT FRAMEWORK



Notes: Should the assessment be carried out after board approval, a legal condition might be included in the loan contract for it to be conducted.

Source: IDB, 2019.

The nine natural hazards that were included in this assessment are:

- Earthquake;
- Volcanic;
- Landslide;
- Hurricane;
- Flooding;
- Extreme Heat;
- Extreme Cold;
- Drought/Water Scarcity; and
- Wildfire.

Of the nine considered natural hazards, only six were determined to have moderate to high-risk levels. It was determined that the main high-risk present for the Project area is the risk stemming from Hurricanes. Hurricane risk was rated as high for all the considered time frames. The secondary source of high risk for the Project originates from extreme heat. While this natural hazard risk is moderate for the baseline time frame, the future projections have high risks. The flooding hazard has a moderate risk for only the baseline time frame, while earthquake, landslide, and volcanic risks are moderate for all time frames. The risk matrices for each time frame are shown in Figure 5.2 and for each of the natural hazards in Figure 5.4, and Figure 5.5. It is key to note that this risk assessment does not consider any mitigation measures, either planned or already implemented, for the hazards. This initial risk assessment, without the mitigation measures, is referred to as the general risk assessment. It will be used as the basis to evaluate the effectiveness of existing mitigation measures in reducing the risk from high and moderate-risk hazards.

FIGURE 5.2 GENERAL RISK MATRIX FOR THE PROJECT SHOWN ACROSS TIME FRAMES OF BASELINE, 2030, 2050, AND 2080

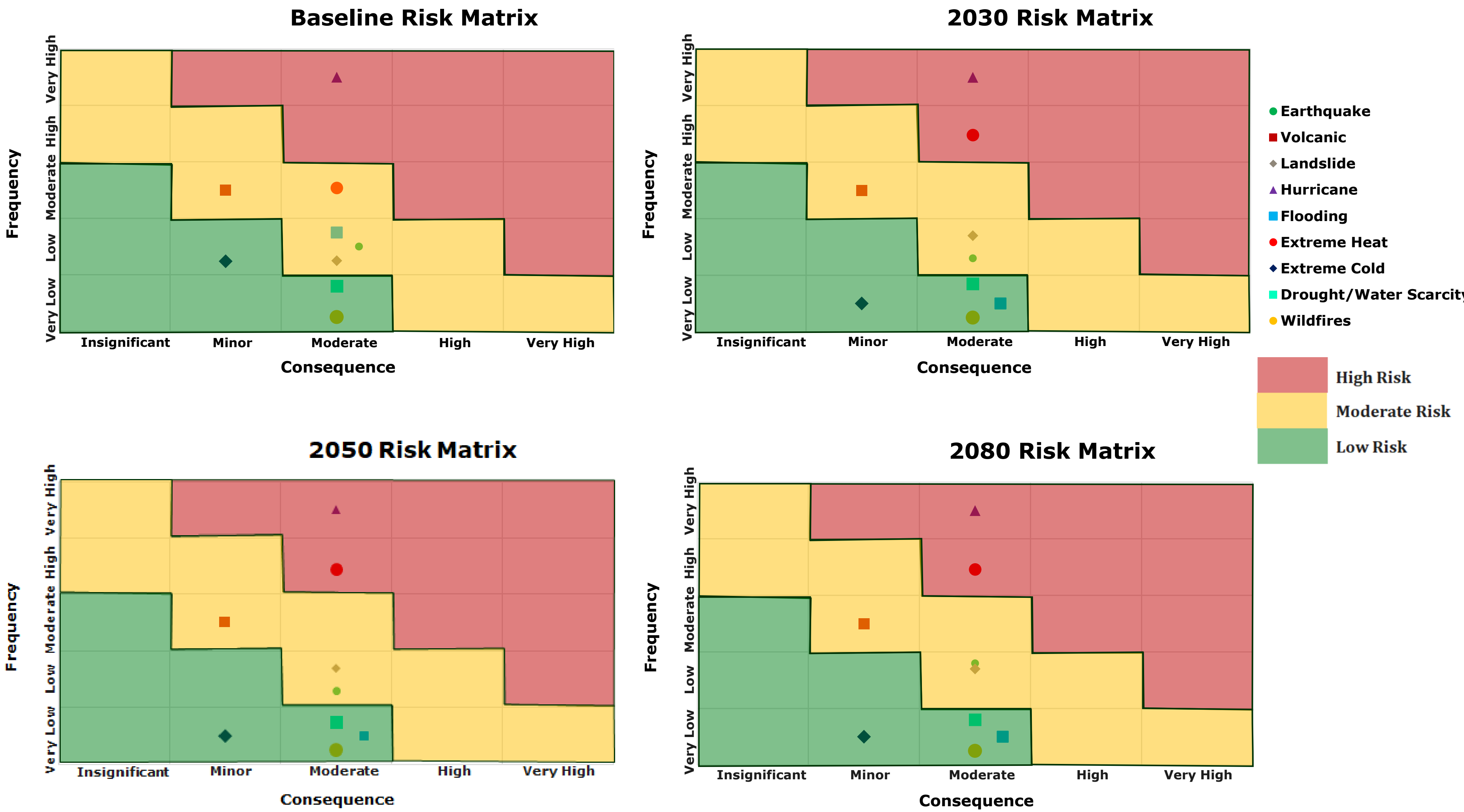


FIGURE 5.3 GENERAL RISK MATRIX FOR PROJECT – HAZARD-BASED (EARTHQUAKE, VOLCANIC, LANDSLIDE, HURRICANE)

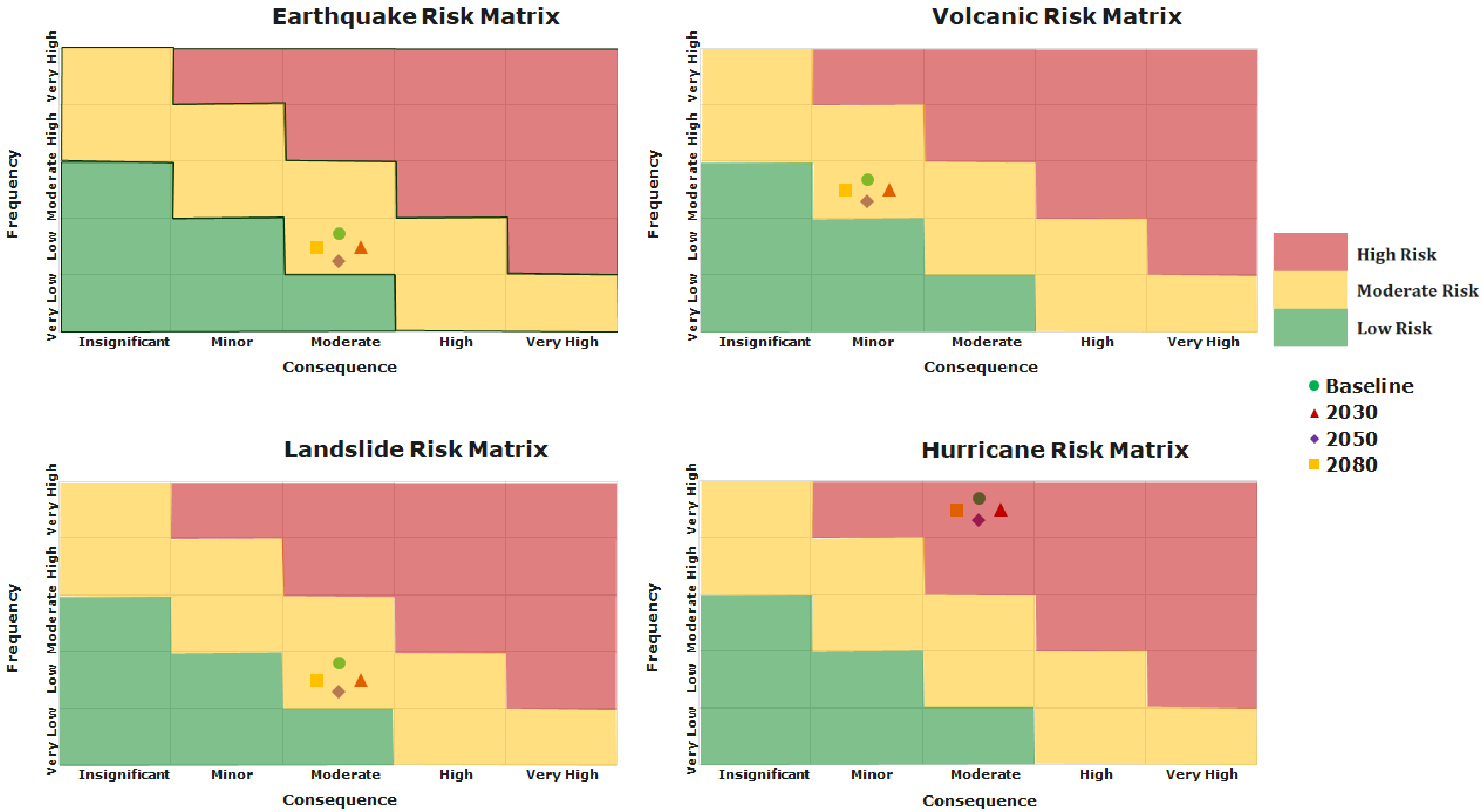


FIGURE 5.4 GENERAL RISK MATRIX FOR PROJECT – HAZARD-BASED (FLOODING, VOLCANIC, LANDSLIDE, HURRICANE)

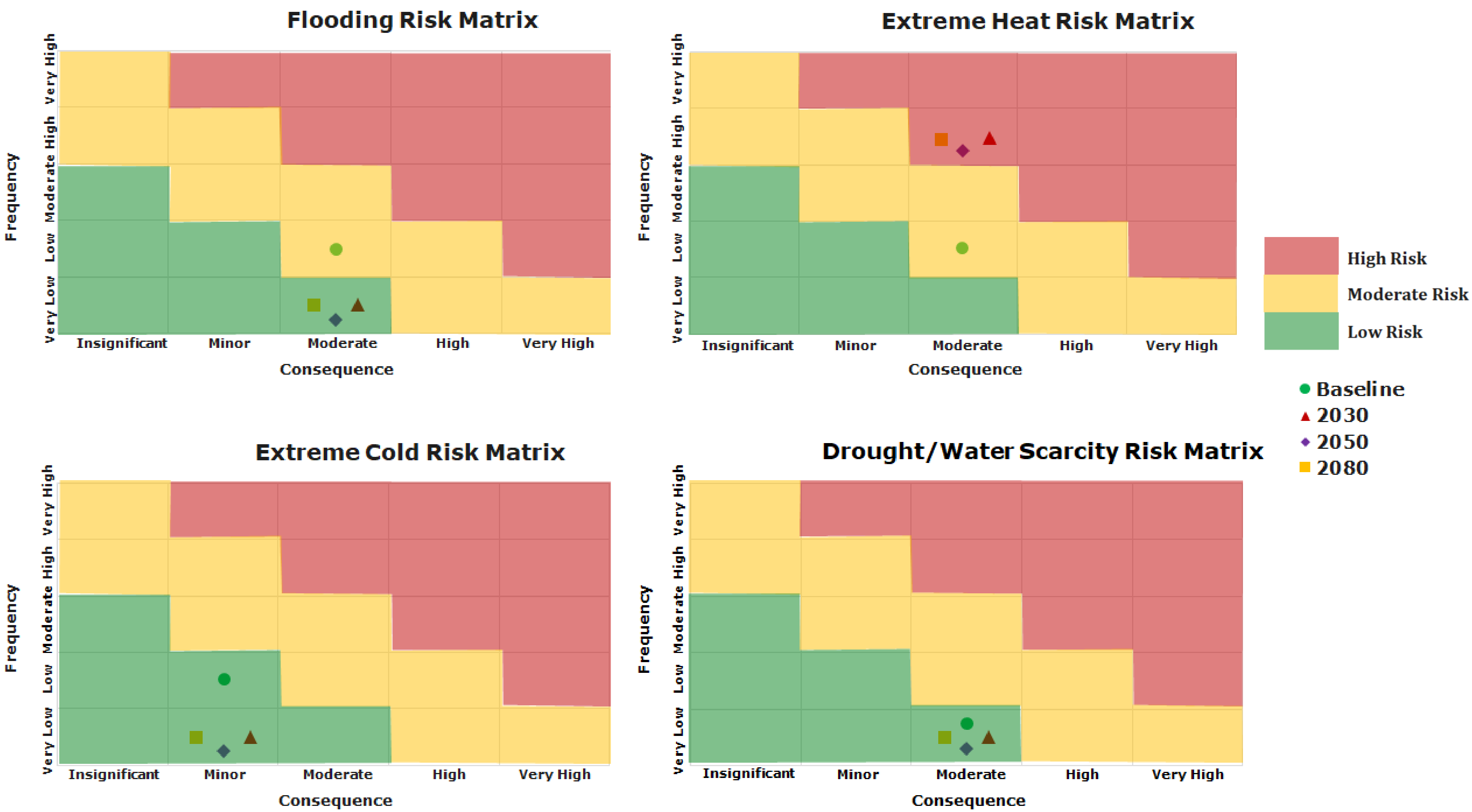
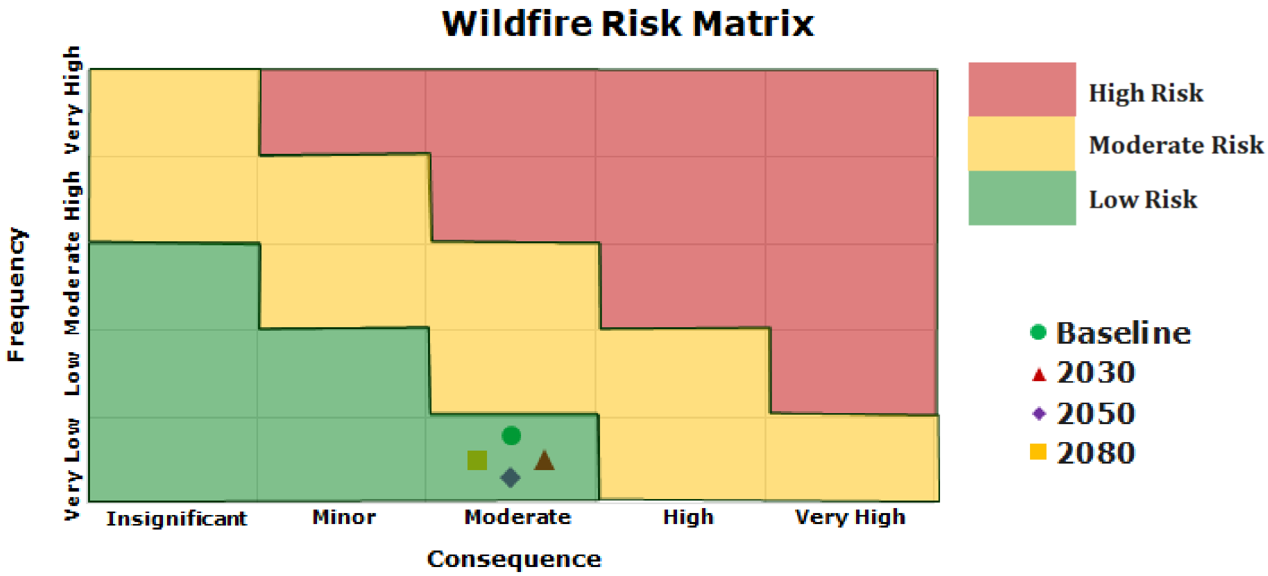


FIGURE 5.5 GENERAL RISK MATRIX FOR PROJECT – HAZARD-BASED (WILDFIRE)

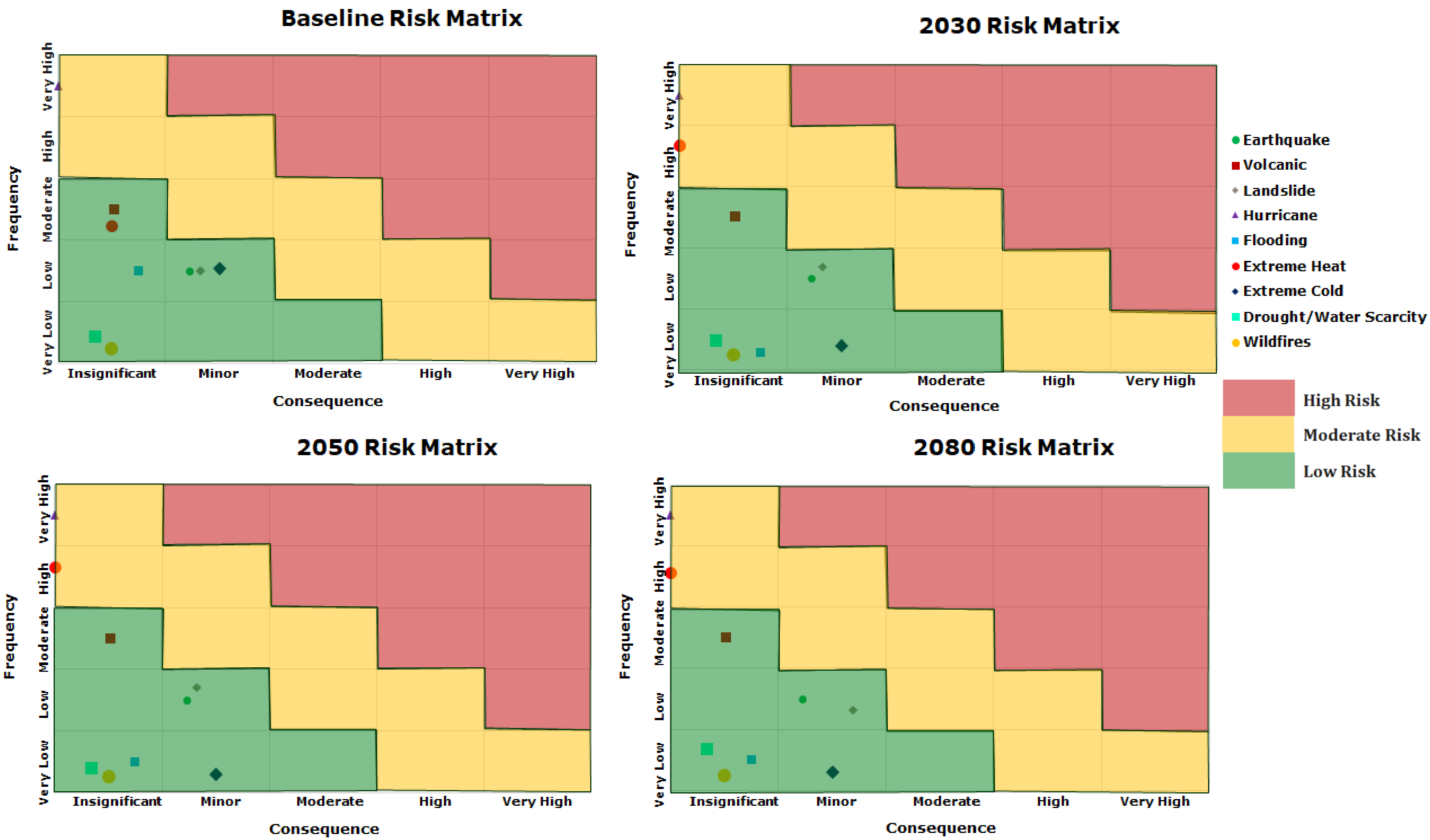


The general risk assessment was meticulously reevaluated, incorporating both the proposed and already implemented mitigation measures. This comprehensive reassessment was conducted across the various assets and their respective components within the Project, ensuring a thorough integration of the mitigation strategies. As a result, the general risk matrices were updated to reflect the highest frequency and consequence observed across the entire project, rather than focusing on individual components. These revised risk matrices, as depicted in It's crucial to highlight that the maximum frequency and maximum consequence may not coincide within the same asset or component. For instance, while the hurricane hazard exhibits an extremely high frequency, its maximum consequence is considered minor. Similarly, extreme heat presents a very high frequency, yet its impact is classified as insignificant. These insights from the risk assessment and reassessment served as a validation tool, confirming that the mitigation measures implemented by ORMAT effectively address the moderate hazards identified in the initial assessment.

Figure 5.6, provide a holistic view of the project's risk profile.

It's crucial to highlight that the maximum frequency and maximum consequence may not coincide within the same asset or component. For instance, while the hurricane hazard exhibits an extremely high frequency, its maximum consequence is considered minor. Similarly, extreme heat presents a very high frequency, yet its impact is classified as insignificant. These insights from the risk assessment and reassessment served as a validation tool, confirming that the mitigation measures implemented by ORMAT effectively address the moderate hazards identified in the initial assessment.

FIGURE 5.6 MAXIMUM FREQUENCY AND CONSEQUENCE MATRIX FOR THE PROJECT, INCLUDING MITIGATION MEASURES, SHOWN ACROSS TIME FRAMES OF BASELINE, 2030, 2050, AND 2080



5.3 WORKER INFLUX

The 2022 ESIA considered worker influx as a 'moderate' impact considering that there would be 50 workers at the power plant site at the peak of construction and that most would be sourced from Dominica. Such impact was evaluated as 'minor' after applying mitigation measures, including:

- Implement Project Grievance Mechanism
- Evaluating the need for security guards
- Code of conduct
- Issue a policy statement regarding sexually transmitted infections including HIV/AIDS and sensitization campaigns throughout the construction phase
- Develop a Socioeconomic and Community Health and Management Plan
- Workers Accommodation Plan and Checklist
- Local Hiring Plan and Local Supplier Plan
- Training Plan

Current estimates are around 90-100 workers, most of which (~95%) will be local. Such workers will be contracted through Dominican subcontractors (i.e., they will not be Ormat employees). The 90-100 estimate is the total during construction; Ormat will have an average of 30 people at a time for each Project phase (civil works, mechanic, electrical, etc.). Therefore, the worker's peak is smaller than previously estimated. This impact is considered to have the same magnitude if applying the management measures described above.

6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PROGRAM

6.1 GENERAL

Because the modified project does not generate new or changed significant impacts, the measures described in Environmental and Social Management Plan from the 2022 ESIA Update require no significant changes.

Ormat, as the new project sponsor and EPC is now responsible for executing all environmental and social management plans.

6.2 ROLES AND RESPONSIBILITIES

The implementation of mitigation measures from the ESMP (including this addendum) and Management Plans are Ormat's responsibility and will be managed in accordance with the roles and responsibilities outlined below (Table 6.1). Specific Management plans may include additional responsibilities for Ormat's staff.

TABLE 6.1 ROLES AND RESPONSIBILITIES OF THE ESMS IMPLEMENTATION

Role	Responsibility
Project Manager	• Coordination of the Project’s construction phase, including engineering and technical aspects. • Supervises the site manager, project coordinator and EHS specialist.
Site Manager	• Ensure compliance with administrative regulations, production, safety, and industrial hygiene. • Supervision of maintenance, operation and / or assembly work. • Ensure that the operation of the plant is continuous, effective, and efficient. • Control and execution of budget. • Ensure the optimization of productivity and quality in the operation of all equipment installed in the plant. • Support the environmental and social policy. • Ensure adequate allocation of resources to allow effective operation and continuous improvement of the ESMS.
Project Coordinator	• Provides support to the Project Manager, the Site Manager the EHS specialist for the ESMS implementation.
Environment, Health and Safety Specialist	• Coordinates with the DGDC for participation in community meetings or public consultations. • Supervise the ESMS implementation (including the ESMP and Grievance Mechanism). • Supervise personnel to carry out established recycling procedures and activities. • Carry out rounds of measurement and control of particles and polluting gases in the air. • Carry out rounds of measurement of acoustic environmental impact caused by the operation of the plant. • Supervise the handling, elimination and transfer of waste from industrial inputs. • Supervise the collection and temporary storage of lubricants used in the operation of the plant. • Coordinate and supervise maintenance of drainage systems. • Deliver organic and inorganic waste to companies dedicated to process these wastes. • Collaborate and participate in the environmental impact study that is carried out periodically. • The Environmental Supervisor in conjunction with the Office Manager must carry out the management review annually to guarantee the commitment of senior management and the integration of the ESMS with the strategies established for its implementation and continuous improvement. • Evaluate performance and give training to suppliers, contractors and subcontractors weekly, monthly, or as required in the field of Environment, Health and Safety.
Corporate Social Responsibility (During operations)	• Promotion of Relationship Policies with groups of interest. • Articulation of the Company's business activity based on standards that promote sustainable development. • Promotion and monitoring of environmental practices in balance with the economic and social dimensions of the Company. • Promotion of Socially Responsible Actions. • Indicators report and corresponding data analysis. • Comply with the occupational safety regulations established in the Company during the execution of their work.

Role	Responsibility
	• Inform Senior Management about the potential risks perceived and the problems in Preventive Medicine and Labor, Hygiene and Industrial Safety that arise. • Promote safety at work as one of the most important tasks and responsibilities.
Management	• Help environmental and social manager and supervisors ensure that the ESMS is effectively implemented and maintained in accordance with established procedures. • Assume the responsibility and action of the supervisors when these are not available. • Streamline and prioritize the resources necessary for the fulfillment of ESMS objectives
Human Resources (Operations only)	• The Office Manager will consolidate training needs and prepare an annual training plan for all employees. It will also organize or coordinate the training and keep the training records accordingly
General employees (Operations only)	• Work in accordance with environmental, safety and health and social procedures and instructions, documented with the specific responsibilities defined in individual procedures and instructions. • Report problems or deviations associated with environmental and social problems to their superiors. • Make observations and suggestions on Industrial Safety and Environment.
Contractors and subcontractors	• Abide by Ormat's Policies and applicable procedures • Support Ormat where applicable during the ESMS implementation • Allow Ormat to conduct audits and supervision to their activities as needed and cooperate with Ormat when required to present evidence or other supporting information of the ESMS implementation • The scope of application of Ormat's Management plan includes Ormat's contractors and subcontractors • Prepare project-specific plans for EHS topics as required

Source: Ormat's ESMS, 2024.

6.2.1 EPC CONTRACTOR

Ormat will enforce the application of mitigation measures and the implementation of Ormat's ESMS with its EPC Contract (Ormat Nevada, Inc), whose contract was signed on March 4th, 2024.

The contract includes provisions for the EPC contractor to comply with the latest environmental guidelines within US OSHA and NFPA standards, including air quality, visual aspects, and noise, as well as H&S and site security aspects. Ormat will conduct regular QEHS inspections to their EPC Contractor during construction to make sure the ESMS (which includes the ESMP) is followed.

6.3 MITIGATION HIERARCHY

Ormat's ESMS and all Management Plans adopt the mitigation hierarchy (IFC, 2012):

- Avoid – It is preferable to avoid impacts, which may include changes in proposed activities and alternative analysis
- Minimize – where avoidance is not possible, the company will seek to minimize the impact's significance (e.g., by attempting to diminish the impact's magnitude)

- Mitigate – Apply mitigations measures to further minimize the impact's residual significance
- Offset/Compensate - where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment

The update on Management Plans is explained in the next section. A summary of all management measures is in Section 6.5.

6.4 MANAGEMENT PLANS UPDATE

The full list of management plans of Ormat's ESMP is displayed in Table 6.2. The table lists the contents overview of each plan and updates for this 2024 addendum. In general, main changes comprised a shift in the implementation responsibility to Ormat, as well as additional measures incorporated from Ormat's experience in similar Projects. None of the management measures from the 2022 ESIA were omitted or eliminated.

TABLE 6.2 LIST OF ALL MANAGEMENT PLANS FROM THE 2022 ESIA UPDATE AND THIS ADDENDUM

Name of the Plan	2022 ESMP description	2024 Update
Environmental and Social Management System (ESMS)	Non-existent	Ormat's Project specific ESMS was issued on February 20th, 2024 (Doc. ID. ESMS-SOM-01, Version 1.0). It is an overarching document that provides the framework for the evaluation, mitigation, and management of E&S risks. This ESMS is based on the 2022 ESIA addendum and was designed to follow the International Financial Corporation (IFC) of the World Bank for Environment and Social Sustainability, the Guidelines on Environment, Health, and Safety (EHS) of the IFC and ISO 14001: 2015.
Biodiversity Management Plan	Included primary species of concern present in the biodiversity area of influence and management measures during construction and operations.	No changes except that the responsible party of the implementation is Ormat.
Erosion and Sediment Control Plan	It describes measures taken by the Project to minimize soil disturbance, degradation and erosion resulting from construction activities	No changes except that the responsible party of the implementation is Ormat.
Waste Management Plan	Includes general measures to manage waste generation, transportation and final disposal during construction and operations.	General waste management measures were included in Ormat's ESMS and will remain the same as the previous ESIA. In addition, the EPC Contractor is required to develop a Waste Management Procedure that they and all Subcontractors will implement during all Project

Name of the Plan	2022 ESMP description	2024 Update
		construction works. This document is still a work in progress.
Water Management Plan	It includes water minimization measures and management measures for storm and wastewater	No changes except that the responsible party of the implementation is Ormat and that during construction water will be procured from water trucks, not from nearby streams. Ormat's ESMS includes additional measures to avoid excessive water consumption, and it includes groundwater monitoring. Ormat will conduct monthly monitoring for water usage.
Air Emissions Management Plan	It includes measures for dust control, combustion gases/mobile sources, odors and process emissions, Greenhouse Gas Emissions, and ambient air quality maximum limits to potential air contaminants.	No changes except that the responsible party of the implementation is Ormat. Maximum allowable limits remain the same and are aligned with the IFC and World Bank Guidelines.
Noise Management Plan	It includes measures during construction and operations.	No changes except that the responsible party of the implementation is Ormat. Maximum allowable limits remain the same and are aligned with the IFC and World Bank Guidelines. Ormat is currently conducting noise monitoring in the project area, to complement baseline data from the 2018 ESIA. The results were a work in progress at the time of writing but will be shared with affected communities in future consultations.
Energy Use	No specific measures for energy efficiency	Ormat's ESMS includes measures to avoid excessive energy use, which fall within the following major themes: • Efficient planning and design • Energy-efficient Equipment and Machinery • Low-energy technology • Energy management on the construction site • Equipment shutdown • Energy saving policies • Optimization of transport and logistics • Waste management and recycling • Use of smart technologies
Disaster Risk and Emergency Management Plan	The Disaster Risk and Emergency Management Plan (DREMP) was prepared by the DGDC and included disaster scenarios, prevention and mitigation measures and emergency preparedness and response measures.	This addendum includes an updated Disaster Risk Management and Adaptation Plan, which incorporated information on the hazards from the previous plan but added adaptation measures derived from climate change risk scenarios to 2080, a Failure Mode and Evaluation Analysis

Name of the Plan	2022 ESMP description	2024 Update
		(FMEA) Workshop and a qualitative assessment of disaster and climate change vulnerabilities. The updated plan will cover all project phases (construction and operations). This Plan is still a work in progress.
Well blowout Prevention Plan	This plan was designed for implementation throughout the entire life of the Project, all the way to decommissioning. It includes emergency response measures in the event of a blow-out.	No changes except that the responsible party of the implementation is Ormat.
Emergency Response Plan	Emergency response was originally covered in the DREMP prepared by the DGDC.	Ormat issued an Emergency Action Plan (EAP) in March 2024. The EAP is specific to the Power plant's latest design and includes the procedural steps and checklists for an effective response in case of an emergency. A summary of this plan is shown in Section 6.4.2 of this addendum. Ormat will also coordinate with the DGDC and other relevant agencies in case of an emergency.
Security Management Plan	Plan to assure an effective protection of people, assets, and operations of the Project, in accordance with the Applicable Standards and minimizing any possible impact on local communities.	No changes except that the responsible party of the implementation is Ormat.
Operational Health and Safety Management Plan	A thorough Plan prepared by DGDC which includes procedures for potential emergency situations that could be experienced by the Project.	No changes except that the responsible party of the implementation is Ormat.
Labor Conditions and Workers Selection Plan	Establishes a framework of action to promote mutual benefits and ensure workers are involved with the vision, mission, objectives, principles and organizational values.	No changes except that the responsible party of the implementation is Ormat.
Internal Grievance Mechanism (applicable to workers)	The objective of the mechanism is to identify and manage the potential internal nonconformities and/or complaints in a timely and effective manner. The internal GM is applicable to workers, including contractors, subcontractors and suppliers.	No changes except that the responsible party of the implementation is Ormat. In addition to the project-level GM, Ormat's Corporate-level Whistleblower policy provides the procedure to report to the Audit Committee, General Counsel or Chief Compliance Officer about complaints and concerns of employees and other interested parties, including shareholders, about breaches in the code of conduct and non-ethical behavior (see policy for a more detailed description). Complaints

Name of the Plan	2022 ESMP description	2024 Update
		can be submitted in writing, by phone or through the following third-party channels: • Ethics Point - www.ethicspoint.com • GAN Integrity – https://ormat.gan-compliance.com/p/report
Community Health and Safety Management Plan	Seeks to avoid or minimize the potential risks and impacts to health and community safety that may result from activities related to any of its projects during the construction and operations phase, specially focusing on vulnerable groups.	In addition to the measures from the 2022 ESIA, Ormat's included, as part of its ESMS, additional measures for Health and Community Safety potential impacts (e.g., water pollution (surface and groundwater), air emissions, waste disposal pollution (solid and hazardous), exhaustion of water sources, high noise level, traffic safety, acquisition and land use, dismantling of buildings, and infrastructure, use of security personnel). The responsible party of the implementation is Ormat. All measures are listed in Table 6.5 under "community Health and Safety.".
External Grievance Mechanism	Its objective is to identify and manage the potential external nonconformities (e.g. from the affected communities) and/or complaints in a timely and effective manner.	Ormat launched its own External Grievance Mechanism, which was disclosed to Laudat community members in June 2024 and later in Roseau Valley in July 2024. DGDC GM is still operational and in place, led by their Community Liaison Officer. Ormat and the DGDC are in communication to respond to community's questions, concerns and grievances.
Sexual and Gender-Based Violence Management Plan	Non-existent as a stand-alone plan, but gender considerations were included in other plans, including the labor and worker relations plan.	Supplemental measures were added to further prevent SGBV. This addendum includes a Gender Action Plan (GAP) that will consider management of sexual and gender-based violence, prevention of sexually transmitted diseases and infections, and employment of female and male workers.
Contractor Management Plan	The plan describes a technical and organizational measures to ensure all the conducted work by Contractors and Subcontractors is managed in a correct manner, in conformity with local, state and internal requirements.	No changes except that the responsible party of the implementation is Ormat.
Stakeholder Engagement Plan	The SEP is designed for an ongoing exchange of information that allows the Project to 1) identify, understand and address community/stakeholders' priorities and concerns, and 2) improve decision-making and	The DGDC will continue to lead stakeholder engagement events and consultations, in coordination with Ormat.

Name of the Plan	2022 ESMP description	2024 Update
	transparency. Furthermore, this is an evergreen document that will evolve according to DGDC's activities.	
COVID-19 Contingency Plan	The plan aims to establish good practices to be adopted by the Project with regards to the COVID-19 pandemic, including minimum procedures and strategies that must be observed by DGDC, its subsidiaries and its employees.	No changes, but now Ormat's the responsible party.
Chance Find Plan	Designed for the protection of the cultural heritage from Project related impacts. Includes a Chance Find Plan, monitoring, training, and site protection programs.	No changes except that the responsible party of the implementation is Ormat.
Transportation Management Plan	The plan establishes measures to minimize the effects of the Project's construction and operations on traffic, road infrastructure, and accident risk within the Area of Influence. An Operational Health and Safety Plan which includes Traffic Management Procedures was prepared by DGDC.	Ormat Nevada is currently working on a Traffic Management Plan, which will be issued in August.
Training Plan	The Plan provides a reference compiled guide of all the training requirements detailed throughout the individual Project's ESMP. The training will ensure all Project personnel, and their contractors are trained in all health, safety, environmental, social and Emergency Response procedures and requirements.	No substantial changes except that the responsible party of the implementation is Ormat. Training will also include Ormat's ESMS and policies, including the code of conduct.
Resettlement Action Plan	Describe the framework of the restoration or improvement of the economic conditions of displaced persons caused by the Project.	No updates to this Plan as it has been implemented. The DGDC was responsible for the RAP's implementation. The results of the RAP audit are in a closing report which was issued separately.

Source: 2022 ESIA (ERM) and Ormat's ESMS (2024).

The EPC Contractor Ormat Nevada is currently preparing the following plans:

- Emergency and Disaster Plan for Construction
- ESCP - Construction Works
- Traffic Management Plan - Construction Works
- Transportation Management Plan
- Waste Management Plan

- The first three plans will be provided to Ormat on August 9th, 2024: the last two on August 16th, 2024.

The Project's new and updated plans of this addendum are described below.

6.4.1 DISASTER RISK AND EMERGENCY MANAGEMENT PLAN

In the initial evaluation of nine potential hazards for this project, only two—hurricanes and extreme heat—continue to be classified as moderate risks after the implementation and planning of necessary mitigation measures. It is important to note that, although both hazards remain at a moderate risk level, their potential impacts are relatively minor.

The risk associated with hurricanes, while initially significant, has been substantially mitigated through a combination of comprehensive design strategies and rigorous preparedness measures. These efforts have ensured that any residual risk is effectively minimized. Similarly, the extreme heat hazard, though still considered moderate, has been thoroughly addressed in the design of the wells and components in other assets, which incorporate safeguards against extreme ambient temperatures. Consequently, no further mitigation measures for the plant itself are deemed necessary at this time.

However, it is essential to recognize that while extreme heat may not directly threaten the plant's operational integrity, it remains a serious concern for the health and safety of the personnel. To mitigate this risk, the Environmental and Social Management Plans (ESMPs) include a detailed Occupational Safety Plan specifically designed to protect staff during extreme heat conditions. This plan reflects our unwavering commitment to safeguarding the well-being of all personnel, even in the face of challenging environmental circumstances.

During the FMEA workshop, the mitigation measures recommended in the 2018 and 2021 Environmental and Social Impact Assessment (ESIA) reports, along with the 2018 DGDC's Disaster Risk and Emergency Management Plan (DREMP), were meticulously reviewed. ORMAT confirmed that many of these mitigation strategies have already been integrated into the project's design and emergency response plans. However, specific details regarding design specifications and any associated cost-benefit analyses were not provided to ERM.

The mitigation strategies reportedly implemented by ORMAT include a series of critical interventions aimed at enhancing the project's resilience and safety. These include:

Land Stabilization and Outreach: Implementation of measures to stabilize the terrain, preventing landslides and erosion, complemented by community outreach efforts to raise awareness and preparedness.

Flood Mitigation: Deployment of engineering solutions and infrastructure to manage and reduce flood risk and erosion thereby protecting both the project and the surrounding areas.

Enhanced Design Standards: Adoption of design standards that go beyond baseline requirements, ensuring the structural integrity of the project under extreme conditions related to earthquake, volcanic debris, hurricanes, landslides and temperature.

Use of Fire-Resistant Materials: Selection of non-combustible materials to minimize fire risk, thereby enhancing overall safety and reducing potential damage.

Protective Shields Over Critical Structures: Installation of robust shields designed to protect essential infrastructure from volcanic debris and extreme hurricane winds. These shields are engineered to deflect or absorb impacts from volcanic ash and larger debris, and they are constructed to withstand high-velocity winds, ensuring the continued security and operation of critical structures during severe weather events.

Advanced Sensors, Controls, and Monitoring Systems: Deployment of cutting-edge technology to enable real-time monitoring and control, facilitating prompt responses to emerging risks.

Given the project's complexity and scale, ERM strongly advises ORMAT to develop comprehensive Disaster Risk Management Plans (DRMPs) in compliance with Inter-American Development Bank (IDB) requirements. These plans should document the existing mitigation measures providing details on the method, period of completion, cost-benefit, monitoring and revision. Moreover, it is vital that these DRMPs receive approval from DGDC to align the project’s risk management strategy with broader regional and institutional frameworks.

By formalizing and implementing these DRMPs, ORMAT will demonstrate its commitment to upholding the highest standards of safety and resilience. This will also assure all stakeholders, including DGDC and the local community, that the project is fully equipped to withstand and recover from any potential disasters.

6.4.2 EMERGENCY ACTION PLAN

6.4.2.1 OVERVIEW

Ormat’s EAP is an internal document that was issued in March 2024, specifically for the 10 MW Power Plant in Dominica. It contains the necessary information to recognize an emergency, who and how to notify responders, actions for plant personnel, evacuation and accountability procedures, expected interaction with emergency responders and tools (i.e., checklists and contact numbers) to implement the plan.

The plan was prepared for the operation phase. For Emergency Preparedness and Response during construction, Ormat Nevada will implement its own procedures, in coordination with the GoCD agencies for disaster management.

6.4.2.2 SCOPE

The EAP applies to all personnel working or visiting the Power Plant. The EAP is applicable to the operation phase.

6.4.2.3 ROLES AND RESPONSIBILITIES

All employees, temporary employees, contractors, and support personnel will follow the EAP. Key roles are the following:

- Plant manager:
    - Overall responsible for implementing the EAP

- Notifies the Regional Manager and Vice President of Electricity Segment of the activation of the Emergency Action Plan.
  - Serves as the primary contact with the press until either the Regional Manager, Vice President of Electricity Segment or Corporate Public Relations personnel are available.
- Provides a point of contact for additional training if any individual does not understand their specific duties or responsibilities under the EAP.
- Operations and Maintenance Managers/Supervisors/Leads
- Fills the responsibilities of the Plant Manager if they are not available during an emergency.
- Assists Control Room Operator (CRO) and PO with implementation of the emergency action plan.
  - Contacts the HAZMAT responder to perform site cleanup and decontamination after motive fluid spills or after a fixed fire suppression system discharge.
- Provides a point of contact for additional training if any individual does not understand their specific duties or responsibilities under the EAP.
- EHS Coordinator
  - Ensures alarm indications and detector locations are verified
  - Trains Ormat operations and maintenance personnel in the EAP
  - Coordinates an annual EAP drill
  - If EAP revisions are deemed necessary, works through the plant manager to propose changes to this procedure as events or findings identify the need.
  - Provides a point of contact for additional training if any individual does not understand their specific duties or responsibilities under this procedure
- Shift supervisor
  - Notifies Dominica's Operations management of any emergency at the Dominica Facility.
  - Assumes the duties of person in charge of the emergency until relieved by emergency responders and/or plant management.
  - Assists the CRO with emergency shutdown, communications, camera operation, event logging, and notifications.
  - Coordinates with Administrative Assistants to account for all personnel onsite.
  - Meet with the emergency responders upon arrival
  - Coordinates with DOMLEC to deenergize the transmission lines to/from the affected plant(s) when requested by the applicable fire department
- Control Room Operator
  - Informs the remote location operators on shift of the emergency and the need for them to monitor their respective plant(s) locally.
  - Initiates the emergency evacuation over the radio and continues to make the emergency announcement every two minutes until accounting for all personnel on site.
  - Notifies all other remote office locations onsite, of the emergency evacuation.

  - Starts the emergency shutdown of the unit using the Human Machine Interface (HMI), as needed.
  - Alerts all personnel onsite using the information maintained in the Dominica Electronic Tracking Program for all Active Personnel Onsite.
  - Provides emergency reports and updates to the emergency response agencies, as needed.
  - Keeps a log of the event throughout the entire emergency by recording the times, accounting for personnel on-site and personnel entering and exiting the site and providing as much detail as possible to support incident investigations.
  - Establishes communications with onsite emergency services personnel and Ormat personnel to assist with the flow of information between the Ormat Management and on-site emergency services personnel.
- Coordinates with DOMLEC to deenergize the transmission lines to/from the affected plant(s) when requested by the applicable fire department.
- On-site personnel
  - Logs in and out at the Dominica Electronic Tracking Program when entering and exiting the Dominica Facilities and/or plants, as required.
  - Notifies the Control Room, and all other nearby personnel, of any emergency that occurs at the site.
  - Evacuates immediately to the evacuation point when directed and passes the word to others on the plant site to evacuate as well.
  - Initiates, if possible and without placing oneself in greater danger, an emergency shutdown of the plant, and shutdown the Evacuation, Transfer and Storage System if in use at the time of the emergency.
  - Activates Fire Suppression Systems as needed.
  - Performs duties, as assigned by Plant Management or the Shift Supervisor, to block roads, flag down emergency responders, and assist with the accountability of all onsite personnel

6.4.2.4 KEY EAP SECTIONS

Table 6.3 provides a summary of the contents of the EAP.

TABLE 6.3 SUMMARY OF THE EMERGENCY ACTION PLAN

Section	Summary
Emergency Responder Coordination	It includes emergency numbers (911) and instructions on first response and interactions between emergency responders and plant personnel. Additional guidance on the notification process is detailed in Appendix A of the EAP.
Communication During Emergencies	Describes the location of landline and satellite phones, and minimum information that needs to be provided to responders during an emergency. This section also contains Ormat’s radio communication protocol.

Section	Summary
Plant Stand Down & Evacuation	Section describing how to take the actions for a plant stand down or a plant evacuation. The actual actions are presented in Appendix A.
Response to Fires	Describes how to report a fire, general safety points, what to do in case there are motive fluid fires, in case of wildfires and electrical fires.
Emergency Response for Medical / Law Enforcement	It contains a description of what a medical emergency entails and the steps in case there are people seriously injured.
Severe Weather / Earthquakes	It describes the steps in case of thunderstorms, and earthquakes.
Dominica Contingency Plan / Business Plan	This is a directory and data sheet about Ormat's subsidiary: The business name, operator, location of the facility, mailing address and the number of shifts and number of employees at the plant
Emergency Reporting, Titles and Duties	The plan contains placeholders with contact information of the emergency coordinator and alternates. These will be defined closer to the operations phase.
Motive Fluid, Hazardous Waste or Brine Release Response Procedures	Procedures to manage spills and how to manage these substances.
Medical Assistance	This section is focused on medical emergencies related to exposure to hazardous substances.
Emergency equipment	A list of emergency equipment
Appendices	• Appendix A – Emergency Actions • Appendix B – Motive Fluid reporting forms • Appendix C – Liquid Petroleum reporting form • Appendix D – Evacuation Map • Appendix E – Employee Alarm System Specification, Validation, and Maintenance • Appendix F – EAP Program Implementation
Monitoring and Continuous Improvement	• Once a year, evaluate emergency preparedness and readiness to respond to emergencies. This includes: o Monitor training o Verify equipment o Reiterate agreements with local authorities o Enact improvements as needed

Source: Ormat, 2024 (EAP)

6.4.2.5 TRAINING

All Ormat personnel will receive an initial training on the EAP procedure. Training will include, but is not limited to, the following:

- Location and sounds of the Gas, Fire, and Evacuation Alarms and Detectors.
- Expectations of response to injuries and emergencies by personnel on-site.
- Evacuation routes and evacuation points.
- OSHA Hazard Communication.
- Hazardous Waste Operations and Emergency Response (HAZWOPER).
- Annual refresher training will be conducted with all employees and documented.

- Management and other personnel responsible for incident reporting will receive special training regarding the reporting of releases or threatened releases of hazardous materials. This training will be documented

6.4.3 TRANSPORTATION PLAN

The EPC Contractor is developing a Traffic Management Plan which will establish measures to minimize the effects of the Project’s construction and operations on traffic, road infrastructure, and accident risks within the Area of Influence and routes utilized to Project's facilities. This Plan will focus on the prevention or reduction of impacts and describes management measures, monitoring and reporting processes, Key Performance Indicators (KPIs), and responsibilities for implementation of the Plan.

The objectives of this plan are to manage and reduce Project-related risks and minimize potential impacts resulting from Project-related traffic while providing a safe environment for drivers, passengers, pedestrians, workers, communities and fauna of the Area of Influence.

The plan should focus on addressing the following measures:

6.4.3.1 DRIVER SAFETY MEASURES

- Training includes defensive driving, use of vehicle safety systems, and appropriate precautions in adverse conditions.
- Establishment of maximum driving shifts minimum rest times for driving.
- Require all drivers to have appropriate licenses, insurance, and training specific as applicable.
- Establish a code of conduct including prohibition of cellphone use and other distractors while driving.

6.4.3.2 VEHICLE INTEGRITY AND CONDITIONS

- Schedule preventative inspection and maintenance of vehicles and use of parts approved by the manufacturer, to reduce the risk of accident due to vehicle malfunction or premature failure.
- Immediately withdraw vehicles from service upon detection of defects; repair or replace vehicles as necessary.
- Keep a record of inspections, maintenance and repair for each vehicle.

6.4.3.3 COMMUNITY SAFETY

- Communication with the stakeholders, based on the Stakeholders Engagement Plan to provide information and opportunity for participation to the community in discussion of Project impacts related to traffic.
- Plan routes and timing of deliveries to minimize the interaction of pedestrians with delivery and construction vehicles.
- Collaborate with surrounding communities and relevant authorities to improve signage, visibility and general road safety, especially near schools or other places where there may be children.

- Use traffic safety control measures, including road signs and flag personnel, to warn of and direct traffic around dangerous conditions.
- For oversized vehicles, coordinate with local authorities, use escort vehicles, and provide information to the community of schedule and potential impediments to travel.
- Identify preventive measures to avoid and minimize traffic accidents and disturbances to nearby communities.
- Minimize road infrastructure degradation; and
- Address transportation-related noise, vibration, and dust

6.4.4 GENDER ACTION PLAN

This addendum includes a Gender Action Plan (GAP) which has the objective of preventing gender-based violence, sexual transmitted diseases (STDs) and sexual transmitted infections (STIs). It includes measures and actions to enhance gender equality in the employment and labor conditions. The GAP includes measures from the 2022 ESIA and additional measures. The GAP includes indicators, activities, time frame for completion and responsible parties. All the actions in this plan will be funded through Ormat's regular operation budget.

6.4.4.1 OBJECTIVE

The purpose of the GAP is to identify concrete reasonable actionable approaches for the Project to prevent, respond, and act on sexual and gender-based violence and harassment (SGBVH) risks related to the Project. In addition, guide the training and awareness on the prevention of sexually transmitted diseases (STDs) and sexually transmitted infections (STIs), and human immunodeficiency virus (HIV). The plan also delineates measures and direct actions to enhance gender equality in employment and labor conditions.

6.4.4.2 SCOPE

This plan includes the key actions that will be implemented to prevent and respond to SGBVH risks posed by the Project. It applies to Ormat, its contractor and sub-contractors.

6.4.4.3 ACTION PLAN

The following table describes the actions present in the action plan including the key actions and responsibilities of the Project.

TABLE 6.4 GENDER ACTION PLAN

No.	Action	Responsible	Timeline	Indicator
1	Prepare and sign a Project-Specific SGBVH policy for the Project and share it with EPC and all subcontractors and their personnel Disclose and provide copies of existing Ormat policies that reference SGBVH. These include: • Code of Conduct (already signed) - must be signed by all workers • SGBVH Policy (to be prepared) with clear definitions to also include sexual exploitation and abuse • Human Resources Policy • Human Rights and Labor Policy • Whistleblower policy	Ormat	Immediately (and before the start of civil works in September 2024)	• Copy of relevant policies • Photos of signed policies around the site (e.g., workers' tents)
2	SGBVH induction/orientation for workers, Toolbox Talk and task Briefing. Inclusion of SGBVH in safety inductions, including details on how to access SGBVH Grievance Redress Mechanism. This is in addition to regular HSE training through the app "First Verify" that Ormat currently uses.	Ormat and EPC Contractor	• Ongoing as workers are hired	• Photos and sign sheets of toolbox talks and meetings regarding Ormat's policies and procedures • Induction presentation for new hires or subcontractors
3	Identification and mapping of SGBVH service providers for survivors[17]. Inform workers of the existing of the list by posting it in the workers' rest area.	Ormat EPC Contractor	• Within 2 months of the start of the construction phase or September 2024, whichever occurs first	• Directory of referral service providers.

[17] The DGDC has a directory for such services in their website: https://www.geodominica.dm/grievance/gbv-service-providers/

No.	Action	Responsible	Timeline	Indicator
4	Development of a referral mechanism for SGBVH cases, including: a. Which service provider takes precedence when contacting them b. Means to contact them (telephone, email, in-person, other) c. Follow-up as needed to make sure survivors get the help, they need	Ormat and EPC Contractor	• Within 2 months of the start of the construction phase or September 2024, whichever occurs first	• Copy of referral mechanism • Evidence of mechanism disclosure with all direct and indirect workers
5	Create a procedure and allocate budget to manage SGBVH cases	Ormat EPC Contractor	• Within three months of the start of the construction phase or October 2024, whichever occurs first	• Specification on how the Grievance Mechanism will manage SGBVH cases • Referral pathway established • Evidence of budget allocated towards providing support to victims.
6	Design a training program about SGBVH for Ormat, EPC Contractor and subcontractor staff which includes at a minimum: • Definition of SGBVH • Ormat's Policies (including the SGBVH Policy) • Legal provisions on sexual harassment in the workplace • Unacceptable conduct towards local community members and other workers • Prevention of Sexual transmitted diseases • Project SGBVH procedures. • How to report cases and what remedies will be in place in case of an incident.	Ormat EPC Contractor	• Within three months of the start of the construction phase or October 2024, whichever occurs first • Quarterly refreshers	• Training materials • Photos and attendance registers of workers attending the training

No.	Action	Responsible	Timeline	Indicator
8	Create a SGBVH Grievance Committee.	Ormat in coordination with DGDC and the EPC Contractor.	• Within three months of the start of construction	• Organizational chart of the SGBVH Committee. • Number of females represented in the Committee.
8	Stakeholder consultations: Continuous stakeholder consultations will be conducted in local communities to inform them about SGBVH risks and existing mechanisms to report cases	DGDC Ormat EPC Contractor	• Ongoing as part of regular community engagement.	• Feedback from the community members and actions taken by the Project where applicable. • Community meeting recording
9	• Gender-Specific Facilities: Provide separate social and sanitary facilities for male and female workers to maintain privacy and hygiene.	Ormat EPC Contractor	• With start of construction	• Number & condition of social and sanitary facilities provided for women and men. • Documentation that gender-specific facilities are provided (e.g., photographs)
10	Undertake regular Monitoring and reporting on the progress of implementing mitigation measures and identification of emerging SGBVH risks.	Ormat	• Quarterly during construction. • Annually during the operations	• Successful implementation of the Action Plan. Quarterly reporting during

No.	Action	Responsible	Timeline	Indicator
				construction & annually during operation.
11	Tracking of SGBVH incidents reported to the Project based on the following interactions: • Project personnel & workers, among workers • Workers and external stakeholders including local communities	Ormat EPC Contractor	• Ongoing throughout the Project's lifecycle	• Number of cases submitted, resolved, and/or referred for support services during the construction and operational phase of the project.
12	Prevention of sexually transmitted infections (STI) and diseases (STD) including Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS), specifically: a. Awareness campaigns (talks, presentations) about STIs and STDs and how to prevent them b. Free distribution of condoms c. Support for workers who require medical assistance (i.e., referring them to hospitals or clinics)	Ormat EPC Contractor	• Within 2 months of the start of the construction phase or September 2024, whichever occurs first, and ongoing	• Photos of the meetings and campaigns organized • Copy of training materials
13	Equal Pay for Equal Work: Ensure equal pay for equal work, eliminating any wage disparities based on gender, ethnicity, or other discriminatory factors	Ormat EPC Contractor	• Ongoing throughout the Project's lifecycle	• HR assessment of the wage gap for direct workers • Awareness campaigns regarding the wage gap with all workers, including subcontractors

No.	Action	Responsible	Timeline	Indicator
14	Skill development program: Provide training and skill development programs to help workers advance in their careers and earn higher wages.	Ormat	• Develop within 2024 and implement it during 2025 and until the end of construction.	• Number of training events • Evidence of training conducted for the community
15	Implement Ormat's Anti-discrimination Policy to prevent discrimination in hiring and promotion, and make sure the EPC Contractor and its subcontractors are aware of such practices.	Ormat	• Immediately (and before the start of civil works in September 2024)	Sensitisation materials Minutes of meetings where gender equality in the workplace is discussed (toolbox talks, meetings) Evidence of awareness campaigns on the subject
16	Ensure equal pay for equal work, eliminating any wage disparities based on gender, ethnicity, or other discriminatory factors.	Ormat	• Immediately	• Wage data

6.4.4.4 RESPONSIBLE PARTIES

The party responsible for the reviewing, updating and managing this document is Ormat.

6.4.4.5 MONITORING AND REVIEW

Monitoring of the actions described in the table above, will be undertaken by the Project on a quarterly and annually basis during construction and operational phases respectively.

The GAP will be reviewed after construction and periodically during the operations of the Project, in coordination with Ormat and the operations contractor, and other focal point persons. During operations, audits will be carried out to monitor the implementation and effectiveness.

6.4.5 COVID-19 PLAN

This plan will be updated to reflect the most up to date information generated of the current contagious diseases. Covid-19 will be treated as other contagious respiratory diseases in accordance with local health laws. General recommendations to prevent diseases are workers' vaccination schemes completed, use of masks when appropriate (e.g., immunosuppressed), covid detection tests, and rest days for sick workers.

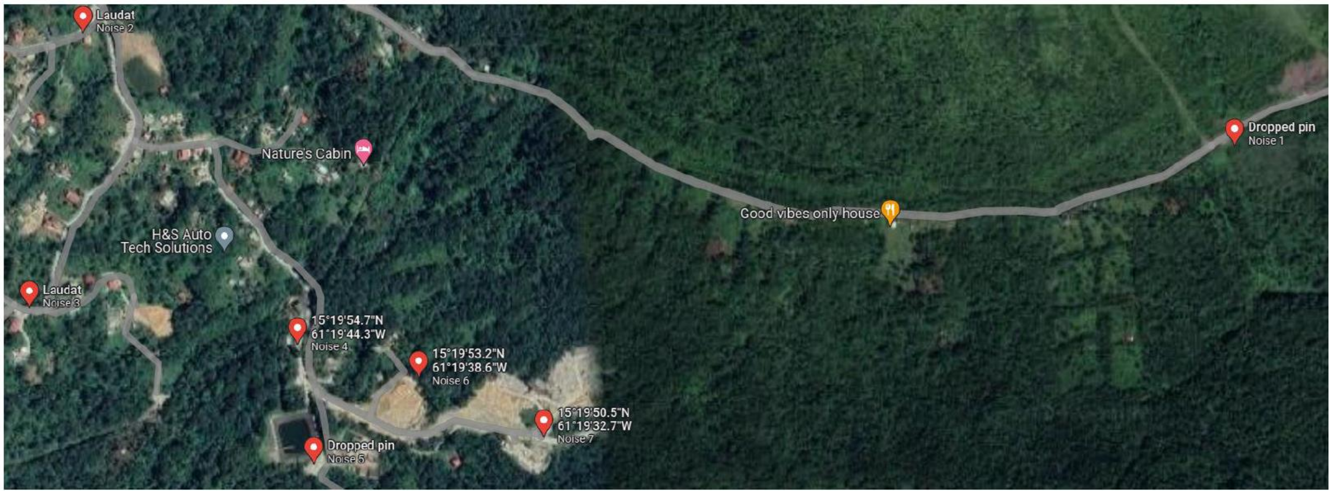
6.4.6 NOISE MONITORING

Ormat's Noise Monitoring Plan has no change from the 2022 ESIA. The noise monitoring in the adjoining neighborhood will be monthly, and during construction it will be weekly. Ormat conducted a pre-construction monitoring in Laudat, at seven points shown below. All measurements were below 57 dB.

ID	Coordinates		Result (dB (A)	Location description
	Latitude (N)	Longitude (W)		
1	15°20'03.8"N	61°19'00.0"W	54.6	On Valley Road to Fresh Water Lake – very windy
2	15°20'08.8"N	61°19'54.5"W	52.4	At Health Center and many homes
3	15°19'56.4"N	61°19'57.0"W	50.4	At Catholic Church near community hall and guest house
4	15°19'54.7"N	61°19'44.3"W	52.2	Near Pato Café and DOMLEC Power Station
5	15°19'49.3"N	61°19'43.5"W	52.7	Near P1 entrance
6	15°19'53.2"N	61°19'38.6"W	56.4	At disposal area near concrete house.
7	15°19'50.5"N	61°19'32.7"W	51.6	At P2 access road

Source: Ormat, 2024. Note: measurements taken on July 8th, 2024, from 11 to 13 hrs.

FIGURE 6.1 PRE-CONSTRUCTION NOISE MEASUREMENT IN 2024



6.4.7 WATER QUALITY MONITORING

The Project will generate sanitary wastewater during construction and operations. During construction the Project will use portable toilets who will be cleaned by an authorized third-party. During operations, the Project will have septic tanks, also managed by an authorized vendor. The Project will not generate industrial wastewater from operations.

However, Ormat plans to monitor stormwater quality quarterly, the list of parameters is:

- Temperature (measured *in situ*)
- Turbidity
- Nitrates
- Phosphates
- Sulphur
- pH (measured *in situ*)
- Heavy metals (arsenic, nickel, zinc, mercury, cadmium, chromium)
- Biological analysis for *Escherichia coli*

Ormat will hire a laboratory certified by Dominica's Bureau of Standards to analyze the samples. Consultants from Eclipse will support in taking stormwater samples. For parameters measured *in situ*, Eclipse consultants will use certified equipment that has been calibrated.

6.4.8 NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

Radioactive contaminants at geothermal facilities are often omitted in site assessments, or environmental impact statements. Such omissions may occur because the radioactivity is unexpected or because the principal resource being processed was not suspected to be radioactive (cf. https://semspub.epa.gov/work/HQ/189962.pdf).

There is no evidence of NORM in geothermal projects in the Caribbean, but also there is no evidence that project developers have assessed the likelihood of NORM in these projects. The design of the project includes a closed cycle, in which materials from the subsurface are not in contact with the atmosphere but in cases of emergency. Therefore, NORM exposure is not expected even if the geothermal resource may contain NORM.

In the absence of a specific assessment of NORM occurrence in the project, Ormat will provide personal radiation detectors to workers at the plant during maintenance activities that require removal, change of equipment (pipes, valves, wellheads, etc.), or waste management of scales, and conduct assessments in case positive readings are detected.

6.5 SUMMARY OF MANAGEMENT MEASURES

Table 6.5 includes a summary of all management measures from the 2022 ESIA and this addendum. It also includes additional measures that Ormat included as part of lessons learned from other projects, as the technology for energy generation is the same.

The measures listed below are part of Ormat's ESMS. New Management measures for this 2024 ESIA addendum are marked with an asterisk (*).

TABLE 6.5 AGGREGATED MITIGATION AND ADAPTATION MEASURES

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
1	Environment	Emission of atmospheric pollutants and odors	Construction	**Dust Control** • Watering unpaved roads/temporarily exposed bare soils - Construction dust will be suppressed with water applied by water sprinklers and/or water carts. For access tracks, it is recommended that water is sprayed on roads at least twice a day during the dry periods. • Material from stockpiles of soil, aggregate, sand etc. prone to being windblown, will be held in bins or other enclosures, and stockpiles of material including soil, and where practicable covered with a tarpaulin. • Dust on the wheels of vehicles will be removed through wheel washing prior to leaving the site. • Vehicle speed on the construction site will be set to a maximum of 15 mph to reduce dust release from road surfaces. • Vehicle maximum speed limit will be respected in the area of influence outside the Project. • In the event of high winds during dry periods, it may be necessary to cease some construction activities until the wind subsides. • Reseeding bare soils as soon as possible to establish grass coverage and limit soil dispersion – To reduce windblown material, the EPC Contractor will sow grass seed on soil stockpiles that will remain dormant for more than three months. • Ensuring all trucks moving materials are covered - When transporting material that is prone to wind blow, vehicles will be equipped with a tarpaulin cover when passing through residential areas. • Minimize earth movement activities.	Ormat's Environment, Health and Safety
			Construction and Operations	**Combustion Gases and Mobile Sources** • Regardless of the size or type of vehicle in question, fleet owners/operators must apply the mechanical maintenance programs recommended by the manufacturers. • Drivers will receive training on the advantages of vehicle driving practices that reduce both the risk of accidents and fuel consumption, as well as the importance of avoiding sharp accelerations and respecting speed limits. • Replacement of old vehicles with modern alternatives, with greater energy control. • Adaptation of the most used vehicles to cleaner energies, whenever feasible. • Installation and maintenance of emission control devices, such as catalytic converters. • Implementation of a periodic vehicle maintenance and repair plan.	
			Construction	**Air Emissions Monitoring and Response** • Visual dust inspection of the site daily 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 performed and recorded. • The results of the visual inspections will be reported monthly and shared with the community through stakeholder engagement activities. • During construction, monitoring of air emissions will be done with a handheld monitor. Parameters to be measured are SO_2, NO_2 PM10 and PM2.5 (maximum limits are found in Table 1.1.1 of IFC EHS Guidelines for Air Emissions, and it the Air Emissions Management Plan from the 2022 ESMP). Ormat will use a hand-held device to monitor such parameters. • Ormat will verify that control systems such as dust suppression sprays are operating correctly.	
			Operation	**Air Emissions Monitoring and Response** • During operations, Ormat will monitor Hydrogen sulfide, mercury and carbon dioxide. • Install Filtration and Scrubber Systems: Utilize high-efficiency particulate air (HEPA) filters, electrostatic precipitators, and scrubbers to capture and reduce harmful pollutants and odors before they are released into the atmosphere. • Ambient monitoring for H_2S can be easily undertaken at sensitive locations (e.g. nearby residential areas) using low-level ambient H_2S monitors such as Odalog, which can be deployed at multiple locations for up to two months at a time. All instruments used should have a valid calibration certificate.	Ormat's Environment, Health and Safety
			Construction and Operations	**Awareness and Continuous Improvement** • Regular Maintenance and Upgrades: Ensure all emission control technologies are regularly maintained and upgraded to operate at optimal efficiency, minimizing the risk of malfunction and emission spikes. • Transparent Reporting: Implement a transparent system for reporting air quality data to local communities, stakeholders, and regulatory bodies, demonstrating accountability and fostering trust.	Environment Health and Safety and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Open Communication Channels: Establish open lines of communication with local communities to inform them about ongoing and planned measures to control emissions and address their concerns promptly. • Public Forums and Workshops: Organize regular public forums and workshops to educate the community about the Company's efforts to manage air quality and to seek their input on additional measures that could be implemented. • Comprehensive Training Programs: Provide regular training for employees on best practices for reducing emissions and managing industrial processes to minimize the release of pollutants and odors. • Awareness Campaigns: Launch internal awareness campaigns to highlight the importance of air quality control and encourage proactive measures among staff. • Process Optimization: Optimize industrial processes to reduce the generation of pollutants and odors, including the use of cleaner production techniques and materials. • Preventive Maintenance: Establish a preventive maintenance schedule to ensure all equipment operates efficiently and any potential sources of emissions are addressed before they become problematic. • Energy Efficiency Measures: Implement energy-efficient technologies and practices to reduce the overall environmental footprint of industrial operations, thereby lowering emissions. • Use of Cleaner Fuels: Transition to cleaner fuels and renewable energy sources to further reduce the emission of harmful pollutants. • Adherence to Standards: Ensure full compliance with all relevant local, national, and international environmental regulations and standards. • Investment in R&D: Invest in research and development to explore new technologies and methods for reducing emissions and controlling odors. • Collaboration with Environmental Experts: Partner with environmental experts and organizations to stay updated on best practices and emerging technologies in emission control.	
2		Discharge of liquid effluents or contaminated wastewater in local water bodies, or inadequate treatment of wastewater.	Construction	**Domestic wastewater** • Domestic wastewater will be taken from portable toilets by an authorized third-party vendor.	Environment Health and Safety
			Operations	**Septic System** • Sanitary water will be managed by septic tanks, which will be well maintained to allow effective operation. • Installed in an area with sufficient soil percolation for the design wastewater loading rate. • Installed in an area of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.	Environment Health and Safety and Corporate Social Responsibility
			Construction and Operations	**Pollution awareness and prevention** • Implementation of Best Management Practices (BMPs): • Establish comprehensive water management plans that include sediment and erosion control measures to prevent runoff from construction sites. • Conduct regular water quality monitoring of nearby surface water bodies to detect any signs of contamination early, parameters to be analyzed are those indicated in the IFC EHS General Guidelines. The sampling points are yet to be determined. The monitoring will be performed every 3-6 months or as required. • The Dominica Bureau of Standards will be used for the water quality laboratory analysis, the parameters to be analyzed are temperature, turbidity, nitrates, phosphates, Sulphur, pH, presence of *Escherichia coli*, and heavy metals (arsenic, nickel, zinc, mercury, cadmium, chromium). • Implement a transparent reporting system to share water quality data with local communities and stakeholders. • Engage local communities in discussions about water protection measures and seek their input on potential impacts and mitigation strategies. • Provide education and awareness programs to workers and residents about the importance of protecting water bodies and the role they can play in these efforts. • Develop and implement strict waste management protocols to ensure that no hazardous materials or waste products don't enter water bodies. • Train employees on spill response procedures and equip the site with spill containment kits to quickly address any accidental releases. • Adopt water-saving technologies and practices to minimize the overall water usage of the project. • Recycle and reuse water where possible to reduce water consumption. • Ensure full compliance with all relevant local, national, and international environmental regulations and standards.	Environment Health and Safety and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Regularly review and update environmental management plans to align with the latest best practices and legal requirements.	
3		Groundwater pollution	Construction and Operations	• Comprehensive Planning: Develop and implement detailed pollution prevention plans that address potential sources of groundwater contamination; these are included in the Erosion Prevention Plan, Waste Management Plan and Water Management Plan. • Risk Assessments: Conduct regular risk assessments to identify activities and processes that pose a risk to groundwater quality, when applicable. • Hazardous Waste Handling: Ensure proper handling, storage, and disposal of hazardous waste materials to prevent leaks and spills. • Waste Segregation: Segregate waste types to minimize the risk of cross-contamination and manage hazardous and non-hazardous waste separately. • Secondary Containment: Implement secondary containment systems for storage tanks and other facilities handling hazardous materials. • Impermeable Liners: Use impermeable liners in areas where hazardous materials are stored or used to prevent leaching into the groundwater. • Spill Prevention Plans: Develop and enforce spill prevention plans, including the installation of spill containment systems. • Emergency Response: Establish and train an emergency response team for quick and effective action in the event of a spill or leak. • Substitute Materials: Replace harmful chemicals with environmentally friendly alternatives wherever possible. • Erosion and Sediment Control: Implement BMPs to prevent erosion and sediment runoff that can carry pollutants into groundwater sources. • Stormwater Management: Design and maintain effective stormwater management systems to control runoff and reduce contamination risks. • Regular Inspections: Perform regular inspections and maintenance of infrastructure such as pipelines, storage tanks, and containment systems. • Review and Update: Regularly review and update groundwater protection measures to incorporate new knowledge, technologies, and best practices. Feedback Mechanisms: Establish mechanisms for receiving and acting on feedback from employees, communities, and stakeholders.	Environment Health and Safety and Corporate Social Responsibility
4		Generation of solid waste, and inadequate management	Construction	• The Contractor is required to develop a Waste Management Procedure that they and all Subcontractors will implement during all Project construction works. • During construction, the Contractor shall be responsible for the clean-up of the Site daily. • The Site is to be always kept clean and tidy and clean-up shall be performed throughout the day with a final emphasis on site clean-up at the end of each shift. This clean-up emphasis is to contribute to the safe working conditions at the Site. • Disposal of waste materials, both solid and fluid, shall be in accordance with local regulations, good hygiene, and good construction practice, including the avoidance of oil or chemical spillage or run-off into local water ways. At a minimum, the waste management plans, specific to each activity, shall demonstrate compliance with the following: • Use and re-use of materials to minimize waste and, whenever practicable, using materials and products from sustainable sources. The Waste Management Procedure will be prepared in accordance with the waste hierarchy. • Mechanisms for the collection, identification, temporary storage, and transportation of the waste before its transfer outside the Project areas. • Waste will be stored in closed containers away from direct sunlight, wind and rain. Waste packaging will be in good condition, undamaged, corrosion and leak free. • Waste will be stored in a manner that prevents the commingling or contact between incompatible wastes. Sufficient space is needed between incompatibles or physical separation such as walls or containment curbs. • Highly visible waste signs will be put on all waste containers and collection areas, labelling as Domestic Waste, Non-Hazardous Waste or Hazardous Waste and include the responsible person with contact information and how to handle the waste. • Descriptions of responsible parties, procedures for registering and documentation of waste transfers, options for recycling, treatment and disposal of waste, including the proposed final destinations of those that cannot be reused, and measures for the reuse of waste. • Hazardous and non-hazardous waste transportation, collection, recycling, and disposal will be managed by a dully authorized company.	Environment, Health and Safety

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Solid waste produced during construction will be disposed of in compliance with the regulatory requirements and classification regulations and will be outlined in the Waste Management Procedure. Areas of waste storage will include signaling and measures to avoid pollution by inadequate waste disposal. • Expected types and estimation of waste volumes should be provided in the Waste Management Procedures. • All records of waste generated, treated and/or disposed in the Project should be kept in site. • Comprehensive Waste Segregation: Implement a rigorous waste segregation system at the source, separating recyclable, compostable, and hazardous waste to ensure proper disposal and reduce the environmental impact.	
			Operations	• Ormat will adopt the Construction's Waste Management Procedure and the Hazardous Substances Management Procedure and update them for the operations phase. • Waste will be stored in closed containers away from direct sunlight, wind and rain. Waste packaging will be in good condition, undamaged, corrosion and leak free. • Waste will be stored in a manner that prevents the commingling or contact between incompatible wastes. Sufficient space is needed between incompatibles or physical separation such as walls or containment curbs. • Highly visible waste signs will be put on all waste containers and collection areas, labelling as Domestic Waste, Non-Hazardous Waste or Hazardous Waste and include the responsible person with contact information and how to handle the waste. • Hazardous and non-hazardous waste transportation, collection, recycling, and disposal will be managed by a dully authorized company. • All records of waste generated during operations, treated and/or disposed in the Project should be kept in site.	Environment, Health and Safety
			Construction and operations	**Solid waste pollution awareness and prevention** • Recycling Initiatives: Establish recycling programs to manage recyclable materials effectively. Zero Waste to Landfill Goal: Commit to a "zero waste to landfill" goal by maximizing recycling and reuse and minimizing the amount of waste sent to landfills through improved waste management practices. • Use of Environmentally Friendly Materials: Prioritize the use of biodegradable and recyclable materials in production processes and packaging to reduce the volume of non-recyclable waste. • Comprehensive Training Programs: Educate employees on waste management best practices, emphasizing the importance of waste segregation, reduction, and recycling. • Awareness Campaigns: Conduct awareness campaigns to encourage responsible waste disposal behaviors among employees and promote a culture of sustainability within the organization. • Proper Disposal of Hazardous Waste: Ensure that hazardous waste is disposed of in accordance with environmental regulations and best practices, preventing contamination of soil and water sources. • Adherence to Standards: Ensure compliance with all relevant local, national, and international environmental regulations and standards for waste management.	Environment, Health and Safety
5		Inadequate handling of hazardous substances.	Construction and operations	• Dedicated Waste Segregation Systems: Establish clear protocols for segregating hazardous waste from non-hazardous waste at the source, ensuring proper handling and disposal. • Labeling and Containment: Use appropriate labeling and containment methods to identify and store hazardous waste safely, preventing accidental exposure or spillage. • Minimization of Hazardous Waste Generation: Implement process improvements and adopt cleaner production technologies to reduce the volume of hazardous waste generated. • Environmentally Friendly Alternatives: Where possible, replace hazardous materials with less harmful or non-toxic alternatives in the production processes. • Waste Tracking Systems: Develop and maintain comprehensive waste tracking systems to monitor the generation, storage, transportation, and disposal of hazardous waste. • Transparent Reporting: Provide regular, transparent reports on hazardous waste management practices and performance, including compliance with regulations and efforts to reduce hazardous waste. • Certified Disposal Facilities: Ensure that all hazardous waste is disposed of at certified and licensed hazardous waste treatment and disposal facilities. • Adherence to Legal Requirements: Ensure full compliance with all relevant local, national, and international environmental regulations and standards related to hazardous waste management. Regular Environmental Audits: Conduct regular environmental audits to assess compliance, identify potential risks, and implement corrective actions as needed. • Ormat will utilize the services of the Dominica Solid Waste Management Cooperation – Fond Cole Sanitary Landfill, which is authorized to handle and dispose hazardous waste. • There will be a diesel storage tank with secondary containment.	Environment, Health, and Safety and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
7		Excessive water consumption*	Construction	• Compliance with Regulations: Adhere to all local, national, and international regulations concerning water use and conservation. • Water Usage Monitoring: Implement comprehensive monitoring systems to track water usage and identify trends or areas for improvement.	Environment, Health and Safety
			Operations	• Monthly reports on water usage would be maintained on-site to monitor water usage. Maintenance and inspection logs will be maintained on-site. There are no regulatory requirements to submit summary reports on water usage or wastewater to the Government. • Any permits relating to water supply will be maintained on site indefinitely. • Drinking water will be purchased from a third party, with the highest quality standards.	Environment, Health and Safety
			Construction and operations	• Recording of Leaks/Opportunities to Reduce Consumptive Use • Water will be sourced from an authorized source. • Record of the amount of water withdrawn will be kept at site. • Water Audits: Conduct regular water audits to identify areas of high-water usage and opportunities for reduction. Implement measures to optimize water use across all operations. • Efficient Water Technologies: Invest in water-efficient technologies and practices, such as low-flow fixtures, efficient irrigation systems, and water-saving industrial processes. • Reuse greywater for non-potable applications, such as landscaping or industrial processes, only if it complies with quality requirements for these uses. • Alternative Water Sources: Identify and utilize alternative water sources, such as rainwater harvesting or the use of reclaimed water, to reduce dependency on ground or surface water. • Leak Detection and Repair: Implement robust leak detection and repair programs to prevent water loss through leaks in pipes and infrastructure. • Efficient Process Management: Optimize industrial processes to reduce water waste, ensuring that water use is kept to the absolute minimum necessary for operations. • Ecosystem Protection: Ensure that water extraction does not negatively impact local ecosystems.	Environment, Health and Safety
8		Elevated or excessive noise levels*	Construction and operations	• Regular Noise Assessments: Conduct regular noise level assessments using sound level meters to identify sources and intensity of noise pollution within and around the industrial site. • Continuous Monitoring: Implement continuous noise monitoring systems to track real-time noise levels and ensure compliance with regulatory limits. The noise monitoring in the adjoining neighborhood will be monthly, and during construction it will be weekly. • Sound Barriers: Install physical barriers such as walls or berms around noisy equipment to block and absorb sound. • Acoustic Enclosures: Enclose particularly noisy machinery within acoustic enclosures to reduce the spread of noise. • Scheduling: Schedule noisy activities during times when they will have the least impact on the surrounding community, such as during daytime hours. • Maintenance: Ensure regular maintenance of machinery to prevent excessive noise due to mechanical wear and tear. • Low-Noise Equipment: Invest in low-noise machinery and equipment. • Noise Reduction Technologies: Implement noise reduction technologies such as mufflers, silencers, and vibration isolation mounts. • Communication with Neighbors: Maintain open communication with the local community about noise levels and mitigation efforts. Inform them of any potential noise disturbances in advance. • Noise Complaints: Establish a system for receiving and addressing noise complaints from the community promptly and effectively. • Adherence to Standards: Comply with all local, national, and international noise regulations and standards. Ensure that noise levels do not exceed permissible limits. • Vegetative Buffers: Create green spaces or buffer zones with trees and shrubs around the industrial site to absorb and deflect noise. • Natural Barriers: Utilize natural topography to serve as noise buffers wherever possible.	Environment, Health and Safety
9		Excessive energy use*	Construction and operations	**Efficient Planning and Design** • Site Design Optimization: Use designs that minimize earth movement and the need for additional infrastructure. • Material Selection: Choose local and sustainable materials that require less energy for transportation and processing. • Energy-Efficient Equipment and Machinery: • Use of Efficient Equipment: Employ construction machinery and equipment that are highly energy efficient.	Control and Instrumentation, Environment Health and Safety and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Regular Maintenance: Ensure regular maintenance of machinery to operate optimally and consume less energy. • Low-Energy Technology: Implement construction technologies that reduce energy consumption, such as LED lighting in work areas and low-consumption electric equipment. • Energy Management on the Construction Site: • Energy Consumption Monitoring: Install monitoring systems to track and manage energy consumption on the construction site. • Equipment Shutdown: Turn off equipment and machinery when not in use to avoid unnecessary energy consumption. • Energy Saving Policies: Establish and communicate clear energy-saving policies, including specific instructions on minimizing energy use. • Optimization of Transport and Logistics: • Efficient Transport: Plan efficient transport routes and use low-emission, high-efficiency vehicles to reduce fuel consumption. • Delivery Coordination: Coordinate and group material deliveries to minimize the number of trips and thus reduce energy use. • Waste Management and Recycling: • Material Reuse: Reuse construction materials and waste where possible to reduce the need for new materials production, which in turn decreases energy consumption. • Waste Recycling: Implement recycling programs on the construction site to manage waste efficiently and reduce the energy required for waste treatment. **Use of Smart Technologies**: • Energy Management Systems: Implement smart energy management systems that automate energy consumption control and optimize efficiency.	
10		Biodiversity loss	Construction	• A dedicated qualified biologist will be contracted to lead and manage mitigation measures outlined related to biodiversity and its management plan. • Avoid removal of trees, where possible, and vegetation along Project boundaries and in undeveloped areas • Minimize impacts by demarcating area of removal with fences to avoid “creep” into surrounding areas and have technical specialist implement best-practice vegetation clearing methods • Vegetation removed from clearance activities will not be burn. Alternative uses will be considered, such as erosion control, composting, or donation to the community if feasible. • Employ an environmental/ biodiversity construction monitor during site preparation activities to make sure proper implementation of the measures defined herein, identify potential unforeseen impacts to terrestrial, and to apply adaptive management where needed to minimize impacts on vegetation and wildlife, particularly rare species • Pre-clearing surveys will occur twice a week and the contractor will report immediately any observation of endangered and important species observed. • Deter fauna from Project clearing areas using acoustic deterring methods • Implement a Chytrid Prevention protocol when handling all amphibians, if found. Fauna monitoring happens twice a week. The contractor is also asked to report any observations. • Conduct bat roost census and implement physical or acoustic exclusion measures to keep bats away from site • Rescue and relocate sessile species to undisturbed sites • Avoid vegetation clearing and site preparation activities, as feasible, between January and August to avoid impacts on bird breeding season • Assess areas for frequent wildlife crossing, install wildlife crossing signs and speed bumps. • Implement, maintain and manage a buffer zone for Morne Trois Piton National Park World Heritage Site.	Project Coordinator from Ormat and external consultants (Biologist from ECLIPSE)
			Operations	• Restore and revegetate temporary laydown areas post construction with native trees and shrubs • Implement the Habitat Management Procedure (which is part of the Biodiversity Management Plan of the 2022 ESMP) to mitigate impacts to terrestrial natural habitat caused by Project components. • Revegetation and restoration of temporary laydown areas with native and endemic species.	Project Coordinator and external consultants
11		Soil Erosion	Construction	• Installing of Temporary and permanent drainage systems (gulleys and stormwater conveyance systems) to divert stormwater away from the Project • Deforestation and site clearance activities will be minimized to the extent possible. • Prepare a Landslide Management Procedure (LMP) and a Stormwater Management Procedure (SMP) • Follow general mitigation measures to prevent erosion:	EPC contractor and Environment, Health and Safety

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• The laying of overland flow diversion drains, and preload fill should be completed preferably during the dry season and prior to the power plant construction earthworks commencing. • Disturbance area will be minimized and clearly demarcated. • Works will only be conducted within the works zone. • Vehicle movements will be restricted to the defined roads/tracks. • Where possible, works area will be designed to ensure stormwater runoff drains into the site. • Where runoff from the site is required, it will be via the longest flow path possible to ensure maximum sediment retention. Flows to undisturbed areas will be prioritized. • Where required, sediment controls (e.g., sediment ditches, rock check dams, sediment basins, sediment fences and silt socks, silt curtains, fibrous mats etc.). will be placed across as temporary stormwater drains to reduce the efflux velocity of the water and to aid settling of suspended sediment from the water. • Develop banks and excavation slopes in accordance with the guidelines for geotechnical stability. All soil stockpiles that will not be immediately re-used will be seeded. Temporary stockpiles will be watered as required to suppress dust. Excavated earth should be strongly compacted, and cut-off ditches should be dug in erosion prone areas to divert water away for the earthworks and to settling ponds before discharge to nearby water courses. • Avoid building roads or access roads on slopes greater than 15% as a soil conservation measure. • Deposit surplus material in previously approved areas or reuse it as fill material. • Stabilization and progressive reforestation of affected areas with plants and vegetation native to the island. • Along the reinjection pipeline route catchment areas will be kept to small sizes with their own temporary drains and specific treatment devices • Install a stormwater system designed to capture and treat any runoff. Stormwater conveyance systems will be adequately maintained to ensure stormwater flow does not lead to erosion and sedimentation. • Areas of the plant that are at risk of having contaminant discharges (such as oil leaks from vehicles or fluid spills) should be isolated, with their flows first draining through an oil water separator. The outflows from this separator could then drain to the sump/settling pond for further treatment. • Diversion drains will be installed around the site, the capacity of these drains needs to convey adequate flood events to reduce the likelihood of this occurring. • Stormwater collected in secondary storage facilities will be discharged once it has been inspected for contamination, at low flow rates through the existing stormwater conveyance systems to allow for infiltration into the ground at the site. If any signs of oil sheen or contamination are observed in the collected stormwater, then it shall be handled in accordance with the Waste Management Plan. • Sourcing a water supply for firefighting will be infrequent, however would require >500 m3 stored in a tank. • Develop an Erosion and Sediment Control Procedure and a Subsidence Management Plan	
12		Air emissions and noise due to vehicular transport	Construction and Operations	Emissions Control: • Low-Emission Vehicles: Invest in and use low-emission or zero-emission vehicles, such as electric or hybrid vehicles, to minimize air pollution. • Regular Maintenance: Ensure regular maintenance of all vehicles to keep them in optimal condition, reducing emissions from exhaust systems. • Emission Filters: Equip vehicles with advanced emission control technologies, such as catalytic converters and particulate filters, to reduce harmful emissions. Noise Control • Noise-Reducing Equipment: Use vehicles equipped with noise-reducing technologies, such as noise-dampening materials and quieter engines. • Routing and Scheduling: Plan transport routes and schedules to avoid residential areas during sensitive times (e.g., early morning or late evening) to minimize noise disturbances.	Environment Health and Safety and Corporate Social Responsibility
13		Improper or excessive land use.	Construction	• Land Use Planning: Collaborate with local authorities and stakeholders to ensure land use planning aligns with environmental and social considerations. • Compact Design: Design facilities to occupy the smallest possible footprint without compromising operational efficiency. • Phased Development: Implement phased development to reduce the immediate impact on land and allow for better management of environmental impacts. • Vegetation Cover: Preserve existing vegetation where possible and replant native species to stabilize soil and enhance biodiversity. • Stakeholder Engagement: Engage with local communities and stakeholders to incorporate their input into land use decisions and address any concerns.	Environment, Health and Safety

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Regulatory Adherence: Ensure compliance with all local, national, and international regulations related to land use and environmental protection. • Permitting and Approvals: Obtain all necessary permits and approvals before commencing land-altering activities.	
	Environment		Operations	• Land Rehabilitation: Develop and implement land rehabilitation plans to restore disturbed areas post-construction, including reforestation and soil restoration efforts. • Monitoring and Maintenance: Establish monitoring programs to assess the effectiveness of land rehabilitation efforts and ensure ongoing maintenance. • Integrated Land Management: Adopt integrated land management practices that balance geothermal development with agricultural, residential, and conservation needs.	Environment, Health and Safety
14	Human Resources & Human Rights	Absence of contracts, use of contracts that workers do not understand, or use of contracts with conditions that differ from actual working conditions	Construction and Operations	• Standardized Contracts: Use standardized contracts that clearly outline the terms and conditions of employment, including job roles, responsibilities, compensation, benefits, working hours, and conditions. • Language and Understanding: Ensure contracts are written in the local language and are easily understandable by the workers. Provide translations if necessary. • Compliance with Labor Laws: Ensure all contracts comply with local and international labor laws and standards. • Alignment with Actual Conditions: Ensure that the terms and conditions in the contracts accurately reflect the actual working conditions and are fair and reasonable. • Pre-Employment Orientation: Conduct pre-employment orientation sessions to explain the contract terms, job responsibilities, and rights to the workers. • Ongoing Communication: Maintain open lines of communication with workers to address any questions or concerns regarding their contracts and working conditions. • Legal Review: Have all contracts reviewed by legal experts to ensure compliance with relevant labor laws and regulations. • Ethical Practices: Adopt ethical recruitment and employment practices, avoiding any form of exploitation or unfair treatment of workers.	General Management and Human Resources
15	Human Resources & Human Rights	Low or Insufficient Wages	Construction and Operations	• Adherence to Local and International Laws: Ensure that all wages comply with local minimum wage laws and international labor standards, such as those set by the International Labour Organization (ILO). • Regular Review and Adjustment: Regularly review wage levels to ensure they are competitive and adjust them to reflect inflation and cost-of-living increases. • Living Wage Policy: Adopt a living wage policy that ensures wages are sufficient to meet the basic needs of workers and their families, including food, housing, education, and healthcare. • Equal Pay for Equal Work: Ensure equal pay for equal work, eliminating any wage disparities based on gender, ethnicity, or other discriminatory factors. • Clear Communication: Clearly communicate the wage structure to all employees, including the basis for wage levels, increments, and any bonus or incentive schemes. • Provide detailed pay slips that clearly outline earnings, deductions, and net pay. • Union and Worker Representation: Engage with worker representatives and unions to negotiate fair wages and address any wage-related concerns. • Community Relations: Maintain good community relations by ensuring fair wages and addressing any community concerns related to employment practices. • Comprehensive Benefits: Offer comprehensive benefits packages that include health insurance, retirement plans, and other social benefits to supplement wages. • Performance Bonuses: Implement performance-based bonuses and incentives to reward high-performing employees and enhance overall compensation. • Skill Development Programs: Provide training and skill development programs to help workers advance in their careers and earn higher wages. • Career Advancement Opportunities: Clearly outline career paths and opportunities for promotion within the Company.	General Management and Human Resources
16	Human Resources & Human Rights	Excessive Working Hours	Construction and Operations	• Adherence to Legal Working Hour Limits: Ensure that all work schedules comply with local and international labor laws regarding maximum working hours and mandatory rest periods. • Regular Monitoring: Implement a system to regularly monitor working hours to ensure compliance with legal requirements. • Reasonable Work Hours: Develop and enforce policies that set reasonable limits on daily and weekly working hours, including clear guidelines for overtime.	General Management and Human Resources

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Mandatory Rest Periods: Ensure that workers receive mandatory rest periods and breaks during their shifts to prevent fatigue. • Fatigue Management: Implement fatigue management strategies, such as rotating shifts, providing adequate rest between shifts, and monitoring workers for signs of fatigue. • Safety Training: Provide regular safety training to educate workers about the risks associated with excessive working hours and the importance of rest. • Flexible Scheduling: Where possible, offer flexible work schedules that allow workers to balance their work and personal lives. • Encourage Time Off: Encourage workers to take their entitled leave and time off to rest and recuperate. • Overtime Pay: Ensure that workers are fairly compensated for any overtime work, in accordance with labor laws and the Company policies. • Incentives for Compliance: Offer incentives for teams that consistently comply with working hour limits without compromising project deadlines. • Health and Wellness Programs: Implement health and wellness programs that support workers' physical and mental health, including access to healthcare, counseling, and fitness activities. • Stress Management: Provide resources and training on stress management techniques to help workers cope with job-related stress. • Worker Feedback: Establish channels for workers to provide feedback on their work schedules and report any concerns about excessive working hours. • Open Communication: Maintain open communication with workers to ensure they feel heard, and their concerns are addressed promptly.	
17	Human Resources & Human Rights	Lack of freedom of affiliation or complaint mechanisms.	Construction and Operations	• Freedom of Association Policy: Develop and enforce a clear policy that ensures workers have the freedom to join or form trade unions and engage in collective bargaining without fear of retaliation. • Complaint Mechanisms: Establish transparent and accessible complaint mechanisms that allow workers to raise concerns or grievances without fear of reprisal. • Worker Education: Conduct regular training sessions for workers on their rights to freedom of association and how to use complaint mechanisms effectively. • Management Training: Train supervisors and managers on respecting labor rights and handling grievances appropriately. • Encouragement of Unionization: Support and encourage the formation of worker organizations or unions and ensure they have the necessary resources and facilities to operate. • Facilitate Dialogue: Foster regular dialogue between management and worker representatives to address issues and improve working conditions. • Whistleblower Hotline: Implement anonymous reporting channels such as a whistleblower hotline or suggestion boxes where workers can safely report concerns. • Confidentiality Assurance: Ensure that all complaints and reports are handled confidentially and that workers are protected from any form of retaliation. • Internal Monitoring: Conduct regular internal audits and inspections to ensure compliance with policies on freedom of affiliation and grievance handling. • Third-Party Audits: Engage third-party auditors to review practices and verify that workers' rights are being upheld. • Prompt Response: Ensure that all complaints are addressed promptly and effectively, with appropriate corrective actions taken to resolve issues. • Continuous Improvement: Use feedback from grievances and complaints to continuously improve policies and working conditions. • Community and Stakeholder Consultation: Engage with community leaders, labor unions, and other stakeholders to understand their concerns and expectations regarding worker rights and grievance mechanisms. • Transparent Communication: Maintain open and transparent communication with all stakeholders about the measures being taken to uphold worker rights. • Adherence to Labor Laws: Ensure full compliance with national and international labor laws regarding freedom of association and grievance mechanisms. • Legal Support: Provide legal support and guidance to workers to help them understand their rights and the mechanisms available to them.	General Management and Human Resources
18	Human Resources & Human Rights	Discriminatory practices in hiring and promotion.	Construction and Operations	• Anti-Discrimination Policy: Create a comprehensive anti-discrimination policy that explicitly prohibits discrimination based on race, gender, age, disability, religion, sexual orientation, or any other protected characteristic. • Inclusive Hiring Practices: Implement inclusive hiring practices that ensure all candidates are evaluated based on their qualifications and experience without bias.	General Management and Human Resources

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Diversity Training: Conduct regular diversity and inclusion training for all employees, particularly those involved in the hiring and promotion processes. • Bias Awareness: Train hiring managers and promotion committees on unconscious bias and how to mitigate its effects in decision-making. • Standardized Procedures: Develop standardized hiring and promotion procedures that include clear criteria and guidelines to ensure fairness and consistency. • Documentation and Tracking: Maintain thorough documentation of the hiring and promotion processes, including the reasons for selection and rejection of candidates. • Diverse Recruitment Channels: Use diverse recruitment channels to attract a wide range of candidates from different backgrounds. • Affirmative Action Programs: Implement affirmative action programs to promote diversity in the workforce, particularly in underrepresented groups. • Regular Audits: Conduct regular internal audits to assess compliance with non-discrimination policies and identify any potential issues. • Monitoring Metrics: Track and analyze hiring and promotion metrics to ensure diversity goals are being met and to identify areas for improvement. • Anonymous Reporting: Provide anonymous reporting mechanisms for employees to report any instances of discrimination without fear of retaliation. • Prompt Investigation: Ensure that all complaints are promptly and thoroughly investigated, with appropriate corrective actions taken. • Diversity Committees: Establish diversity committees or task forces to promote an inclusive culture and address any issues related to discrimination.	
19	Health and Safety Labor (Physical Risks)	Physical, verbal, sexual or psychological harassment.	Construction and Operations	• Comprehensive Anti-Harassment Policy (Sexual and Gender Based Violence and Harassment – SGBVH): Create and enforce a comprehensive anti-harassment policy that clearly defines and prohibits all forms of harassment, including physical, verbal, sexual, and psychological. • Zero-Tolerance Policy: Adopt a zero-tolerance policy for any form of harassment, ensuring that all employees understand the serious consequences of such behavior. • Mandatory Training: Provide mandatory anti-harassment training for all employees, with special sessions for supervisors and managers on recognizing and addressing harassment. • Awareness Campaigns: Conduct regular awareness campaigns to educate employees about the forms of harassment and the importance of maintaining a respectful workplace. • Anonymous Reporting Channels: Establish anonymous reporting channels, such as hotlines or online reporting systems, to allow employees to report harassment without fear of retaliation. • Clear Reporting Procedures: Clearly communicate the procedures for reporting harassment and ensure employees know how to use these mechanisms. • Investigative Team: Form a dedicated team to promptly and thoroughly investigate all harassment complaints. • Fair Process: Ensure that investigations are conducted impartially, respecting the confidentiality of all parties involved. • Counseling Services: Provide access to counseling and support services for victims of harassment; map SGBVH service providers in Dominica. • Create a SGBVH committee to handle cases. • Protective Measures: Implement protective measures for victims, such as temporary reassignments or adjustments in work schedules, to prevent further harassment. • Consistent Enforcement: Enforce disciplinary actions consistently for those found guilty of harassment, up to and including termination of employment. Track incidents throughout the Project life cycle and implement corrective actions when needed. • Documentation: Maintain thorough documentation of all incidents and the actions taken to address them. • Leadership Commitment: Ensure that the Company's leaders and managers demonstrate a strong commitment to maintaining a harassment-free workplace. • Employee Engagement: Engage employees in creating a positive and respectful work environment through team-building activities and open communication. • Periodic Reviews: Conduct periodic reviews of anti-harassment policies and their effectiveness. • Employee Surveys: Use employee surveys to gauge the workplace environment and identify any areas of concern.	General Management and Human Resources
20	Health and Safety Labor (Physical Risks)	Threat or intimidation	Construction and Operations	• Comprehensive Anti-Intimidation Policy: Establish and enforce a clear anti-intimidation policy that prohibits any form of threats, bullying, or intimidation. • Zero-Tolerance Approach: Adopt a zero-tolerance policy for threats and intimidation, ensuring all employees are aware of the serious consequences.	General Management and Human Resources

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Mandatory Training: Provide mandatory training for all employees on recognizing, preventing, and reporting threats or intimidation. • Awareness Programs: Conduct regular awareness programs to educate employees about the importance of maintaining a respectful and safe work environment. • Anonymous Reporting Systems: Implement anonymous reporting systems, such as hotlines or online platforms, to allow employees to report incidents without fear of retaliation. • Clear Reporting Procedures: Clearly outline the procedures for reporting threats or intimidation and ensure employees are familiar with these processes. • Investigative Team: Establish a dedicated team to investigate complaints of threats or intimidation promptly and thoroughly. • Fair Process: Ensure investigations are conducted impartially, respecting the confidentiality of all parties involved. • Counseling and Support Services: Provide access to counseling and support services for victims of threats or intimidation. • Protective Measures: Implement protective measures for victims, such as temporary reassignments or adjustments in work duties, to prevent further incidents. • Consistent Enforcement: Apply disciplinary actions consistently for individuals found guilty of threats or intimidation, up to and including termination of employment. • Documentation: Maintain detailed records of all incidents and the actions taken to address them. • Leadership Role: Ensure that leaders and managers demonstrate a strong commitment to a safe and respectful workplace. • Employee Engagement: Foster employee engagement in creating a positive work environment through team-building activities and open communication channels. • Periodic Reviews: Regularly review the effectiveness of policies and procedures related to threats or intimidation. • Employee Feedback: Collect feedback from employees through surveys or focus groups to identify areas for improvement.	
21	Health and Safety Labor (Physical Risks)	Slips, trips and falls in the working area	Construction and Operations	• Regular Cleaning: Ensure that the work area is regularly cleaned and free from debris, spills, and unnecessary materials. • Clear Walkways: Maintain clear walkways and passageways by removing obstacles and ensuring that they are well-organized and free of clutter. • on-Slip Surfaces: Install non-slip flooring materials in areas prone to wet or slippery conditions. • Repair Damages: Promptly repair any damaged or uneven surfaces to prevent trips and falls. • Warning Signs: Use clear and visible warning signs to indicate wet floors, uneven surfaces, or other potential hazards. • Floor Markings: Apply high-visibility floor markings to highlight safe walkways and hazardous areas. • Adequate Lighting: Ensure that all working areas, pathways, and staircases are adequately lit to prevent accidents due to poor visibility. • Emergency Lighting: Install emergency lighting in critical areas to ensure visibility during power outages or emergencies. • Proper Footwear: Provide workers with appropriate footwear with non-slip soles. • Fall Protection Gear: Provide fall protection gear such as harnesses and guardrails in areas where there is a risk of falling from heights. • Hazard Awareness: Encourage workers to remain vigilant and report any potential hazards immediately. • Proper Storage: Ensure that tools and equipment are stored properly when not in use to prevent them from becoming tripping hazards. • Secure Cables: Securely fasten cables and hoses to the ground or overhead to avoid creating trip hazards. • Regular Inspections: Conduct regular site inspections to identify and address potential slip, trip, and fall hazards. • Safety Audits: Perform safety audits to evaluate the effectiveness of existing measures and identify areas for improvement. • First Aid Kits: Ensure that first aid kits are readily available and stocked with necessary supplies. • Emergency Procedures: Develop and communicate clear emergency procedures for responding to incidents involving slips, trips, and falls.	Industrial Health and Safety and Departments Supervisors
22	Health and Safety Labor (Physical Risks)	High altitude falls	Construction	• Implement the Fall Arrest System (FAS) as a last resort and used when work cannot be conducted within the confines of a guarded catwalk or work platform. Follow the specific procedure for work at heights. • Personnel are trained and competent to use the FAS	The responsibility for establishing and administration of Fall Arrest Systems (FAS) lies

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Equipment is inspected and maintained in accordance with manufacturers specifications and the Standard Practice for Fall Arrest • A rescue plan is prepared and reviewed in the event a worker falls and becomes suspended • All elevated tools are analyzed to identify as well as provide adequate fall protection systems • Compliance to recognized standards relating to fall arrest. • Responsibility for the proper care and use of personal Fall Arrest System lies with the user. • Personnel are required to wear FAS when the possibility exists for a worker to fall a vertical distance greater than 1.8m. • Management shall recognize that a Fall Arrest System (FAS) is the last resort and shall only be used when the work cannot be conducted within the confines of a guarded catwalk or work platform. This form of passive protection is preferred over wearing harnesses.	with the supervisor. The authority for administration of the Fall Arrest program may be delegated to a competent worker.
23	Health and Safety Labor (Physical Risks)	Collision with moving equipment (ex. vehicles, forklifts, etc.).	Construction and Operations	• Traffic Flow Design: Develop a detailed traffic management plan that clearly defines routes for vehicles, equipment, and pedestrians to minimize the risk of collisions. • Separation of Pathways: Where possible, create separate pathways for vehicles and pedestrians to avoid conflicts. • Clear Signage: Use clear and visible signs to indicate vehicle routes, pedestrian crossings, speed limits, and other important traffic information. • Road Markings: Apply high-visibility road markings to delineate lanes, crossings, and hazardous areas. • Speed Limits: Enforce strict speed limits for all vehicles and equipment operating on-site and offsite. • Speed Bumps: Install speed bumps in critical areas to ensure vehicles operate at safe speeds. • Operator Training: Ensure all vehicle and equipment operators are properly trained and certified. • Safety Inductions: Conduct safety inductions for all workers to raise awareness about the risks of moving equipment and proper safety practices. • Communication Protocols: Establish clear communication protocols, such as the use of hand signals or two-way radios, to enhance coordination between operators and ground personnel. • High-Visibility Clothing: Require all workers, particularly those working near moving equipment, to wear high-visibility clothing. • PPE Usage: Provide all workers the appropriate PPE, helmets, protective clothing, gloves, face shields, goggles, facemasks, earplugs safety boots, etc. • Regular Inspections: Conduct regular inspections and maintenance of all vehicles and equipment to ensure they are in safe working condition. • Pre-Operation Checks: Implement pre-operation checks for all equipment to identify and address any potential issues before use. • Physical Barriers: Install physical barriers and guardrails in high-traffic areas to protect pedestrians from moving vehicles. • Dedicated Loading/Unloading Zones: Establish dedicated loading and unloading zones that are clearly marked and separated from pedestrian areas. • Adequate Lighting: Ensure all working areas, especially those with vehicle traffic, are well-lit to enhance visibility. • Reflective Markings: Use reflective tape and markings on vehicles and equipment to improve their visibility in low-light conditions. • Emergency Response Plan: Develop and communicate an emergency response plan for incidents involving collisions, including first aid and evacuation procedures. • First Aid Training: Provide first aid training to workers to ensure quick and effective response to any injuries resulting from collisions.	Industrial Health and Safety and Departments Supervisors
24	Health and Safety Labor	Entrapment by improperly isolated machines, without protections.	Construction	• Fixed Guards: Ensure all machines are equipped with fixed guards that provide a physical barrier between workers and moving parts. • Interlocking Guards: Use interlocking guards that shut down the machine if the guard is removed or opened. • Adjustable Guards: Install adjustable guards on machines that can be tailored to different tasks while maintaining protection. • LOTO Program: Develop and implement a comprehensive Lockout/Tagout (LOTO) program to ensure that machinery is properly de-energized and isolated before maintenance or repair work is conducted. • Training: Provide thorough training on LOTO procedures for all workers and supervisors who work with or around machinery. • LOTO Devices: Supply appropriate LOTO devices and ensure their proper use. • Scheduled Maintenance: Conduct regular maintenance and inspections of all machinery to ensure they are in safe working condition and that all guards and safety devices are functioning correctly. • Inspection Checklists: Use detailed inspection checklists to identify and rectify any potential hazards.	Industrial Health and Safety and Departments Supervisors

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Safety Inductions: Conduct safety inductions for all workers, emphasizing the risks of entrapment and the importance of using machine guards and following isolation procedures. • Ongoing Training: Provide ongoing safety training and refresher courses on machinery safety and entrapment prevention. • Warning Signs: Place clear warning signs near machines to alert workers of the entrapment risks and the importance of using guards and LOTO procedures. • Labels: Ensure all control panels and isolation points are clearly labelled. • Emergency Stops: Equip all machinery with easily accessible emergency stop mechanisms to allow workers to quickly halt operations in case of an entrapment risk. • Regular Testing: Regularly test emergency stop mechanisms to ensure they function correctly. • Safety Supervisors: Appoint safety supervisors to monitor compliance with machine guarding and LOTO procedures. • Spot Checks: Conduct random spot checks to ensure all safety measures are being followed. • Appropriate PPE: Provide workers with appropriate PPE, such as gloves, safety glasses, and protective clothing, to minimize injury risks. • PPE Training: Ensure workers are trained in the proper use and maintenance of PPE. • Incident Reporting System: Implement a robust incident reporting system to track and analyze any entrapment incidents or near-misses. • Root Cause Analysis: Conduct thorough investigations of any incidents to identify root causes and implement corrective actions. • Review and Update: Regularly review and update safety procedures and training programs to incorporate lessons learned from incidents and to address any new risks that arise.	
25	Health and Safety Labor (Physical Risks)	Exposure to high noise levels.	Construction and Operations	• Every employee when working at the site shall wear suitable hearing protection appropriate to the work being undertaken and the noise levels. This applies to employees, contractors and sub-contractors alike. • Regular monitoring of occupational noise shall be carried out by The Contractor to determine areas where the 8-hour guideline level of 85 dB(A) is likely to be exceeded. • The Contractor will keep records and undertake appropriate control measures in all locations for which either the 85 dB(A) for 8-hour guidelines or the short-term guideline of 115 dB(A) is exceeded. This shall include sign posting of areas in which guidelines are exceeded. • The contractor will strive to reduce noise exposure by controlling noise at the source wherever practicable. • Site management shall ensure that employees are trained for work in noisy locations and in the use of hearing protection. This shall be included in the induction training and updated regularly according. • Site management must ensure that all members of a work party and all contractors and sub-contractors are wearing appropriate hearing protection. • All employees shall be responsible for the care of personal protective equipment issued to them, including the correct use, cleaning and maintenance of the equipment. • If personal protective equipment is not available, or is inadequate for a task, or insufficient training has been provided, the employee shall inform their supervisor so that suitable equipment can be provided. • Site management shall ensure that noise hazard areas are identified and assessed initially and every two years.	Industrial Health and Safety and Departments Supervisors
26	Health and Safety Labor	Exposure to extreme temperatures.	Construction and Operations	• Every employee shall always wear suitable clothing appropriate to the work being undertaken and the temperature. This applies to employees, contractors and sub-contractors alike. Any requirement for specific clothing items required in either sign posting or in the Safe Work Practices shall be adhered to. • Regular monitoring of heat and cold stress indicators shall be carried out where work is being done in extremes of temperature. • The contractor shall provide a medical assessment to determine suitability of workers required to carry out high or low temperature work. • The contractor shall assess effects of exposure to heat or cold stress. • The contractor will undertake appropriate control measures for all work that must be carried out in temperature extremes. • The contractor shall ensure that employees are trained for work in hot or cold environments. This shall be included in the induction training. Specific training must be provided for work in extreme temperatures.	Industrial Health and Safety and Departments Supervisors
27	(Physical Risks)	Contact with exposed or defective electrical cables.	Construction and Operations	• Qualified Electricians: Ensure that all electrical installations are carried out by qualified and licensed electricians.	Industrial Health and Safety and Departments Supervisors

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Regular Maintenance: Implement a regular maintenance schedule to inspect and repair electrical cables and systems. • Up-to-date Standards: Adhere to the latest electrical codes and standards during installation and maintenance. • Routine Inspections: Conduct routine inspections of all electrical cables and connections to identify and rectify any potential hazards. • Testing Equipment: Use appropriate testing equipment to check for faults or defects in electrical cables. • Cable Management: Use proper cable management systems to keep electrical cables organized and protected from damage. • Conduits and Trunking: Install electrical cables within conduits or trunking to prevent exposure and physical damage. • Insulation: Ensure all electrical cables are adequately insulated and replace any damaged insulation immediately. • Warning Signs: Place clear warning signs near electrical panels and cable runs to alert workers of the electrical hazards. • Labelling: Properly label all electrical cables and circuits to ensure easy identification and maintenance. • Appropriate PPE: Provide workers with appropriate PPE, such as insulated gloves, safety boots, and protective clothing. • PPE Training: Ensure workers are trained in the proper use and maintenance of PPE. • Electrical Safety Training: Conduct comprehensive electrical safety training for all workers and supervisors. • Emergency Response: Train workers on emergency response procedures in case of electrical incidents, including how to use fire extinguishers designed for electrical fires. • LOTO Program: Implement a robust Lockout/Tagout (LOTO) program to ensure electrical systems are de-energized before maintenance or repair. • Training: Provide thorough LOTO training to all relevant personnel. • First Aid Kits: Ensure that first aid kits are readily available and equipped with supplies for treating electrical injuries. • Emergency Contacts: Display emergency contact numbers and procedures prominently on-site. • Safety Supervisors: Assign safety supervisors to monitor compliance with electrical safety protocols. • Spot Checks: Conduct random spot checks to ensure all safety measures are being followed. • Incident Reporting System: Implement a system for reporting and analyzing electrical incidents or near-misses. • Root Cause Analysis: Investigate all electrical incidents to identify root causes and implement corrective actions. • Review and Update: Regularly review and update electrical safety procedures and training programs based on incident data and new regulations.	
28	Health and Safety Labor (Physical Risks)	Explosions or fires due to the ignition of dust or flammable materials.	Construction and Operations	• All fires are to be reported to the site superintendent and the health and safety committee regardless of size. The causes and effects of each fire are to be reviewed by the safety committee with the aim of implementing methods and practices that would prevent a similar fire occurring or to minimize the effects. • Appropriate precautions should be taken during hot work or other work that produces heat, sparks or flames. These would normally involve ensuring a fire extinguisher of a type and size appropriate to the hazard is immediately available. Staff on fire watch trained in the use of extinguishers may be appropriate depending on the risk and consequence of fire in any situation. • Rubbish should normally be placed in designated, purpose designed areas. It is not to be allowed to accumulate adjacent to buildings, fuel stores, in porches or under building overhangs. • Exit corridors and stairs in buildings must be clear and free of rubbish and other flammable material or objects that block or restrict the egress from the building. • Smoking is prohibited within all hazardous areas or within 6m of any flammable stores or other potential fuel source. • Additional precautions must be taken when automatic systems are rendered inoperative. • Buildings and sites will be equipped with both alarm systems and suppression systems. Staff must be aware of the hazards associated with suppression systems (e.g. CO2) and be aware of the appropriate actions to be taken upon system activation.	Industrial Health and Safety and Departments Supervisors
29	Health and Safety Labor (Physical Risks)	Exposure to non-ionizing radiation (Ultraviolet light).	Construction and Operations	• UV Protective Clothing: Provide workers with UV-protective clothing, including long-sleeved shirts, pants, and wide-brimmed hats.	Industrial Health and Safety and Departments Supervisors

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Eye Protection: Ensure workers use safety glasses or goggles with UV protection when performing tasks that could expose them to UV light. • Sunscreen: Supply broad-spectrum sunscreen with a high SPF rating and encourage its use on exposed skin. • Shade Structures: Erect shade structures in outdoor work areas to reduce direct sun exposure. • UV Shields: Install UV shields or filters on equipment and machinery that emit UV radiation. • Work Scheduling: Schedule outdoor work and tasks that involve UV exposure during early morning or late afternoon to avoid peak UV radiation times. • Breaks: Implement regular breaks in shaded or indoor areas to limit continuous exposure to UV light. • UV Safety Training: Conduct training sessions to educate workers about the risks of UV radiation and the importance of protective measures. • Awareness Campaigns: Implement awareness campaigns to remind workers about the dangers of UV exposure and the need for protective measures. • UV Monitoring: Use UV monitoring devices to measure the levels of UV radiation in work areas and identify high-risk zones. • Health Surveillance: Implement health surveillance programs to monitor the effects of UV exposure on workers and provide regular skin and eye check-ups. • Regular Inspection: Conduct regular inspections of protective equipment and UV shields to ensure they are in good condition and provide adequate protection. • Maintenance Programs: Establish maintenance programs for equipment that may emit UV radiation to ensure they operate within safe limits. • First Aid: Provide first aid kits with supplies to treat UV-related injuries, such as burns and eye irritation. • Emergency Procedures: Develop and communicate emergency procedures for dealing with severe UV exposure incidents. • Safety Policies: Develop and enforce safety policies regarding UV exposure and the use of protective measures.	
30	Health and Safety Labor (Chemical Hazards)	Skin contact, inhalation, or ingestion of toxic products (e.g., pesticides, solvents).	Construction and Operations	• Maintain on site a list of hazardous chemicals that are present on site. • Label all chemicals at the construction site properly. • Maintain proper Materials Safety Data Sheets (MSDSs) for all chemicals at the construction site.	Industrial Health and Safety and Departments Supervisors
31		Dust inhalation.	Construction and Operations	• Respirators: Provide workers with appropriate respirators or masks (e.g., N95) that are certified to filter out dust particles. • Protective Eyewear: Use safety goggles to protect workers' eyes from dust. • Coveralls: Supply disposable coveralls to prevent dust from settling on workers' clothing and being carried into clean areas. • Dust Suppression Systems: Install dust suppression systems, such as water sprays or misting systems, to dampen dust at the source during activities like drilling and excavation. • Ventilation Systems: Ensure proper ventilation in enclosed areas to remove dust from the air. • Barriers and Screens: Erect barriers or screens around high-dust activities to contain dust spread. • Work Scheduling: Schedule high-dust activities during times when fewer workers are present or when weather conditions minimize dust dispersion. • Limiting Exposure Time: Rotate workers to limit their exposure time to dusty environments. • Dust Hazard Training: Educate workers about the hazards of dust inhalation and the importance of using protective measures. • Proper Use of PPE: Provide training on the correct use and maintenance of PPE. • Air Quality Monitoring: Use air quality monitors to measure dust levels in the work area and identify high-risk zones. It is recommended to get a hand-held device to monitor dust. • Health Surveillance: Conduct regular health checks and lung function tests for workers to monitor any adverse effects of dust exposure. • Regular Maintenance: Maintain dust suppression and ventilation systems to ensure they operate effectively. • Inspection: Regularly inspect work areas and equipment to ensure compliance with dust control measures. • First Aid: Provide first aid kits with supplies to treat respiratory irritation and other dust-related health issues. • Emergency Procedures: Develop and communicate procedures for dealing with severe dust exposure incidents.	EPC Contractor

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
32	Health and Safety Labor (Chemical Hazards)	Exposure to spaces lacking oxygen in confined spaces.	Construction and Operations	• Pre-Entry Testing: Test the atmosphere of confined spaces for oxygen levels and the presence of hazardous gases before entry. Ensure that oxygen levels are within the safe range (19.5% to 23.5%). • Continuous Monitoring: Use portable gas detectors to continuously monitor oxygen levels while workers are inside confined spaces. • Forced Ventilation: Use mechanical ventilation systems to ensure a continuous supply of fresh air into confined spaces, preventing the buildup of hazardous gases and maintaining adequate oxygen levels. • Natural Ventilation: Where possible, use natural ventilation methods to enhance air circulation. • Supplied Air Respirators: Provide workers with supplied air respirators or self-contained breathing apparatus (SCBA) when working in confined spaces with potential oxygen deficiency. • Protective Clothing: Ensure workers wear appropriate protective clothing to prevent exposure to other hazardous substances. • Confined Space Entry Training: Train workers on the hazards of confined spaces, safe entry procedures, emergency rescue operations, and the use of PPE and monitoring equipment. • Certification: Ensure that only certified personnel are allowed to enter confined spaces. • Permit-to-Work System: Implement a permit-to-work system that requires authorization and documentation before any worker enters a confined space. The permit should include details of the hazards, safety measures, and emergency procedures. • Supervision: Ensure that a qualified supervisor oversees confined space entry operations. • Emergency Response Plan: Develop and communicate an emergency response plan specifically for confined space incidents, including rescue procedures and contact information for emergency services. • Rescue Equipment: Provide appropriate rescue equipment, such as tripods, harnesses, and lifelines, and ensure it is readily available and in good condition. • Rescue Team: Maintain a trained and equipped rescue team on standby during confined space operations. • Two-Way Communication: Ensure reliable communication between workers inside the confined space and those outside. Use two-way radios or other communication devices. • Buddy System: Implement a buddy system where one worker remains outside the confined space to monitor and assist the entrant. • Equipment Maintenance: Regularly inspect and maintain all ventilation, monitoring, and rescue equipment to ensure proper functioning. • Space Inspection: Conduct routine inspections of confined spaces to identify and mitigate potential hazards before entry.	EPC Contractor
33	Health and Safety Labor (Biological Hazards)	Lack of adequate services (ex, potable water, toilets, toilet facilities).	Construction and Operations	• Water Supply Stations: Install sufficient potable water supply stations throughout the worksite, ensuring they are easily accessible to all workers. • Regular Water Quality Testing: Conduct regular testing of water quality to ensure it meets health and safety standards. • Hydration Awareness: Educate workers about the importance of regular hydration, especially in hot and strenuous working conditions. • Adequate Number of Toilets: Ensure there are enough toilet facilities to accommodate the workforce, following the recommended ratio of toilets per number of workers. • Cleanliness and Maintenance: Implement a strict schedule for the cleaning and maintenance of toilet facilities to prevent unsanitary conditions. • Gender-Specific Facilities: Provide separate toilet facilities for male and female workers to maintain privacy and hygiene. • Handwashing Facilities: Install handwashing stations with soap and clean water near toilet facilities and food areas. • Sanitization Supplies: Ensure that hand sanitizers or disinfectants are available at multiple locations on-site. • Portable Toilets: Use portable toilet units if permanent facilities cannot be installed immediately. Ensure these units are regularly cleaned and serviced. • Mobile Water Units: Deploy mobile water units to supply potable water where fixed stations are not feasible. • Health and Hygiene Training: Conduct regular training sessions on health and hygiene practices, emphasizing the importance of using provided facilities correctly. • Signage: Place clear and informative signage around the site to direct workers to water and sanitation facilities and to encourage hygienic practices.	Industrial Health and Safety and Departments Supervisors
34	Health and Safety Labor (Ergonomic Hazards)	Repetitive movements.	Construction and Operations	• Ergonomic Tools and Equipment: Provide tools and equipment designed to reduce strain and fatigue. This includes using ergonomic handles, anti-vibration gloves, and adjustable workstations. • Workstation Layout: Ensure that workstations are designed to minimize awkward postures and excessive reach. Adjust the height and orientation of work surfaces to suit the tasks performed.	Industrial Health and Safety Departments Supervisors Human Resources

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Job Rotation: Implement a job rotation system to reduce the duration of repetitive tasks. Workers should switch tasks frequently to use different muscle groups. • Scheduled Breaks: Ensure regular breaks are incorporated into the work schedule to allow workers to rest and recover from repetitive movements. Short, frequent breaks are more effective than fewer, longer breaks. • Stretching Programs: Incorporate stretching programs into the daily routine. Encourage workers to perform stretching exercises before, during, and after their shifts. • Strength and Conditioning: Promote physical fitness and conditioning programs to improve overall worker health and resilience to physical tasks. • Mechanical Aids: Utilize mechanical aids such as hoists, conveyors, and automated equipment to reduce the need for manual repetitive movements. • Supportive Braces: Provide supportive braces or splints to workers performing tasks that require repetitive wrist or hand movements.	
35	Health and Safety Labor (Ergonomic Hazards)	Inappropriate techniques for lifting heavy objects.	Construction and Operations	• Proper Lifting Techniques: Provide comprehensive training on proper lifting techniques, including bending at the knees, keeping the back straight, and holding the load close to the body. Ensure all workers understand these techniques and the importance of using them. • Regular Refresher Courses: Conduct regular refresher courses to reinforce proper lifting techniques and keep workers informed about the latest best practices in manual handling. • Lifting Equipment: Encourage the use of lifting equipment such as forklifts, hoists, and hand trucks to handle heavy objects. Ensure that mechanical aids are readily available and properly maintained. • Assistive Devices: Provide assistive devices like lifting straps or dollies to help workers manage heavy loads safely. • Workplace Ergonomics: Design the workplace to minimize the need for heavy lifting. Arrange storage and work areas so that heavy items are stored at waist height, reducing the need for bending or reaching. • Work Surface Adjustments: Ensure that work surfaces are at an appropriate height to facilitate safe lifting practices. • Task Rotation: Implement a job rotation system to prevent repetitive strain injuries from lifting heavy objects. Rotate workers through different tasks to give muscle groups time to recover. • Team Lifting: Promote team lifting for heavy or awkward loads, ensuring that workers collaborate to lift safely and distribute the load evenly. • Health Surveillance: Conduct regular health surveillance to monitor for signs of musculoskeletal injuries. Early detection can lead to timely intervention and treatment. • Safety Audits: Perform regular safety audits to ensure that lifting techniques and the use of mechanical aids are being correctly applied in the workplace. • Encourage Reporting: Create an environment where workers feel comfortable reporting potential hazards or incidents related to manual handling. Use this information to improve safety practices. • Safety Briefings: Include safe lifting practices in daily or weekly safety briefings. Regularly discuss the importance of using proper techniques and the risks of not doing so. • Supportive Gear: Provide appropriate PPE, such as back support belts, to workers involved in heavy lifting. Ensure that PPE is used correctly and consistently.	EPC Contractor
36	Health and Safety Labor (Ergonomic Hazards)	Jobs inadequately designed or aligned.	Construction and Operations	• Job Analysis: Conduct thorough job analyses to define the roles and responsibilities of each position clearly. Ensure that job descriptions are detailed and accurately reflect the tasks and expectations. • Task Alignment: Align tasks with workers' skills and qualifications to ensure that each job is well-suited to the individual performing it. • Skill Enhancement: Provide regular training and development opportunities to equip workers with the skills needed for their specific roles. This includes technical training, safety protocols, and job-specific skills. • Cross-Training: Implement cross-training programs to increase workforce flexibility and ensure that workers can adapt to different tasks as needed. • Clear Instructions: Ensure that all job roles and tasks are communicated clearly to workers. Use visual aids, written instructions, and regular meetings to clarify job expectations. • Feedback Mechanisms: Establish open lines of communication where workers can provide feedback on job design and task alignment. Use this feedback to make necessary adjustments. • Ergonomic Assessment: Conduct ergonomic assessments to design jobs that minimize physical strain and maximize efficiency. Adjust workstations, tools, and equipment to fit the needs of the workers. • Adaptive Tools: Provide adaptive tools and equipment that can be adjusted to meet the ergonomic needs of individual workers. • Workflow Analysis: Regularly analyze workflows to identify bottlenecks, redundancies, and misalignments. Optimize processes to ensure smooth and efficient job performance.	EPC Contractor

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Lean Principles: Implement lean management principles to streamline job processes and eliminate waste, ensuring that each job is designed to add maximum value. • Risk Assessments: Conduct regular risk assessments to identify potential hazards associated with job design. Implement control measures to mitigate these risks. • Safety Protocols: Establish and enforce safety protocols to ensure that jobs are performed safely and in alignment with health and safety standards. • Task Variety: Incorporate task variety and job rotation to prevent monotony and reduce the risk of repetitive strain injuries. Ensure that workers can switch tasks periodically. • Flexible Scheduling: Provide flexible scheduling options to accommodate workers' needs and enhance job satisfaction.	
37	Health and Safety Labor (Ergonomic Hazards)	Obligation to stand for long periods.	Construction and Operations	• Anti-Fatigue Mats: Provide anti-fatigue mats in areas where workers are required to stand for long periods. These mats can help reduce the strain on the legs and back. • Adjustable Workstations: Install adjustable workstations that allow workers to alternate between sitting and standing positions throughout their shift. • Scheduled Breaks: Implement a schedule that includes regular breaks to allow workers to sit, stretch, and rest. Encourage workers to take short breaks every hour. • Microbreaks: Promote the use of microbreaks, which are short breaks taken every 20-30 minutes to stretch and move around. • Task Variety: Introduce job rotation to minimize the duration of continuous standing. Rotate workers between tasks that require standing and tasks that allow for sitting or more movement. • Cross-Training: Crosstrain workers so they can perform a variety of tasks, reducing the time spent standing in one position. • Supportive Shoes: Ensure that workers are provided with or required to wear supportive, comfortable footwear that reduces the strain on their feet and legs. • Footwear Policies: Implement footwear policies that mandate the use of shoes with adequate arch support and cushioning. • Seating Options: Provide seating options such as stools or chairs in areas where standing is required. Allow workers to sit when performing tasks that can be done seated. • Footrests: Provide footrests to allow workers to shift their weight and reduce strain on their legs. • Stretching Exercises: Implement health and wellness programs that include regular stretching exercises designed to alleviate the strain from prolonged standing. • Education: Educate workers on the importance of proper posture and movement to reduce the impact of prolonged standing.	EPC Contractor
38	Land acquisition	Acquisition and use of land	Construction and Operations	• Fair Compensation: Ensure that all landowners and affected parties receive fair compensation for the land based on current market value and potential livelihood impacts. • Transparent Process: Conduct the land acquisition process transparently, with clear communication about the purpose, benefits, and potential impacts of the project. • Legal Compliance: Adhere strictly to local, national, and international laws and regulations regarding land acquisition and use. • Stakeholder Involvement: Involve local communities, including marginalized and vulnerable groups, in decision-making processes related to land acquisition and use. • Public Consultations: Hold regular public consultations to inform and gather feedback from the community about the project and its impacts. • Grievance Mechanisms: Establish accessible grievance mechanisms to address concerns and disputes related to land acquisition. • Minimize Land Disturbance: Design the project layout to minimize land disturbance and preserve natural habitats and agricultural land where possible. • Land Rehabilitation: Implement land rehabilitation and restoration programs for areas affected by the project to return them to a productive state. • Protect Ecosystems: Identify and protect critical ecosystems and biodiversity hotspots within the project area. • Wildlife Corridors: Create wildlife corridors and green spaces to maintain biodiversity and ecological balance. • Cultural Sensitivity: Respect and preserve cultural heritage sites, traditional land uses, and practices of indigenous and local communities. • Archaeological Assessments: Conduct archaeological assessments and protect significant cultural artifacts and sites found during the project. • Ongoing Monitoring: Continuously monitor the environmental and social impacts of land use throughout the project lifecycle.	General Management and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Regular Reporting: Report regularly on the project's compliance with land use agreements and its impact on the community and environment. • Support Local Governance: Strengthen local governance structures to better manage land resources and resolve conflicts. • In reference to Section 5.2 to the ESIA for the Project's area of influence.	
39	Community Health and Safety	Traffic safety	Construction and Operations	• Regular Maintenance: Ensure all the Company's vehicles undergo regular maintenance checks to keep them in safe operating condition. • Safety Features: Equip vehicles with modern safety features such as anti-lock brakes (ABS), electronic stability control (ESC), and advanced driver-assistance systems (ADAS) like collision warning and lane departure alerts. • Defensive Driving Training: Provide comprehensive defensive driving training for all drivers to enhance their skills and promote safe driving practices. • Fatigue Management: Implement policies to manage driver fatigue, including mandatory rest periods and limits on consecutive driving hours. • Distraction-Free Driving: Enforce strict policies against the use of mobile phones and other distractions while driving. • Road Signage: Ensure proper installation and maintenance of clear road signage within and around the project site. • Lighting: Install adequate lighting in areas with high traffic, particularly in parking lots and around entrances/exits, to improve visibility. • Traffic Control Measures: Implement traffic control measures such as speed limits, speed bumps, and designated pedestrian crossings to enhance safety. Ormat—through the DGDC—will issue public announcements through social media, online news sites and the radio to let the community know about heavy equipment traffic, including schedules and streets affected. • Clear Pathways: Maintain clear and well-marked pathways for both vehicles and pedestrians to reduce the risk of accidents. • Emergency Response Plans: Develop and communicate comprehensive emergency response plans, including procedures for dealing with traffic accidents. • First Aid Training: Provide first aid training to employees, particularly those who are frequently on the road, so they can respond effectively to accidents. • Public Awareness Campaigns: Conduct public awareness campaigns in local communities about road safety, especially around construction sites and high-traffic areas. • Stakeholder Communication: Engage with local authorities and community leaders to address traffic safety concerns and collaborate on solutions.	Environment Health and Safety and Corporate Social Responsibility
40	Community Health and Safety	Expansion Construction / dismantling of buildings and infrastructure	Construction	**Environmental Protection:** • Waste Management: Develop and implement a comprehensive waste management plan to properly handle and dispose of construction and demolition waste. This includes recycling materials where possible. • Air Quality Control: Use dust suppression techniques, such as water spraying, and install barriers to minimize dust emissions during construction and dismantling. • Noise Reduction: Employ noise-reducing equipment and schedule construction activities to minimize disturbance to nearby communities, especially during early mornings and late evenings. **Community Engagement:** • Public Consultation: Conduct regular consultations with local communities to inform them about construction activities, timelines, and potential impacts. • Grievance Mechanisms: Establish clear and accessible grievance mechanisms to address any concerns or complaints from the community promptly. • Community Benefits: Ensure that the community benefits from the project through job creation, improved infrastructure, or other community development initiatives. **Sustainable Practices:** • Green Building Techniques: Incorporate sustainable construction practices, such as using eco-friendly materials, energy-efficient designs, and sustainable sourcing of resources. • Energy Efficiency: Use energy-efficient machinery and equipment to reduce the carbon footprint of construction activities. • Water Conservation: Implement water-saving techniques and manage water use responsibly to minimize waste and environmental impact. **Social Responsibility:** • Local Employment: Prioritize hiring local workers and contractors to support the local economy and build goodwill within the community.	Environment Health and Safety and Corporate Social Responsibility

ID	Sector	Risk	Project phase	Mitigation Measures	Responsible
				• Capacity Building: Provide training and capacity-building opportunities for local workers to enhance their skills and employment prospects. • Community Benefits: Develop programs to provide additional benefits to the local community, such as education, healthcare, and infrastructure improvements	
41	Community Health and Safety	Use of security personnel	Construction and Operations	**Clear Conflict of Interest Policies:** • Policy Development: Develop and implement comprehensive conflict of interest policies specifically for security personnel. These policies should clearly define what constitutes a conflict of interest and provide examples relevant to security operations. • Policy Dissemination: Ensure all security personnel are aware of and understand the conflict-of-interest policies. This can be achieved through regular training sessions and accessible documentation. **Regular Training and Awareness Programs:** • Conflict of Interest Training: Provide regular training sessions on identifying and managing conflicts of interest. This training should be mandatory for all security personnel and updated periodically. **Independent Oversight:** • Third-Party Oversight: Implement independent oversight mechanisms to monitor the activities of security personnel and ensure that conflicts of interest are identified and managed appropriately. • Regular Audits: Conduct regular audits by an independent third party to review conflict of interest disclosures and the effectiveness of mitigation measures. • Omat's Code of conduct **Transparent Recruitment and Deployment:** • Transparent Hiring Processes: Ensure that the recruitment process for security personnel is transparent and based on merit. Avoid hiring individuals who have potential conflicts of interest. • Deployment Strategies: Develop deployment strategies that minimize the likelihood of conflicts of interest. For example, avoid assigning security personnel to areas where they have personal or business relationships. **Accountability and Enforcement:** • Enforcement Mechanisms: Establish clear consequences for failing to disclose conflicts of interest or for engaging in activities that constitute a conflict of interest. This should include disciplinary actions up to and including termination. • Accountability Structures: Create accountability structures within the organization to oversee the enforcement of conflict-of-interest policies and ensure consistent application across all levels of security personnel.	Human Resources Environment Health and Safety and Corporate Social Responsibility

7. PUBLIC CONSULTATION AND DISCLOSURE

7.1 CONSULTATION PROCESS AND PRINCIPLES

Effective participation requires sharing information related to projects with Affected Communities, facilitating a well-informed consultation process and the contribution of interested citizens to the design and planning of the Project. Therefore, the Project will carry out a process of public consultation and disclosure of information through the following activities:

- **Prior information exchange:** Communication of relevant and important information about the Project to the Affected Communities, before and during the public consultation or community meeting;
- **Stakeholder Consultation**: Consultation with informed stakeholders to discuss Project components and activities including potential challenges and opportunities associated with those affected, in a two-way process that allows for the incorporation of feedback from the parties interested in the design and planning of the Project; and
- **Disclosure**: Verification of the plans, activities and conclusions of the Project with the parties involved so that the feedback has been understood and is effectively incorporated, and to maintain transparency in the participation process.

Additionally, DGDC will include the following considerations and principles for each participation activity:

- **Scheduling:** All forms of participation will be carried out in a timely manner. The invitations to the meetings will be in advance of the participation activities (it will be ensured that the invitations are issued through letters or letters at least two weeks before the event), to ensure that those interested can participate without interruption in their personal schedules. The scheduling of participation meetings will be planned to consider the restrictions of interested parties and local holidays, among others. This programming will be carried out in consultation with the interested parties to ensure its adequacy;
- **Place**: When applicable, all participation activities will be carried out in easily accessible places (with considerations for people with disabilities or low mobility), and where attendees can arrive without major difficulty, cost or travel time. Such venues should also be free of political or other associations, so that stakeholders feel free to openly participate in discussions;
- **Transportation:** When necessary, and according to circumstances and conditions, the Project will provide transportation for participation activities;
- **Cultural Adequacy:** All forms of stakeholder participation and activities will be designed to meet the needs of the beneficiaries, to ensure that everyone has the opportunity to participate freely and in an informed manner;
- **Transparent:** The consultation process should be transparent and based on information, including about the scope of consultation and ability of stakeholders to influence Project decisions.

- **Inclusive:** The consultation will be equitable and non-discriminatory and will ensure that poorer or more vulnerable parts of the affected stakeholders are given a voice, as well as people with disabilities.
- **Gender-equitable**: The consultation process shall reflect women's and men's concerns equally, as women may have different perceptions than men when it comes to how benefits or risks should be assessed, or how different aspects are valued. If joint public consultation meetings are unlikely to capture men's and women's views equally, consideration should be given to holding separate focus group discussions or other methods to engage with women;
- **Free of coercion:** consultation events and other forums or means of engaging with stakeholders should be respectful and free of coercion. Stakeholders who express concerns or criticism against the Project or authorities should be protected from retaliation;
- **Language:** In all cases, activities will be conducted in English using simple terminology (non-technical and concise) and effective communication tools (including verbal, image-based or other alternatives, in written format). This ensures that all participants can understand Project information and actively participate in discussions; and
- **Recording and Feedback**: all group participation activities will be recorded on video, with the due consent of the participants. This will ensure the transparency of the consultation processes and allow verifying the strength of the process. Relevant aspects of the consultation process should be disclosed publicly.

The Project must establish a planning framework for the participation of the groups and interested persons, including their identification, the methods of participation, the information to be shared, responsibilities and the phase of the Project in which these activities should be carried out. This framework must be carried out at the beginning of the Project and must continue to be implemented throughout its life. For this purpose, the Project has a Stakeholder Engagement Plan.

7.2 PAST CONSULTATIONS AND OUTREACH ACTIVITIES

Table 7.1 lists all engagements conducted to date regarding the Project. All engagements have been led by the DGDC, with participation from Ormat since December 2023.

TABLE 7.1 COMMUNITY ENGAGEMENTS AND CONSULTATIONS FROM 2021 TO DATE

Date	Location	Target Audience	Purpose	Component
14-Jan-21	Laudat	Laudat Village Improvement Committee Members	Project update	PP
16-Mar-21	Virtual	Public	Presentations of findings of ESIA Addendum	PP
29-Apr-21	Laudat	Laudat Residents	Project update	PP
05-Jul-21	Copthall	Copthall Residents	Project update	PP

Date	Location	Target Audience	Purpose	Component
10-Jan-22	Laudat	Laudat Residents	Project update/plan for beginning of drilling civil works	PP
22-Feb-22	Trafalgar	Public	Scoping Mission for ESIA	TN
23-Feb-22	Mahaut	Public	Scoping Mission for ESIA	TN
24-Feb-22	Portsmouth	Public	Scoping Mission for ESIA	TN
08-Sep-22	Laudat	Laudat Residents	Ongoing civil works/preparation for drilling	PP
03-Apr-23	Laudat	Laudat Residents	Flow Test of production well	PP
26-Jul-23	Trafalgar	Public	Presentations of findings of ESIA	TN
27-Jul-23	Fond Colé	Public	Presentations of findings of ESIA	TN
11-Dec-23	Laudat	Laudat Residents	Project update/introduction to Ormat	PP / TN
27-Jun-24	Laudat	Laudat Residents	Project Update/Power plant update	PP / TN
25-July-24	Roseau	Public	2024 ESIA addendum	PP

Source: DGDC, 2024.

Note: PP= Power Plant, TN= Transmission Network.

All public documents issued so far can be accessed through the DGDC's website: https://www.geodominica.dm/publications222/

This addendum was also discussed with the community on July 25, 2024. The details of the 2024 public consultation are in Appendix A; the consultation plan can be found in Appendix B.

8. REFERENCES

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APPENDIX A 2024 PUBLIC CONSULTATION

APPENDIX CONTENTS LIST

- Public Consultation Report
- Consultation materials
  - Event invitations
  - MS Power Point Presentation
  - Attendance Register
  - Photos
- Summary of Q&A

INTRODUCTION

According to the IDB's Guidelines on Consultation and Stakeholder Engagement in IDB Projects, "people should be able to receive accurate, comprehensible information about the objectives, scope, timing and potential impacts and risks associated with a project. It means that they will be given the opportunity to express their concerns, fears, and doubts, will be allowed to share their knowledge, insights, an understanding, and will be able to recommend modifications or changes in the operation. It also means that their concerns, fears and recommendations will be seriously considered and, wherever possible, addressed" (IDB, July 2013[18]).

DGDC and Ormat conducted a public consultation on July 25, 2024, to present the contents of the 2024 ESIA addendum for Dominica's Geothermal Project. This report summarizes the results from the public consultation, includes an overview of participation in the consultation and provides evidence from the consultation process.

OBJECTIVES

The public consultation had the following objectives:

- Present and communicate the outcomes of the Project Update and Addendum (2024); and
- Share and hear the stakeholders' feedback, ideas, comments and opinions on the Project, risks, impacts, management plans and grievance mechanism.

SCOPE

The event was open to all stakeholders, including residents within the Project's area of influence (Laudat, Trafalgar, Wotten Waven) and the public, such as residents from Roseau Valley, where the consultation took place.

PUBLIC CONSULTATION LOGISTICS

The Consultation took place on July 25, 2024, at 10:00 hrs. The venue selected was the Good Will Parish Hall located at Winston Ln, Roseau valley, Dominica. The event was recorded and livestream through the Dominica Geothermal Development Company Ltd (DGDC) Facebook page[19], where people joined virtually.

A week before the event, the DGDC published the 2024 addendum on its website and broadcasted the event through the Facebook page and Dominica News Online[20]. The event was announced for

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[18] Inter-American Development Bank, Guidelines on Consultation and Stakeholder Engagement in IDB Projects, July 2013. Available at: https://publications.iadb.org/publications/english/document/Guidelines-on-Consultation-and-Stakeholder-Engagement-in-IDB-Projects.pdf

[19] https://www.facebook.com/Dominica.Geothermal.Development.Company/

[20] https://dominicanewsonline.com/news/announcements/announcement-public-consultation-event-dominica-geothermal-project-environmental-and-social-impact-assessment-addendum/

everyone in Dominica. People who attended in-person included government representatives and private citizens. The attendance register can be found at the end of this report.

On the day of the event, the DGDC provided hard copies of the executive summary of the 2024 ESIA addendum, for people to grab and read.

FIGURE 8.1 PUBLIC ANNOUNCEMENT ON DOMINICA NEWS ONLINE WEBSITE

There were 30 in-person attendees inclusive of the presenters (see the attendance register below). The DGDC opened the event by introducing the objectives of the meeting and gave the floor to ERM so that the latter explained the contents of the 2024 ESIA addendum. ERM presented for 45 minutes before opening for discussion with stakeholders. The total duration of the consultation was three hours.

The consultation materials are included below, and include:

- Event invitations
- MS Power Point Presentation
- Attendance Register
- Photos

The Summary of Q&A is found at the end of this report.

Event invitations

Public Consultation Event

Dominica Geothermal Project
Environmental and Social Impact Assessment Addendum

The DGDC and Ormat Technologies invite the public to attend a Consultation to present the 2024 ESIA addendum for Dominica's Geothermal Project, to be held as follows:

July 25th - 10:00 to 12:00 hrs

Venue: Good Will Parish Hall
Address: Winston Ln, Roseau valley, Dominica

All are welcome

For more information, please visit:

Facebook: Dominica Geothermal Development Company Ltd | Roseau | Facebook
Website: ESIA – DGDC (geodominica.dm)

Scan here to join the event virtually and access the 2024 ESIA addendum:

MS Power Point Presentation

UPDATES TO DOMINICA’S GEOTHERMAL PROJECT

Public Consultation

JULY 25, 2024

Sustainability is our business

Presenters

Ricardo Calvo

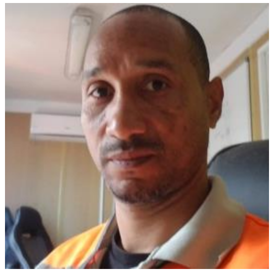
Partner in Charge

Gabriela Morales

Project Manager and Environmental Specialist

Katie Neddenriep

Social Specialist



Dalton Eloi

DGDC Safeguards Specialist

Raelene Bruney

Ormat HSE Coordinator

Dominica Geothermal ESIA Process

Addendums and Public Consultations

July 2006
Exploration program by the GoCD began

July 2018
ESIA for the power plant

November 2020
ESIA for the injection pipeline

February 2022
ESIA update to include World Bank requirements and changes in Project Design.

January 2024
The developer is Ormat

Minor changes in Project design and schedule.

ORMAT

2018-present

Ongoing engagement

2024 ESIA addendum discussion

Consultation agenda

- Project description updates
- Updated Impact Assessment
- Updates to Management Plans
- Roles and responsibilities of E&S aspects
- Grievance Mechanism
- Resettlement Action Plan Audit
- Next Steps
- CONCLUSIONS

How does geothermal energy work?

Link:

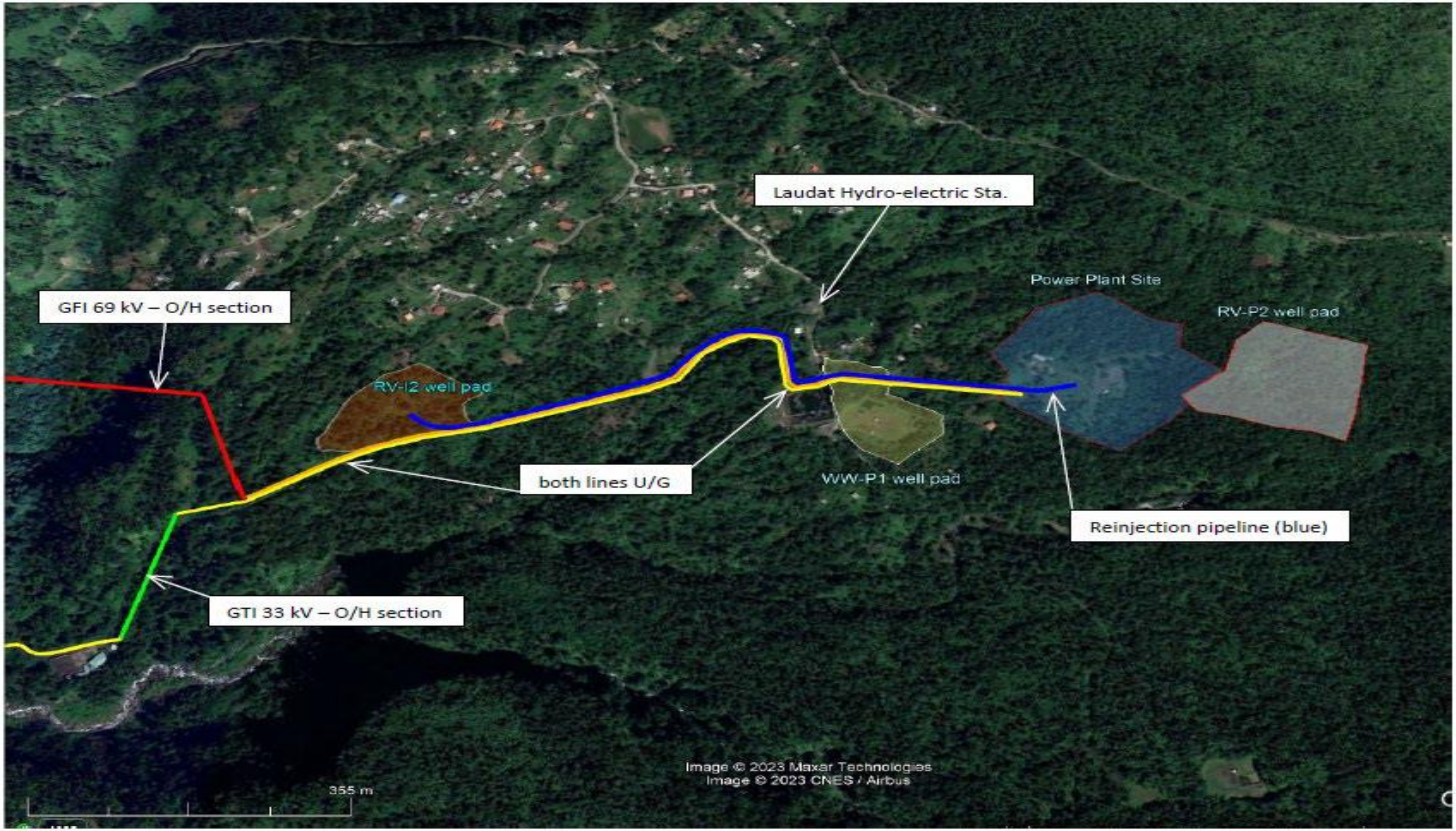
Ormat Geothermal Process.mp4

Project Overview

Summary

- 10 MW binary-cycle power plant (2 turbines of 5 MW each) – New!
- Wells and pads (already drilled)
  - Two production wells (already drilled and flow tested): WW-P1 and RV-P2.
  - One injection well (already drilled and injection tested): RV-I2.
  - Exploration well WW-03 will also be used for production.
- A 1.2 km reinjection pipeline - New!

Project Area



Project Changes from 2002 to 2024

Component	2022 ESIA	2024 update
Buildings	Only one building was planned at the Plant site.	Ormat plans to construct several buildings for operations – within the same site and general footprint.
Wells	Concrete slab around the well.	Concrete slabs were constructed for new wells drilled (2022 and 2023).
Power plant – Organic Rankine Cyle (ORC)	Use of two parallel recuperators.	Use of a single recuperator.
Power plant	Turbines from Atlas Copco.	Turbines will be from Ormat.
Power plant	Motive fluids mentioned are Iso-pentane or N-pentane.	Motive fluid is Cyclo-pentane.

Project Changes

Component	2022 ESIA	2024 update
Power plant	Design parameters based on European Norms (EN).	Design parameters based on the American Society for Testing and Materials (ASTM).
Power plant	There would have been a fiber optic cables path to injection lines.	Fiber cable will run along pipe path. Discreet cable above ground on the existing pipe path for quick installation, and repair/replacement in case of malfunction.
Power plant	Air Cool Condensers (ACC) fans at variable speeds.	ACC fans are single speed.
Power plant	ACC fans wide protection screen.	Additional spare fans.

Project Changes

Component	2022 ESIA	2024 update
Power plant	Steam trap collection system.	Independent gathering (on every steam trap).
Power Plant Facilities	The electrical building will include separate areas for offices, kitchen and meeting rooms, workshop and storage, a control room, and a machinery room.	The electrical building will not include additional areas.
Workforce	• Construction: maximum of 50 people • Operations: 4-6 people	• Construction: Total estimated is 90 (about 30 at a time) • Operations: 6 people (3 per shift) at the plant, plus clerical staff Most workers will be local.

Project Changes

Component	2022 ESIA	2024 update
Water usage	• Construction: 10,000 liters daily (200,000 liters monthly) • Operation: 8-10 m3/hr	• Construction: 1,500 liters/day, or 29,904.75 liters per month. • Operation: 0.3 m3/day.

Project design changes are mainly about technology choices and limited to the original footprint.

Project timeline

Early June 2024
Local Permits

July 2024
Early works.
Final Project design

Early September 2024
Civil foundations.

Mid September 2024
Electrical construction

Late September 2024
Mechanical construction

December 2024
Firefighting system

Mid-January 2025
Buildings

Early March 2025
Gathering system

November 2025
Start-up and testing

December 2025
Operations

Update to the Impact Assessment

2024 UPDATE

Changes 2022-2024

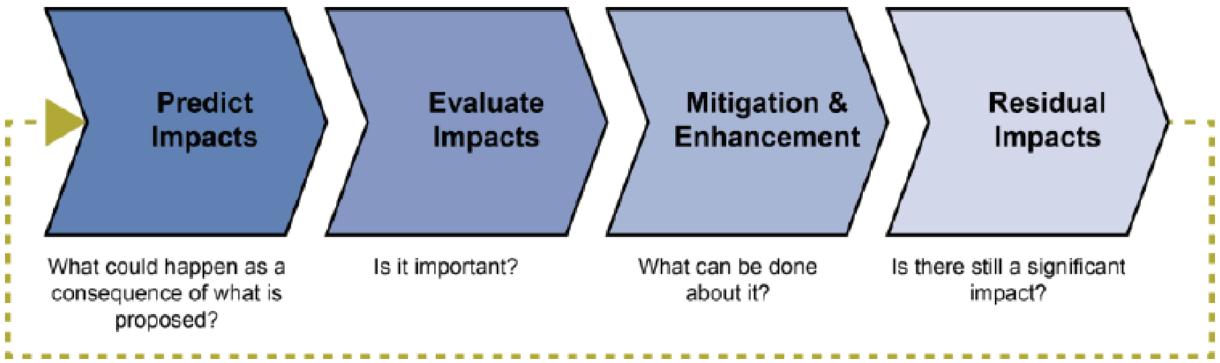
Impacts

- No new impacts identified
- Impacts remain with the same significance
- Most impacts are minor to negligible

Minimal project changes

No significant changes in impacts

Impact Assessment Methodology



Impact Significance Matrix		Sensitivity / Vulnerability / Importance of Resource/Receptor		
		Low	Medium	High
Negative Impacts				
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major
Positive Impacts				
Magnitude of Impact	N/A	Positive	Positive	Positive

E&S Impacts

Type	Receptor	Impact	S	R
Environmental	Soil	Increase runoff and sediment load due to deforestation and land clearing/levelling during construction		
Environmental	Water Quality	Decrease in Roseau River's water quality through increasing turbidity, reducing clarity and causing deposition of fine sediments		
Environmental	Pollution	Potential for hazardous substances or waste to be accidentally discharged to the environment if inappropriately collected and stored on site.		
Environmental	Noise	During construction and commissioning works there will be noise impacts at Laudat (south), Trafalgar (east), Trafalgar (south) and Wotten Waven. Impacts will be short-term.		
Environmental	Air Quality (Operations)	Increase release in H2S as a result of the Project's activities. However, it is considered that there would be a Negligible impact on receptors regarding odor due to the low concentrations predicted at the main residential areas and a likely desensitized local population.		
Environmental	Greenhouse Gas Emissions (GHG)	The total CO2-e per year is significantly less than that of a fossil fuel-derived energy source, and therefore, the Project is considered to have moderate beneficial impacts on air quality.		n/a

Note: S= Significance; R= Residual significance (after applying Management measures)

E&S Impacts

Type	Receptor	Impact	S	R
Environmental	Disaster Risk	The primary hydrological risk to the reinjection pipeline will be flooding. Any pipe crossings (pipe bridges) over waterways will be at risk from potential flood impacts, such as high-water levels and debris carried with these flows.		
Environmental	Disaster Risk	Potential impacts to the Project due to natural disasters (i.e., hurricanes, landslides, eruptions)		
Biodiversity	General	Fragmentation of habitat and reduction of ecological connectivity		
Biodiversity	Vegetation	Direct loss and disturbance of vegetation.		
Biodiversity	Fauna	Mortality and Injury to fauna due vegetation clearing and habitat loss		
Biodiversity	Fauna	Habitat loss for wildlife due to construction within the road improvement/ expansion locations, reinjection and production well pads, reinjection pipeline, power plant area and immediate surrounding areas.		

Note: S= Significance; R= Residual significance (after applying Management measures)

E&S Impacts

Type	Receptor	Impact	S	R
Biodiversity	Fauna	Mortality or injury to fauna due to open geothermal brine ponds.		
Socioeconomic	Community, workers	Gender		
Socioeconomic	Community	Worker Influx.		
Socioeconomic	Community/ Project Affected People	Land Acquisition, Resettlement and Livelihood Restoration.		
Cumulative impacts	Terrestrial and Aquatic Biota (flora and fauna)	Effects and disturbances caused by the plant construction activities will be short-term and reversible. Further Valued Environmental and Social Components (VEC) conversion and/or degradation is not likely to occur.		
Cumulative impacts	Land traffic	The Project and other projects could contribute to the potential negative impacts on this VEC by increasing land traffic. The external driver could exacerbate traffic due to potential damage to road infrastructure. Construction will be short-term. The impact is considered Minor for the short-term construction and then Negligible for operation.		

Note: S= Significance; R= Residual significance (after applying Management measures)

E&S Impacts

Type	Receptor	Impact	S	R
Cumulative impact	Community Health and Safety	The Project, other projects, and external drivers could contribute to the potential negative impacts on this VEC: decreased quality of the air shed. However, the other projects are already in operation and therefore their impacts are already considered in the Project baseline and residual impact assessment. The Project could potentially contribute incrementally to the adverse impact, but further VEC conversion and/or degradation is not likely to occur, or the Project's contribution will be expected to be negligible.		
Cumulative impact	Landscape Aesthetics	The Project and other projects will reduce flora, contributing to the potential negative impacts on this VEC. Additionally, stakeholders identified landscape aesthetics as a highly valued VEC. The Project will be painted in green and will be inconspicuous.		

Note: S= Significance; R= Residual significance (after applying Management measures)

Updates to the Management Plans

2024 UPDATE

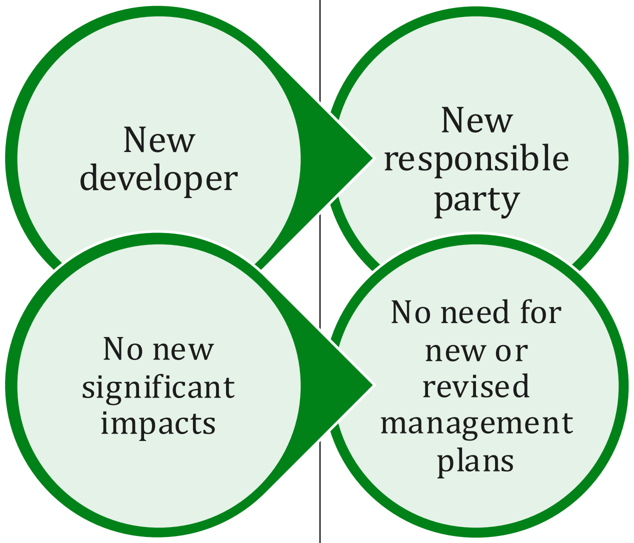
Changes 2022-2024

2022

- The developer was going to be the Government
- E&S plans were developed for the ESMP; the implementation company is the DGDC

2024

- Developer is Ormat, a publicly traded company
- The E&S plans will be implemented by Ormat
- Ormat will develop and implement additional measures and construction-specific plans.



Environmental and Social Management Plans

- Existing since the 2021 update
  - Biodiversity
  - Contractor Management Plan
  - Erosion and Sediment Control Plan
  - Water Management Plan
  - Air Emissions Management Plan
  - Noise Management Plan
  - Well blowout prevention plan
  - Security Management Plan
  - Operational H&S Plan
  - Labor Conditions and Workers Selection Plan
  - Grievance Redress Mechanism (external and internal)
  - Community H&S Management Plan
  - Stakeholder Engagement Plan

Environmental and Social Management Plans

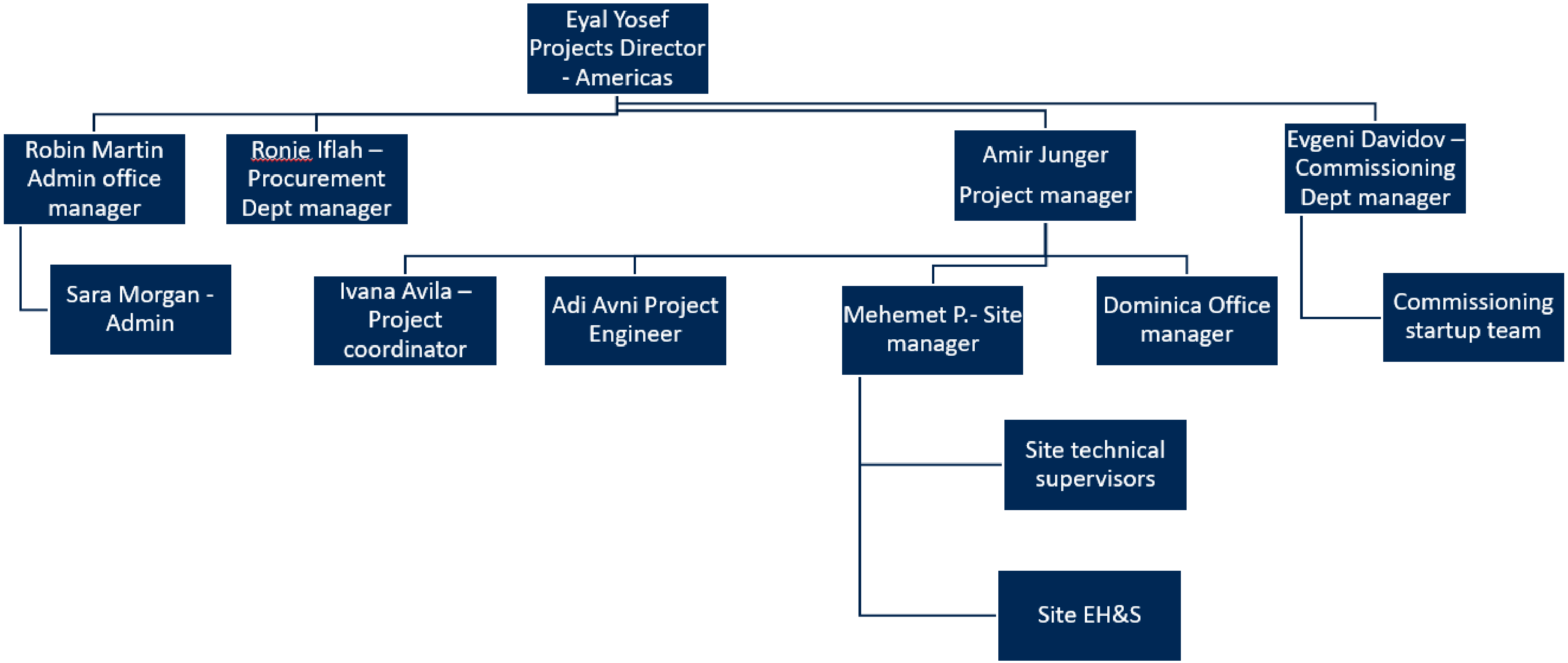
- Already in the current ESMP
  - COVID-19
  - Chance Find Procedure
  - Training Plan
- Plans for the 2024 ESIA addendum (New!)
  - Equal Opportunity, Non-Discrimination Measures
  - Disaster Risk Management Plans

EPC Contractor Site-specific Plans (Adjusted by Ormat Nevada)

- Traffic Management Plan
- Emergency Preparedness and Response Plan for Construction
- Waste Management Plan

Roles and Responsibilities

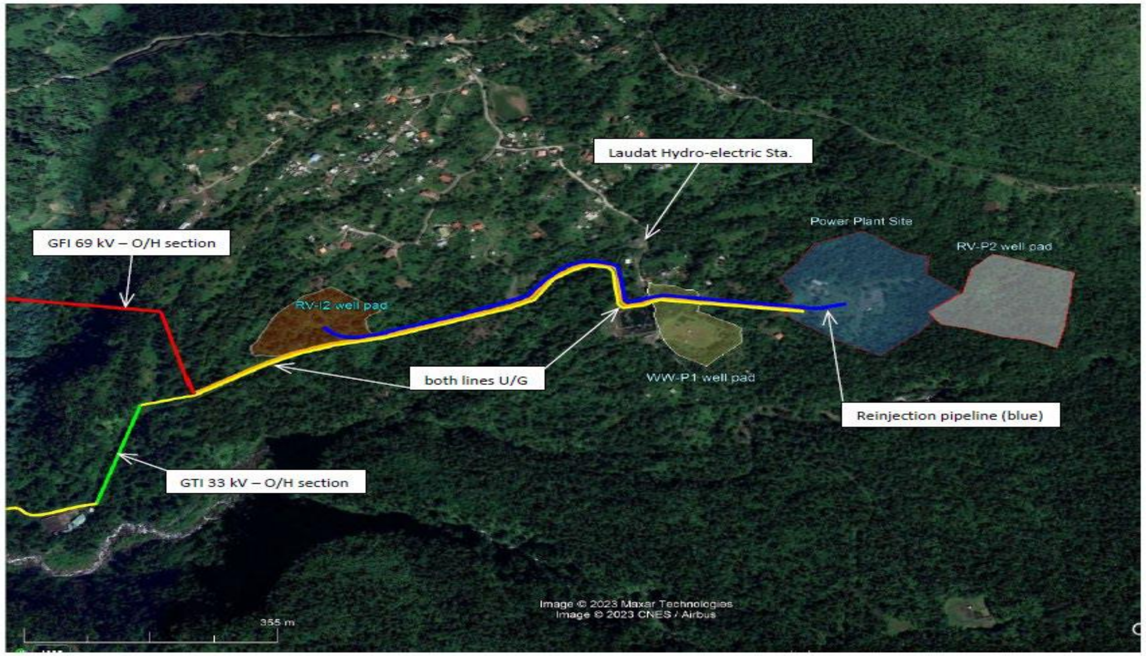
ORG CHART – DOMINICA EPC



Resettlement Action Plan Audit

Steps

- Review documentation on the implementation of the RAP
- Conduct interviews with agencies involved in the implementation
- Conduct interviewed with affected persons
- Prepare report:
  - Summarize of the resettlement and acquisition process
  - Assess compliance with the RAP
  - Include a corrective action plan, if needed



Next steps

Next steps

2024 Update

ESIA process

- Finalize ESIA addendum 2024

Construction

- Continue grading works and subsequent phases
- ESMP implementation

Grievance Process

Report → Investigate → Resolve

Contact: Raelene Bruney (Ormat)
Email: report@gpcod.com
Tel: 767 245 7290

Or contact DGDC's Community Liaison Officer:

Office: 448 6178/9
Allan Toussaint (DGDC): 275 7392
Website: https://www.geodominica.dm/

CONCLUSIONS

CONCLUSIONS

Project design changes are mainly about technology choices and limited to the original footprint…therefore:

Minimal project changes

No significant changes in impacts

New developer

New responsible party

No new significant impacts

No need for new or revised management plans

Additionally, ERM is preparing two new plans (equity and disaster risk assessment and management) and Ormat is preparing its construction protocols in line with the ESIA/ESMP requirements

Dialog

Thank you

For further information, visit:

https://www.geodominica.dm/esia/

ERM

Attendance Register

DOMINICA GEOTHERMAL PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) ADDENDUM
GOODWILL/ST ALPHANSUS PARISH HALL
GOODWILL, ROSEAU, DOMINICA
THURSDAY 25TH JULY 2024
10:00 A.M. to 12:00 NOON

NAME	GENDER M/F/O	AGE RANGE**	ORGANISATION	JOB TITLE	EMAIL ADDRESS	TELEPHONE NO.
Margaux Laroque	F		WAVE	Vice Chair	[redacted]	[redacted]
Athie Martin	M		WAVE	Honorary Member	[redacted]	[redacted]
Daryl James	M	30	GPCD	Inventory Control Specialist	[redacted]	[redacted]
Kia Williams	F	53	DHTA	Executive Vice President	[redacted]	[redacted]
Fred John	M		D[illegible]	—	f6 —	448 6179
Lyn Fontenelle	N/A	N/A	N/A	N/A	N/A	N/A
Grayson Stedman	M					
Dalton Eloi	M	40-49	DGDC	Safeguards Lead	[redacted]	[redacted]
Mehmetemin Pay	M	30-40	GPCD	Construction Man.	[redacted]	[redacted]
Rawlins BRUNEY	M	65-70	DGDC	Project Engr	[redacted]	[redacted]

**** AGE RANGE: 1(6 – 12), 2 (13-17), 3(18-29), 4(30-39), 5(40-49), 6(50-59), 7(60-69), 8(70-79), 9(80+) ****

DOMINICA GEOTHERMAL PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) ADDENDUM
GOODWILL/ST ALPHANSUS PARISH HALL
GOODWILL, ROSEAU, DOMINICA
THURSDAY 25TH JULY 2024
10:00 A.M. to 12:00 NOON

Dominica Geothermal Development Company Limited
Powering a New Generation...

ORMAT

NAME	GENDER M/F/O	AGE RANGE**	ORGANISATION	JOB TITLE	EMAIL ADDRESS	TELEPHONE NO.
Davidson Daily	M.	78.		Pipe Fitter.		[redacted]
Katie Neddenriep	F	5	ERM	Consultant		
Gabriela Morales	F	3	ERM	Consultant		
Ricardo Calvo	M	7	ERM	Partner		
Annie Edwards	F	4	WAVE	Consultant	[redacted]	[redacted]
Allan Toussaint	M	0-100	DGDC	CLO		[redacted]
Michael Savarin	M	~~40~~ 50 – 75	Ministry of ~~DGDC~~ Finance	CCF&ID	[redacted]	[redacted]
Clement Commodore	M	43	NONE	LECTURER	[redacted]	
ROGER BREWSTER	M	68	RADIO/TV	ELECTRICIAN TECHNICIAN		[redacted]

**** AGE RANGE: 1(6 – 12), 2 (13-17), 3(18-29), 4(30-39), 5(40-49), 6(50-59), 7(60-69), 8(70-79), 9(80+) ****

DOMINICA GEOTHERMAL PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) ADDENDUM
GOODWILL/ST ALPHANSUS PARISH HALL
GOODWILL, ROSEAU, DOMINICA
THURSDAY 25TH JULY 2024
10:00 A.M. to 12:00 NOON

Dominica Geothermal Development Company Limited
Powering a New Generation...

ORMAT

NAME	GENDER M/F/O	AGE RANGE**	ORGANISATION	JOB TITLE	EMAIL ADDRESS	TELEPHONE NO.
Vivian Eugene	M	50-60	Lands + Surveys	Surveyor	[redacted]	[redacted]
Stanley Louis	M	50-60	"	"	[redacted]	[redacted]
Jason Timothy	M	40-49	IRC			[redacted]
Michael Didier	M	80-90	Citizen affected	–	[redacted]	[redacted]
Donny Bruno	M	50-60	Lands & Surveys	Surveyor	[redacted]	
Shisha Birmingham			DGDC			
Timona George	F	40-50	Island Safety Supply	Engineer	[redacted]	[redacted]
Mario Torres	M	40-50	ORMAT	Engineer		[redacted]
[illegible]		40				

**** AGE RANGE: 1(6 – 12), 2 (13-17), 3(18-29), 4(30-39), 5(40-49), 6(50-59), 7(60-69), 8(70-79), 9(80+) ****

DOMINICA GEOTHERMAL PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) ADDENDUM
GOODWILL/ST ALPHANSUS PARISH HALL
GOODWILL, ROSEAU, DOMINICA
THURSDAY 25TH JULY 2024
10:00 A.M. to 12:00 NOON

NAME	GENDER M/F/O	AGE RANGE**	ORGANISATION	JOB TITLE	EMAIL ADDRESS	TELEPHONE NO.
Arthur Pemberton	M	30 - ~~40~~ 39	767.dev		[redacted]	[redacted]
Garen Thomas	M	30 - 35	—		[redacted]	

** AGE RANGE: 1(6 – 12), 2 (13-17), 3(18-29), 4(30-39), 5(40-49), 6(50-59), 7(60-69), 8(70-79), 9(80+) **

ERM

Consultation photolog

ERM


Resettlement Action
Plan Audit


ERM
Public Consultation


Project Changes from 2002 to 2024

Summary of Q&A

Question	Answer
You mentioned that if there's a smell coming from the steam there are going to be sensors that shut it down at a certain level, but if you shut down the plant and no electricity is going to be generated, what is the backup to provide electricity?	A Sulphur smell is not predicted to occur during operation and the probability that the plant will be shut down is low because there should be nothing coming out of the tubing and the production well. The sensor is in place in case of an emergency, and if the sensor trips for any reason, the production well has a device which will close the well. There are multiple wells, so if one well has an issue the other wells can continue to provide sufficient water to maintain productivity. There will also be a battery storage of electricity so if for any reason production slows down, the battery can store and maintain the flow of electricity [the 5 MW battery storage is outside the scope of the Project; it is an additional facility sponsored by the GoCD that will be developed by another company].
It seems that the permanent jobs post-construction will be about six technical employees plus clerical and security. What is the plan for locals to be trained in the technical operations of the plant rather than bringing people overseas to manage it?	The operation team intends to hire local.
One of the changes from the original developer to Ormat said the operations will go from eight to ten M^3 per hour to 0.3 M^3 per hour, what does that mean? How did they make this change?	That's the volume of water required in cubic meters, and water consumption will be reduced [current estimates are 0.3 m^3 or 300 litters a day]. Ormat is using an air-cooled condenser to cool down the motor fluid in the cycle, which doesn't use water. There won't be any steam produced during operations either.
What's the projected lifespan of the water reservoir that is being tapped into?	The portion of the reservoir that the project will use is insignificant. Also, the water reservoir used by the community and the reservoir by the project do not interact (one is much deeper than the other); therefore, the Project operations will not affect or use in any way surface water reservoirs.
Did Ormat acquire DGDC? Is it a subsidiary of Ormat?	The Government of Dominica awarded a concession to Ormat to develop the geothermal resource in the Roseau Valley. One of the elements in the concession agreement is that the government appointed DGDC to be its representative in the agreement (the DGDC is "the grantor"). Ormat is a private company who is the

Question	Answer
	concessionaire, who is receiving the financing for the project, and who will construct and operate it for a period of 25 years.
How many times has this project been handed over to a new developer and why is Ormat better suited for the project?	This is the first time that we have signed a concession agreement for this project. Ormat is a world leader in geothermal powerplants especially with their binary technology. There was also a competitive process conducted over several years with other partners and Ormat was the leading vendor.
I don't get the impression that Ormat or the previous company that is working within our regulatory system. A major project like this can never be as perfect as it is explained. There can be long term impacts, and the projects are being done in a pristine area in the source of the Roseau River which can impact the flow of the river.	We have done an assessment in 2018 and 2022 and again in 2024. There is a conception that the water that is going to be pumped for the project is connected to the surface water. The aquifers that feed rivers and wells are located 200 to 300 feet below the surface and are not connected to the much deeper water that is 2,000 to 3,000 feet below the surface. Pumping water from the geothermal reservoir has nothing to do with the water that feeds the river and irrigation, or potable water. In addition, Ormat has obtained the necessary permits by the Physical Planning Department, including the grading permit and the generation license.
You are moving from one building to three buildings. Are there any intentions to submit these plans to the planning department? You also need to work with the environmental health department and the forestry department because of their knowledge of the environment and plants. The entire document and management plan only consists of standards are taken from American standards and brought to Dominica.	The DGDC is working within the system. In 2018 and then in 2022 the Environmental and Social Impact information was submitted to the Planning Department. In 2022 the necessary approvals were issued. Since Ormat has joined the project, Ormat is processing all the permits with all the agencies that are required including the planning department who is issuing every single permit that is required after doing all the required reviews.
You are going to disturb the environment. The plant will be at the foot of the mountain and will impact the flow of water. Digging in the soil will disturb the Roseau River eventually. A previous hydroelectric project promised no impacts, but the freshwater lake was never the same. There was no testing on how the construction of the buildings will affect the flow of water. In the management plan, there should be a reforestation management plan made in consultation with the Forestry	We spoke with the Forestry Department who have given input on how to manage the biodiversity and vegetation topics of the project and gave the suggestion of allowing time for the natural vegetation to take over the site before replanting to create a better structure. The engineers calculated and accounted for the water that will fall on the buildings rather than the vegetation that was previously there by designing a system that will capture, treat, and deliver water back

Question	Answer
Department that starts as soon as the construction does. You cannot depend on the forest growing back. You should also let the people know what the impact of the water used will be. If there are contaminants found in the water and they cannot be disposed of the river it will be taken to the landfill, which may not be suitable for this.	into the system at a volume that is appropriate, as well as at a quality that is required not only by Dominican regulations, but also international regulations imposed by the IDB. To understand the environmental assessment in its entirety please refer to the study in 2018, the update in 2022, and the update in 2024, as the three documents paint the full picture together. Nothing that comes out of the site should be contaminant or detrimental to the environment. There will be impacts, but measures have been applied to ensure that the impacts are mitigated and compensated for so that the result is acceptable within both Dominican regulations and international standards.
The public needs to have access to the management plan and information on how the project will impact our lives. There should be a revision on the website which gives more detailed information so the ordinary layman can read the management plan and compare the proposed project against what takes place.	The document sent out last Friday [08/19/2024] refers only to what was presented today [the ESIA addendum of 2024]. The project has not changed expect on technology choices. The addendum refers to the 2022 document which has the Environmental and Social Management Plan (ESMP). We will discuss with DGDC and Ormat so that as Ormat produces the detailed designs and documents, they will continue to be made public so that you can refer to them to understand how Ormat will carry out the plan laid out in the 2022 document.
Is this the only consultation that will take place? There should be three consultations according to the planning act.	For this update, this is the only consultation.
The exercise you refer to in 2022 was one of several others EIAs and ESIAs done before. One of the issues we raised was a subsurface hydrology assessment. The subsurface hydrology is critical since you are drilling to depths of over a kilometer. When you pump to bring hot water into the plant, you are pumping from deep surface and bringing up materials like boron, molybdenum, cadmium, and other very potentially toxic elements that are available on the surface only in minute amounts. What will you do with these waste materials?	The project is designed as a closed circuit, so the water from the geothermal reservoir will never be exposed to the surface, air, or soil. That, by design, eliminates the potential for any of those contaminants being released. There is always the potential for a blow up or another incident, but Ormat is developing their site-specific plans to manage blow ups or other things.
Dominica's soils are the result of volcanic activity which goes down thousands of meters. When you begin to engage a drill hole that	For the destabilization of the deep geology, our team has not done the geological studies, but DGDC and other consultants have done

Question	Answer
penetrates the subsurface of our volcanic architecture, it changes the architecture. Once you drill into that subsurface geology, water at that level begins to move, and because architecture is slabs of rock and soil, it begins to move as well. There are six volcanoes in the valley, all of which are active.	the geological studies necessary to estimate the geological conditions of the subsurface area, and given that this is a closed circuit, the overall pressure of the reservoir should not be shifting because of the operations of the plant. This is a very small plant in the context of the size of the reservoir so the conclusion of the geological studies, so this project does not represent an undue risk of destabilization of the geological layers.
There is a handbook of best practices for geothermal exploration and development prepared under the chairmanship of the World Bank which states that when you get to the stage where you think you have a viable resource, you must put in place a pilot plant for three to five years to ensure the validity and resilience of the reservoir before commercial power is discussed. You should therefore run a pilot plant to ensure that the source of geothermal power is sustainable.	We are aware of best practices, and we are each operating from Dominican regulatory requirement, the international requirements, our expertise from doing projects like this around the world and taking into consideration the reality of Dominica as it is different from other locations. We look at many guidance documents with best practices and we apply what works best in our experience.
The handbook also says that the consumer will only see the benefit of significant price reduction when you get close to producing 50 megawatts of power. I have seen a government report that says close to 400 million dollars, half grants, and half loans has been spent on the project. If the plant produces 10 megawatts, it will cost 40 million dollars per megawatt. The current government policy on renewable energy in Dominica is a 2012 document that took a team of Dominican scientists 3 years to put together for the government that recommends working simultaneously on solar, wind, hydro, and geothermal power so that you do not end up becoming dependent on any one source of renewable energy. I am an advocate for geothermal, but it must be done right.	The geothermal and business questions are for different forums, but the commercial agreement the DGDC has with Ormat is one where the financial model is already built, which is a private document between the government of Dominica and the developer. Dominica is the one who will distribute the power, and the agreement has already been made on the price it will be brought at. One of the reasons that the government is doing this project, other than that it is renewable and green, is to reduce the price of power to Dominica and that is factored into every decision that is made. This project is also a phased project. The 10 megawatts are the beginning of this project. The Independent Regulatory Commission (IRC) will discuss what the end consumer sees in terms of pricing.
Where are the sensors being placed to detect where the levels of emissions are safe?	The nature of the project is such that it doesn't use processes or chemicals that result in emissions and is a closed circuit by design and nothing is coming out. There is no smoke, particulates, nitrogen oxide, or greenhouse gas. The design will not incorporate sensors for those types of emissions. During the project there will be dust and emissions from tailpipes and machinery, but the project is relatively contained in one site with few machines. We are looking at

Question	Answer
	recommending that the contractors work with handheld detectors that they can use to do spot checks on particulates and other things that could affect the works.
If the system gets shut down, how long will the backup batteries last?	The battery system in the project is only to cover our internal consumption to keep the plant going in case a unit goes down, so that the Human Machine Interface (HMI) and the auxiliary system will keep going. There is a 5-megawatt battery storage that will be developed separately as an ancillary project with a different developer.
How much noise will the air-cooling fans make?	We are aware that we are very close to our neighbors and chose all the blades and motors to be as quiet as possible and as far from receptors as possible. Ormat's HSE coordinator is overseeing the noise monitor continually to ensure that the noise stays in check and within limits. The project operates under both Dominican and International Standards and will follow whichever standard is stricter.
Will you consider a future tourism product in the form of tours of the plant?	Ormat is likely not thinking about that yet, but we have seen projects that have incorporated an educational and tourism element. This can be considered in the final layout of the project and how it works.
If the plant must stop suddenly, how is the fluid in the system handled and what are the risks around it?	There is a system of automated valves that will close to stop the flow. A spill will only occur if there is a well blowout, and there are measures to stop a well blowout as quickly as possible and minimize that.

APPENDIX B CONSULTATION PLAN

Consultation Plan

Dominica Geothermal Project

CONTENTS

1. INTRODUCTION

This Plan defines the mechanisms, channels, and requirements to execute the public consultation of Dominica's Geothermal Project. Public consultation is required by financial institutions who are considering supporting the Project: The Caribbean Development Bank (CDB) and the Inter-American Development Bank (IDB), through the CDB. IDB's OP-102 Access to Information Policy and Environment Safeguard Policy (OP-703) establish the public's right to having access to transparent information about the bank's activities and projects.

Dominica Geothermal Project has had continual public consultation and stakeholder engagement activities; however, due to the change in developer (from the Dominica Geothermal Development Company (DGDC) to the private developer Ormat Technologies, Inc) and minor changes in Project design, Environmental Resources Management (ERM) has prepared an ESIA addendum with updates to the Project. The new public consultation will present the contents of the addendum and discuss the Project's E&S impacts and management measures and grievance mechanism.

1.1 OBJECTIVES

- Present and Communicate the outcomes of the Project Update and Addendum (2024); and
- Share and hear the stakeholders' feedback, ideas, comments and opinions on the Project, risks, impacts, management plans and grievance mechanism .

2. SCOPE

This event will be open to all stakeholders; including residents within the Project's area of influence (Laudat, Trafalgar, Wotten Waven) and the general public, including residents from Roseau Valley.

The consultation will be focused on the updates done to the 2022 ESIA & ESMP and to present risks and impacts and management measures that will be implemented during the construction and operation phases of the project. The grievance mechanism will be presented as well.

3. PRESENTERS AND ORGANIZERS

Although the event will be led by Ormat and the DGDC, the following will present the materials and answer questions from the audience:

- ERM
  - Ricardo Calvo, Partner
  - Gabriela Morales, Project Manager
  - Katie Neddenriep, Social specialist
- Ormat
  - Mhmetemin Pay, Site Manager
  - Raelene Bruney, HSE Specialist
- DGDC
  - Alain Toussant, Community Liaison Manager (CLO)
  - Dalton Eloi-Safeguard Lead
  - Fred John, Managing Director

4. STAKEHOLDERS

The list of stakeholders identified who could potentially participate in the event is on Table 4.1.

TABLE 4.1 LIST OF STAKEHOLDERS CONSIDERED FOR THE PUBLIC CONSULTATION

Group	Interests or concerns	Participation in past engagements (Y/N)	Notes
Laudat Residents	• Noise impacts • Air quality impacts • Electricity costs • Construction debris and potential damage to property • Traffic Management and access to businesses	Y	Potential concerns applicable to the general public: • The Project has been around for almost 10 years, but it has not come into fruition yet. • How much will the electricity tariffs actually decrease. • Jobs • Capacity building for local workers during O&M
Trafalgar Residents		Y	
Wotten Waven Residents		Y	
Copthall Residents	• Not yet identified	N	This community closer to Roseau Valley than to the Project area; however, the DGDC has opened a communication line with residents from this community.
Roseau Residents	• Not yet identified	N	Not available
Landowners (PAPs)	• Dissatisfaction with their compensation package	Y	There is evidence of one PAP present at the December 2023 meeting; concerns have been captured in the Project's Grievance Mechanism
Government agencies	• Government agencies are in favor of the Project	N	• DGDC
Business owners and the tourism sector	Certain businesses have expressed concerns over past engagement events. Potential concerns from business owners • Disruptions to their business due to traffic and noise during construction and O&M • Safety hazards • Water consumption	N	Business owners may attend the meeting. Based on previous experience, stakeholder mapping or distance to the Project.
Vulnerable groups	• Not yet identified	Y	The Project's SEP defines identified vulnerable groups to those belonging to any of the following categories: • Women, children, and elderly

Group	Interests or concerns	Participation in past engagements (Y/N)	Notes
			• Families and individuals in extreme poverty • People with physical and psychological disabilities • Individuals that depend on natural resources
The Media	The media are neutral and have reported about the Project	N	• Dominica Broadcasting Corp • Wice FM • Kairi Radio • Dominica News Online

5. ROLES AND RESPONSIBILITIES

The roles and responsibilities of the public consultation event are in Table 5.1. Each company will appoint a responsible person for the tasks described herein.

TABLE 5.1 ROLES AND RESPONSIBILITIES OF THE PUBLIC CONSULTATION

Company/Role	Responsibility
ERM	Prepare consultation materials, draft invitation language, presenting E&S impacts and measures during the event, answering E&S-related questions and supporting Ormat and the DGDC in transcribing stakeholders' Q&A
DGDC	Review and approve the consultation materials, coordinate the logistics of the event, including distributing invitations and disclosing consultation materials through printed and digital channels (newspaper, social media, local news websites, radio), facilitate venues if needed and support the consultation coordination, leading the public consultation and introducing other participants such as Ormat and ERM
Ormat	Review and approve the consultation materials, attend the site visit, and respond to project design and technical questions from the audience
CDB/IDB	Review and approve the consultation materials, attend the public consultation event (virtually if in person is not possible)

6. LOGISTICS

The Consultation will take place from 17:00 to 18:00 hrs. ERM, Ormat and the DGDC will arrive one hour before to finalize preparations and conduct sound tests. The selected venue is the following:

Good Will Parish Hall

Address: Winston Ln, Roseau valley, Dominica

Stakeholders will have the option to join virtually through MS Teams or Zoom. The DGDC will create the virtual invitation, which will be included in their website and their Facebook page. The event posters will include information on how to access virtually (see Section 7), as well as the link to where to access the 2024 ESIA & ESMP addendum.

The DGDC will coordinate the following:

- Reserve the venue
- Prepare the room set-up: placing chairs, have microphones and multimedia equipment ready to project the consultation slides, add a small table with snacks, coffee / tea and water
- Publicize the event
- Provide transportation to the event venue for Laudat and Trafalgar residents, if requested (See section 6.2)
- Document the event through videorecording: The DGDC retained the Company "Quicklink Pro" who will record the session, as they have done in previous engagements

The DGDC team will support ERM in taking pictures and briefing notes about the questions asked and comments provided by the assistants. ERM will use that input to prepare the Q&A summary of the consultation report.

6.1 LANGUAGE

The event will be conducted in English. The DGDC will encourage people to ask questions in Creole if they feel more comfortable asking in that language. The DGDC team members that will lead the event speak Creole and will provide translation where necessary.

6.2 TRANSPORTATION

The DGDC will provide transportation for community members from Laudat and Trafalgar if needed. Such communities are part of the Project's area of influence and although have been consulted several times, they may be interested in participating in this wider-audience public consultation, which takes place in Roseau Valley (an area that is further away from where Laudat and Trafalgar residents work and live).

Advertisement posters posted in Laudat and Trafalgar will specify that transportation will be available for those who request it.

Residents can get in touch with the DGDC through the Community Liaison Officer Alain Toussant, through their grievance mechanism or by phone (+1-767-448-6178/9).

7. PUBLICITY CHANNELS

Throughout the week before the event, the DGDC will create public announcements on their social media channels (Facebook page), through radio announcements, and print and online media, specifically:

- Dominica Geothermal Development Company Ltd | Roseau | Facebook

- Dominica News Online - The most popular news site in the Commonwealth of Dominica
- Radio Stations: DBS Radio, Kairi FM, Q95 Radio
- Printouts displayed in telephone posts, public spaces such as supermarkets, churches and schools in Roseau Valley, Trafalgar and Laudat
- Public announcements at churches after a service

A copy of the invitation and consultation materials is described below.

8. CONSULTATION MATERIALS

Consultation materials include:

1. Public consultation invitation
2. Attendance Register template
3. MS Power Point Presentation

Dominica Geothermal Development Company Limited
Powering a New Generation...

Public Consultation Event Registration Register

ORMAT

No.	First Name	Last Name	Email	Organization	Date

ERM

APPENDIX C SITE VISIT PHOTOLOG

Photo No. 1. Project site where backfilling is occurring; area naturally devoid of vegetation

Photo No. 2 – Right of Way of the injection pipeline

ERM

Photo No. 3. Grading works at the Project site

Photo No. 4. Existing brine pond and well pad during flow test of WW-P1 and WW-03

ERM

APPENDIX D PAST CONSULTATIONS

Dominica Geothermal Development Company Limited
Powering a New Generation...

Roseau Valley Geothermal Development

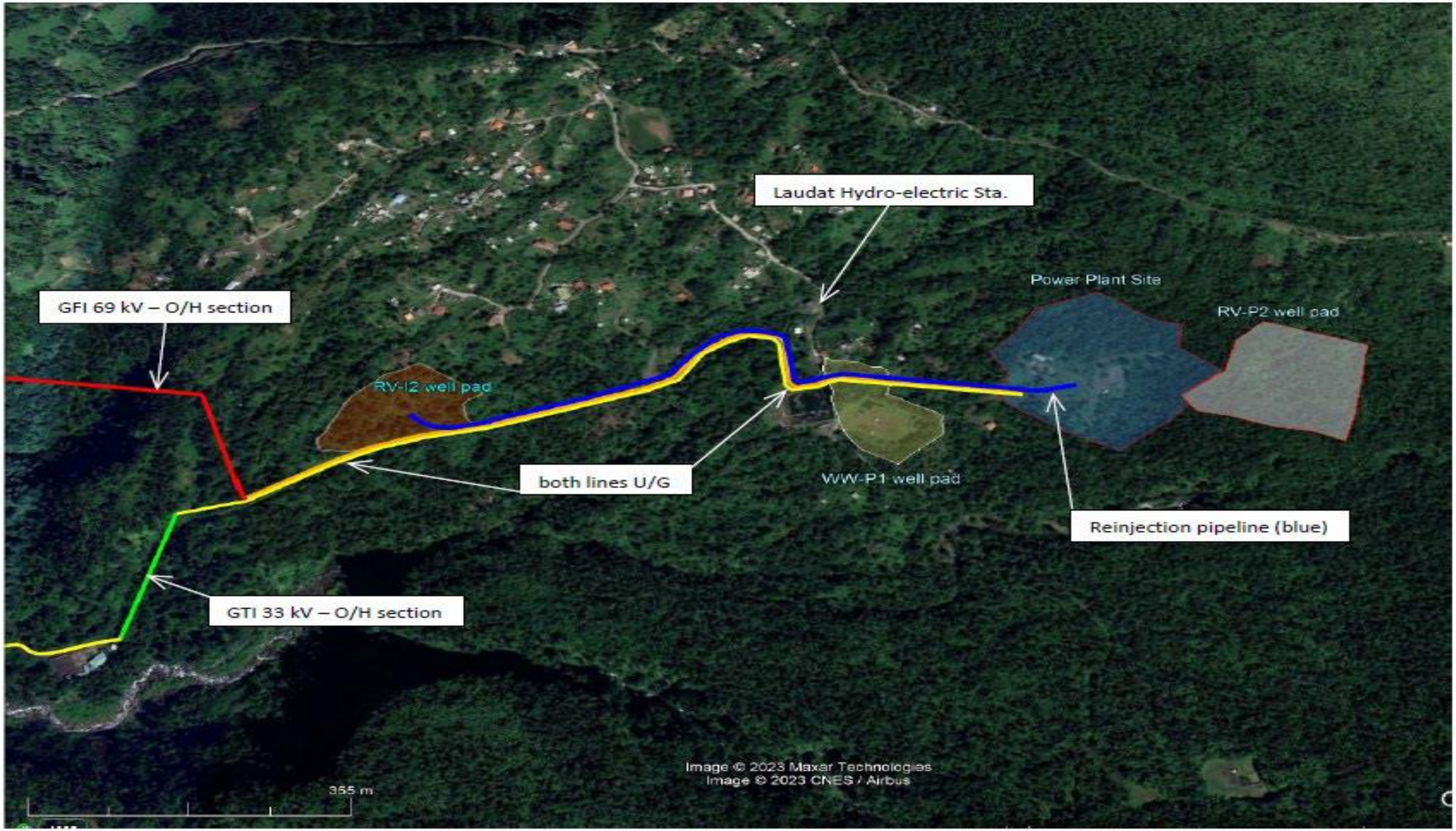
Community Update

27 June 2024

Agenda

- Project Status Updates
  - New Transmission Network (11 kV, 33kV, 69 kV)
  - Geothermal Power Plant (10 MW)
- Next Steps

Project Area

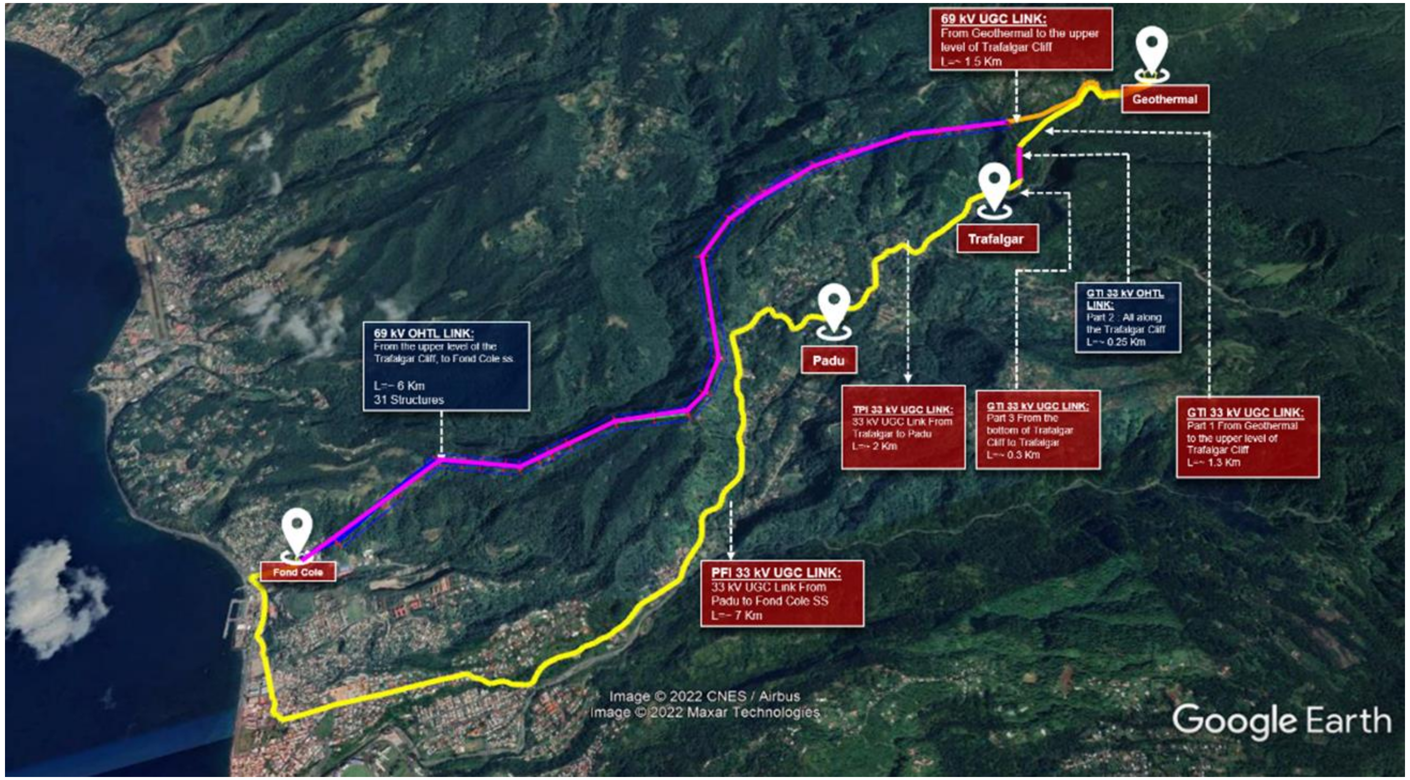


Transmission Network

- Tender (EPC Contractor):
  - Bid-Evaluation in progress
  - Expected award of Contract July 2024

- Land Acquisition:
  - Cabinet approved acquisition of 4 parcels of land in Laudat for 33 kV route

- DOMLEC has commenced preparation work for 3 new substations



Power Plant

- Contracts between the Government of Dominica, DOMLEC and Ormat Technologies (and its subsidiaries) became effective on 4th January 2024

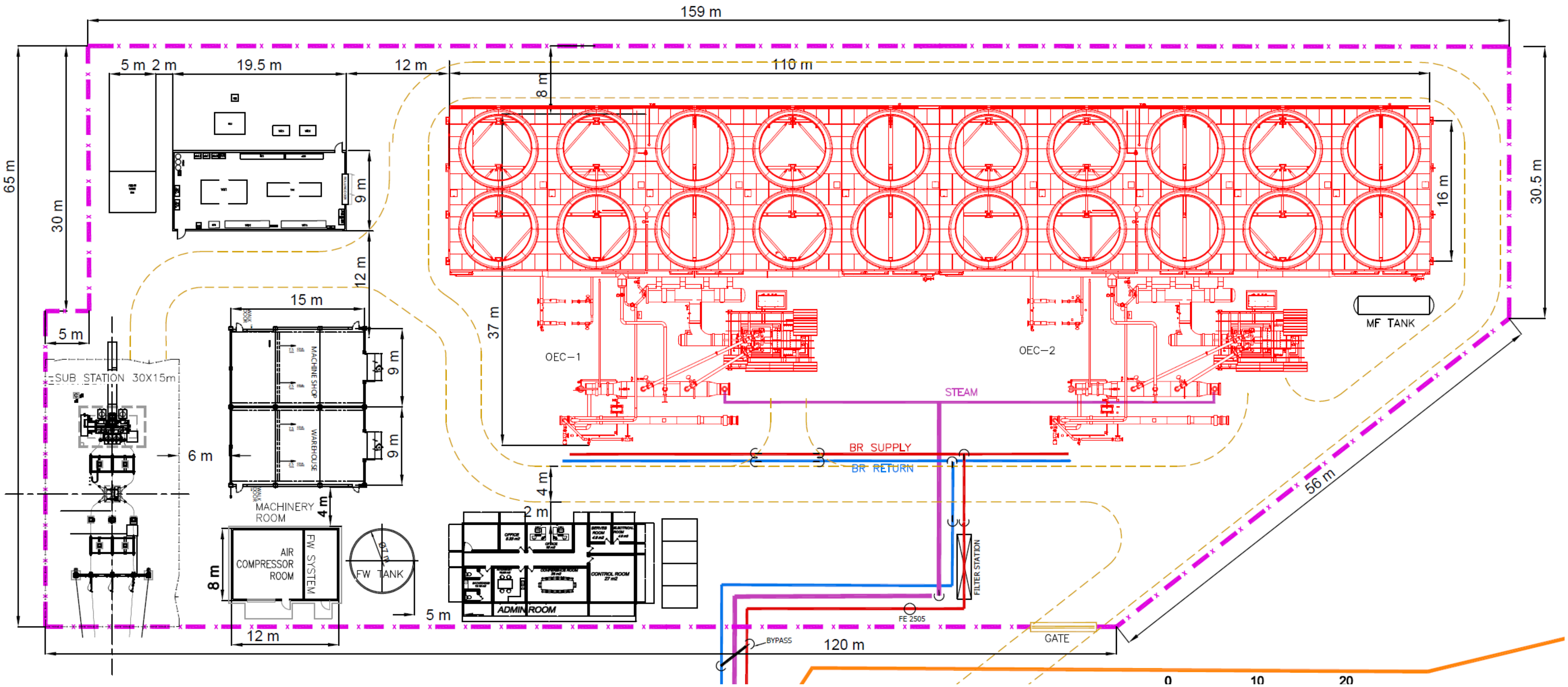
- Ormat Technologies established a local company to construct and operate the Geothermal Power Plant:

  Geothermal Power Company of Dominica (2023) Ltd (GPCD)

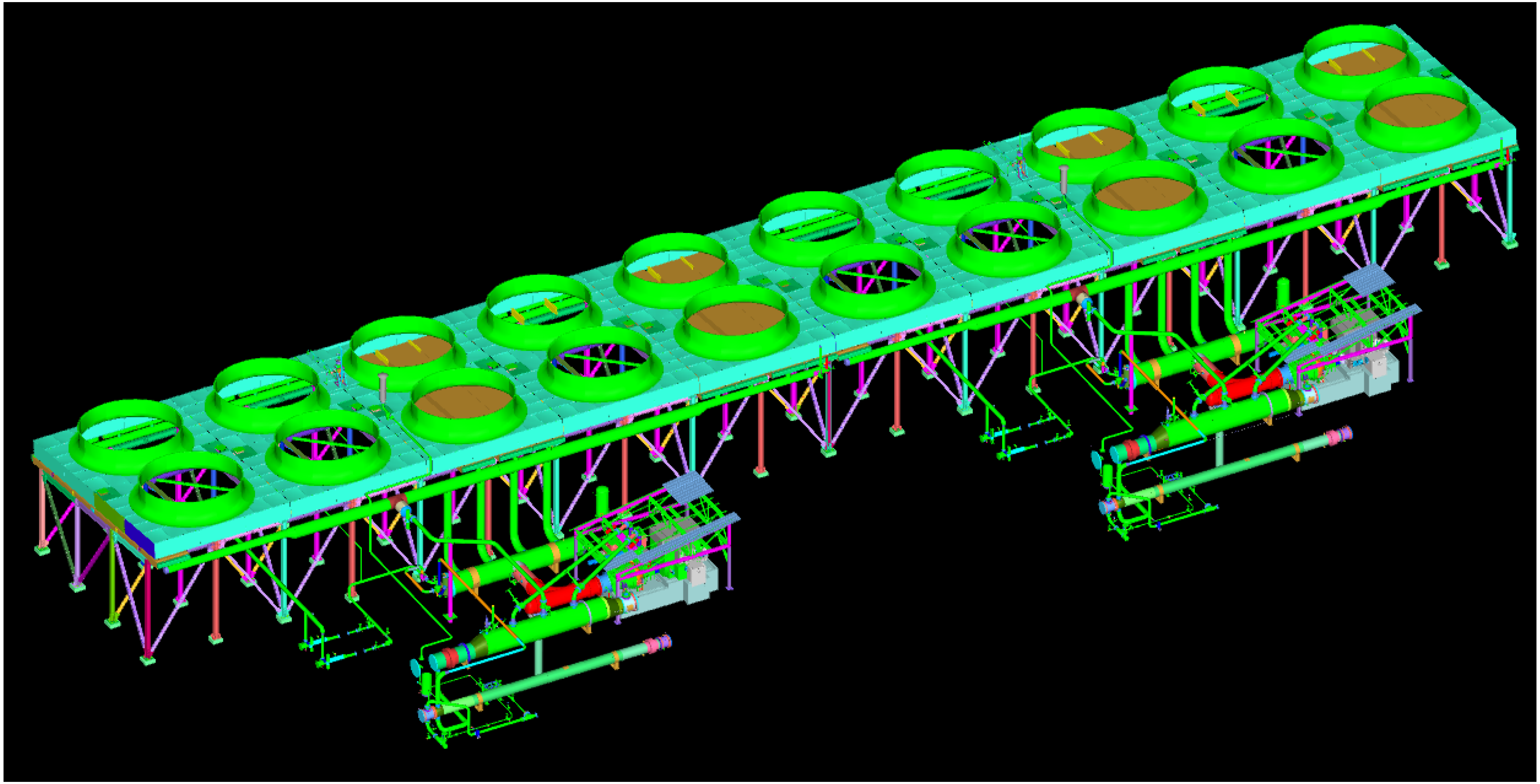
- Introduction: Mehmetemin Pay – GPCD site manager

Power Plant Development Details

Power Plant Development Details



Power Plant Development Details



Power Plant Development Details

Project Schedule

Task	Start	Finish
Earthworks	Early July 2024	Early September 2024
Civil Foundations	Early September 2024	Mid March 2025
Mechanical Construction	Late September 2024	Early May 2025
Gathering System	Early March 2025	Late July 2025
Buildings	Mid January 2025	Mid March 2025
Firefighting System	Late December 2024	Early March 2025
Electrical Construction	Mid September 2024	Mid September 2025
Start up & testing	Early September 2025	Late December 2025

Power Plant Development Details

- **Arrival of Major Equipment**
  - 1st Vessel arriving on July 7th 2024. – ACC Bundles
  - 2nd Vessel arriving on Jan 2025. – Turbine, Heat Exchangers

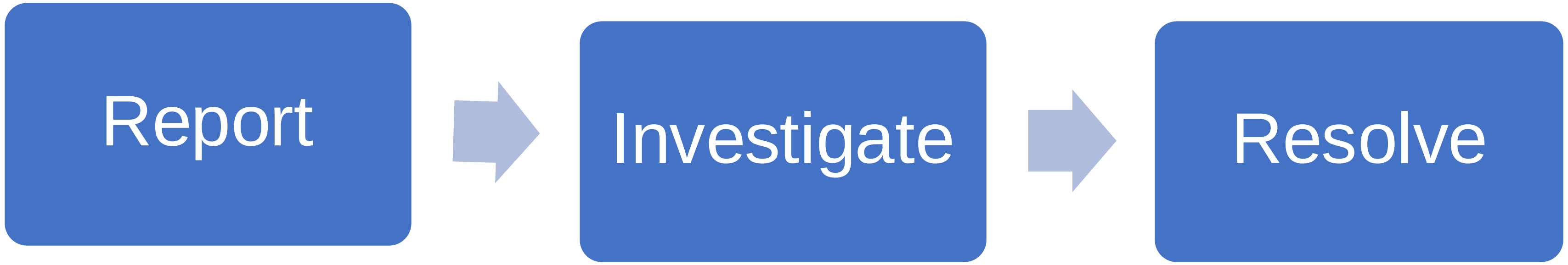
Power Plant Development Details

- **Pre-Construction Activities**
  - Baseline noise measurement taken
  - Baseline water and air quality measurements to be taken
  - Forestry, Wildlife and Park Division approval granted
  - Biodiversity study on vegetation clearance area – July 2nd

- **Construction Phase**
  - Daily, weekly and monthly monitoring
  - Strict enforcement of erosion control
  - Traffic management plan

Power Plant Development Details

Grievance Process



Contact: Raelene Bruney
Email: report@gpcod.com
Tel: to be provided

Or contact DGDC's Community Liaison Officer

Power Plant Development Details (cont'd) – Grading Works

- **Sequence of work**
  - Heavy equipment movement – week of July 8
  - Earth works for power plant pad
  - Earth works for Reinjection pipeline route

- **Working days, hours**
  - Work is expected to be Mon – Fri 7:30 am to 4:30 pm
  - Weekends and additional hours based on project needs. Community will be consulted before any such changes are made.

Power Plant Development Details (cont’d) – Grading Works

- **Noise, dust and mud management**
  - Noise, dust and mud associated with this project will be limited to the immediate site

- **Employment opportunities**
  - Wide range of personnel needed (Skilled, semi-skilled and Labourers)
  - Community-based workers are priority
  - Mechanism to ensure the community is fully engaged.

Next Steps

- Power Plant
  - Mobilization and commencement of construction
- Transmission
  - Payment/Acquisition/Lease of lands *(Laudat to Fond Cole)*
  - Award of engineering, procurement and construction contract
  - Additional ESIA consultation

Next Steps cont'd

- Continued community engagement
  - Next meeting: before Transmission Network Construction (may be in Trafalgar)
  - One-on-one interactions as needed
  - Continue coordination with the VIC/Village Councils

Prepare to provide services to contractors over a two-year period

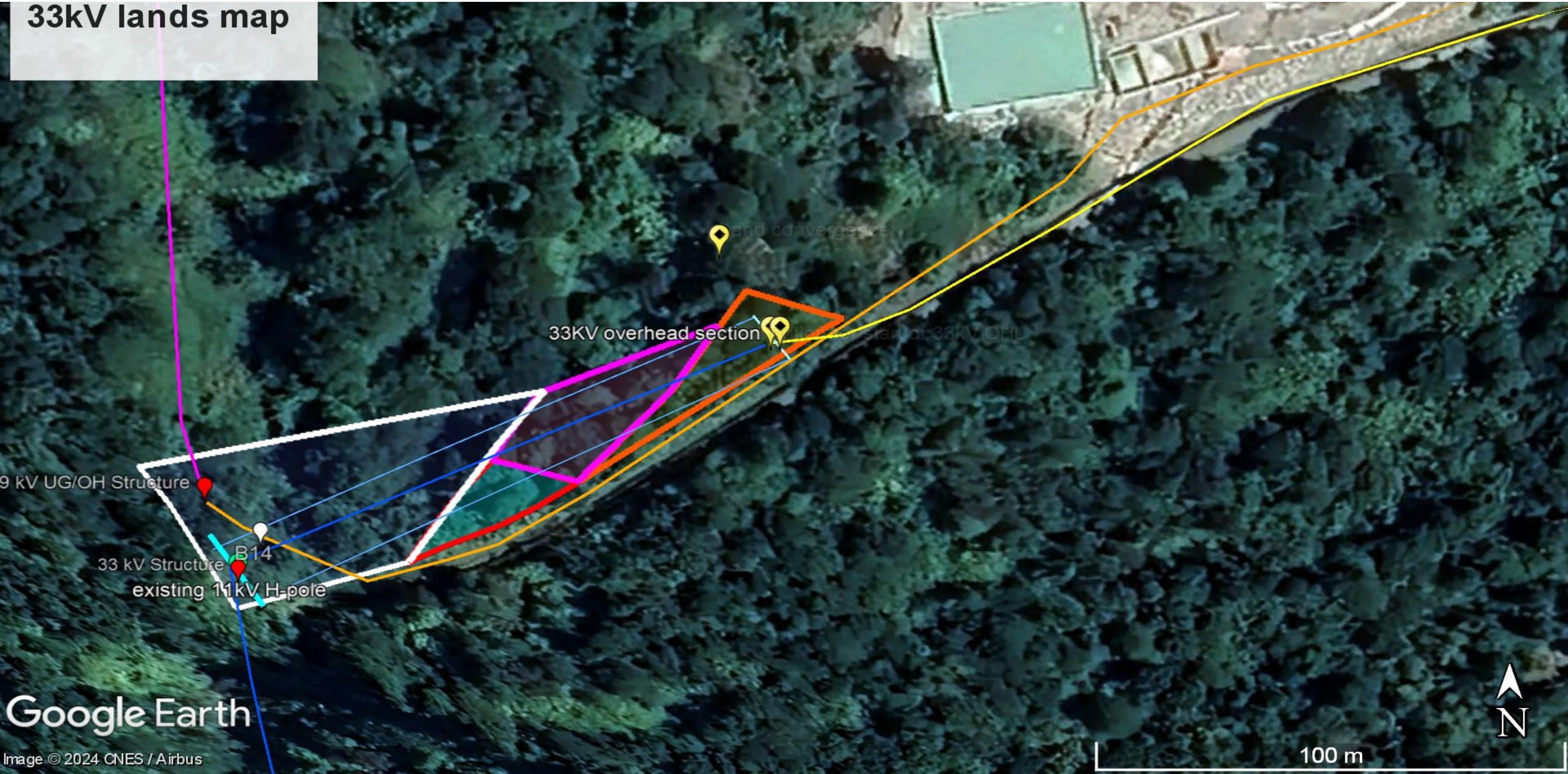
Thank You
If you have any questions …

Office: 448 6178/9
Allan Toussaint: 275 7392
Website: https://www.geodominica.dm/

Appendix

Laudat Power Plant
Geothermal Power Plant Site
Reinjection Well Pad (RV-I2)
Production Well Pad (RV-P2)
WW-03
WW-P1
existing 11kV H-pole
Google Earth
Image © 2023 Maxar Technologies
Image © 2023 CNES / Airbus
400 m
N

Appendix


33kV lands map
33KV overhead section
9 kV UG/OH Structure
B14
33 kV Structure
existing 11kV H-pole
Google Earth
Image © 2024 CNES / Airbus
N
100 m

DOMINICA GEOTHERMAL DEVELOPMENT COMPANY LIMITED
PROJECT UPDATE
LAUDAT COMMUNITY CENTRE
27 JUNE 2024
6:00 PM

NAME	ORGANISATION	OCCUPATION	EMAIL ADDRESS	TELEPHONE NO.
Mehmetemin Pay	GPCD	Site Manager	–	[redacted]
Dalton Eloi	DGDC	Safeguards Lead		[redacted]
Esther David Cerat	Freelancer	Translator Haitian English	[redacted]	[redacted]
Rawlins Bruney	DGDC	Project Support Engineer		[redacted]
Daryl Huntault	D-TREADS	Safety officer	[redacted]	
James Gregor	D-Treads	Surveyor/Land	[redacted]	
Clayton Joseph	D-TREADS	Quantity Surveyor		
Vincent Rolle	NA	Retired	[redacted]	[redacted]
Simon LeBlanc	S.L			
Philip Eusbache				

DOMINICA GEOTHERMAL DEVELOPMENT COMPANY LIMITED
PROJECT UPDATE
LAUDAT COMMUNITY CENTRE
27 JUNE 2024
6:00 PM

NAME	ORGANISATION	OCCUPATION	EMAIL ADDRESS	TELEPHONE NO.
Patricia Rolle		Bartender		[redacted]
RITA EDMUND	DGDC	FHRM		[redacted]
Shisha Birmingham	DGDC			
KATRIN FRIEDRICH	/	/		[redacted]
Lyn Fontenelle	—	—	—	—
Alfred Rolle				[redacted]
Donnie Robinson	D-Treads			[redacted]
Gabrielle Robinson	D-Treeds			[redacted]
Brija Robinson	D-Treeds			[redacted]
Raelene Bruney	DGDC	HSE Officer	[redacted]	[redacted]

DOMINICA GEOTHERMAL DEVELOPMENT COMPANY LIMITED
PROJECT UPDATE
LAUDAT COMMUNITY CENTRE
27 JUNE 2024
6:00 PM

NAME	ORGANISATION	OCCUPATION	EMAIL ADDRESS	TELEPHONE NO.
AKASH BHAKRI	ABL HOLDINGS CABLE CAR DOMINICA	REPRESENTATIVE	[redacted]	[redacted]
Shane Reid	cable car Dominic ~~Operator~~	Operator	[redacted]	[redacted]
Aaron Rolle		Farmer		[redacted]

Dominica Geothermal Development Company Limited
Powering a New Generation...

Roseau Valley Geothermal Development

Community Update

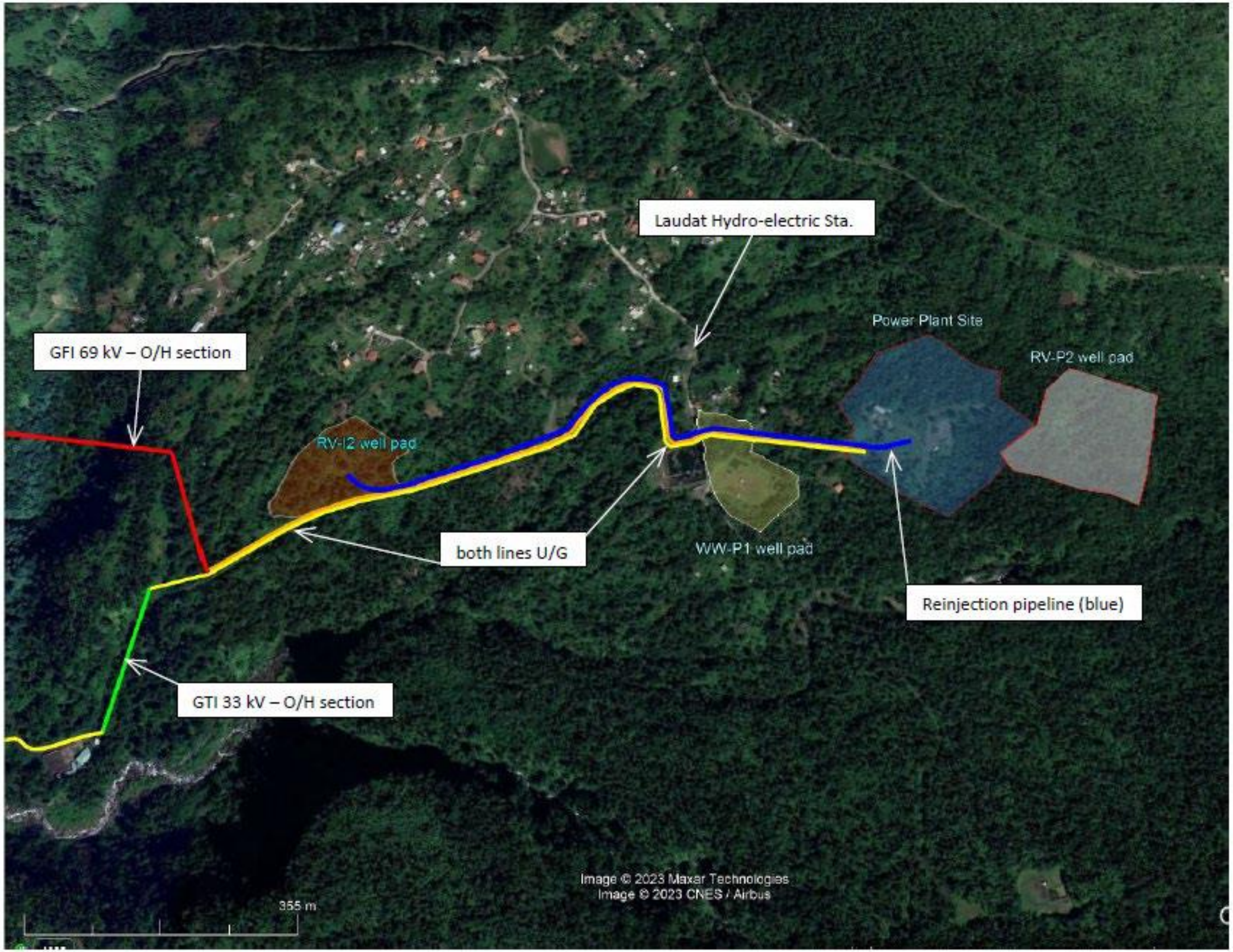
11 December 2023

Season Greetings from the DGDC team

Agenda

- Project Status Updates
  - Drilling
  - Transmission Network
  - Power Plant
- Next Steps

Project Area



Drilling

- ✓ Drilling civil works complete
- ✓ Road works related to drilling complete
- ✓ Production well complete and successful
- ✓ Reinjection well complete and successful
- ✓ Rig demobilization complete

Thank you for the support and patience during this phase of intense work

We will apply learnings to upcoming works

Drilling (cont'd)

Production Well (RV-P2) Test 2023

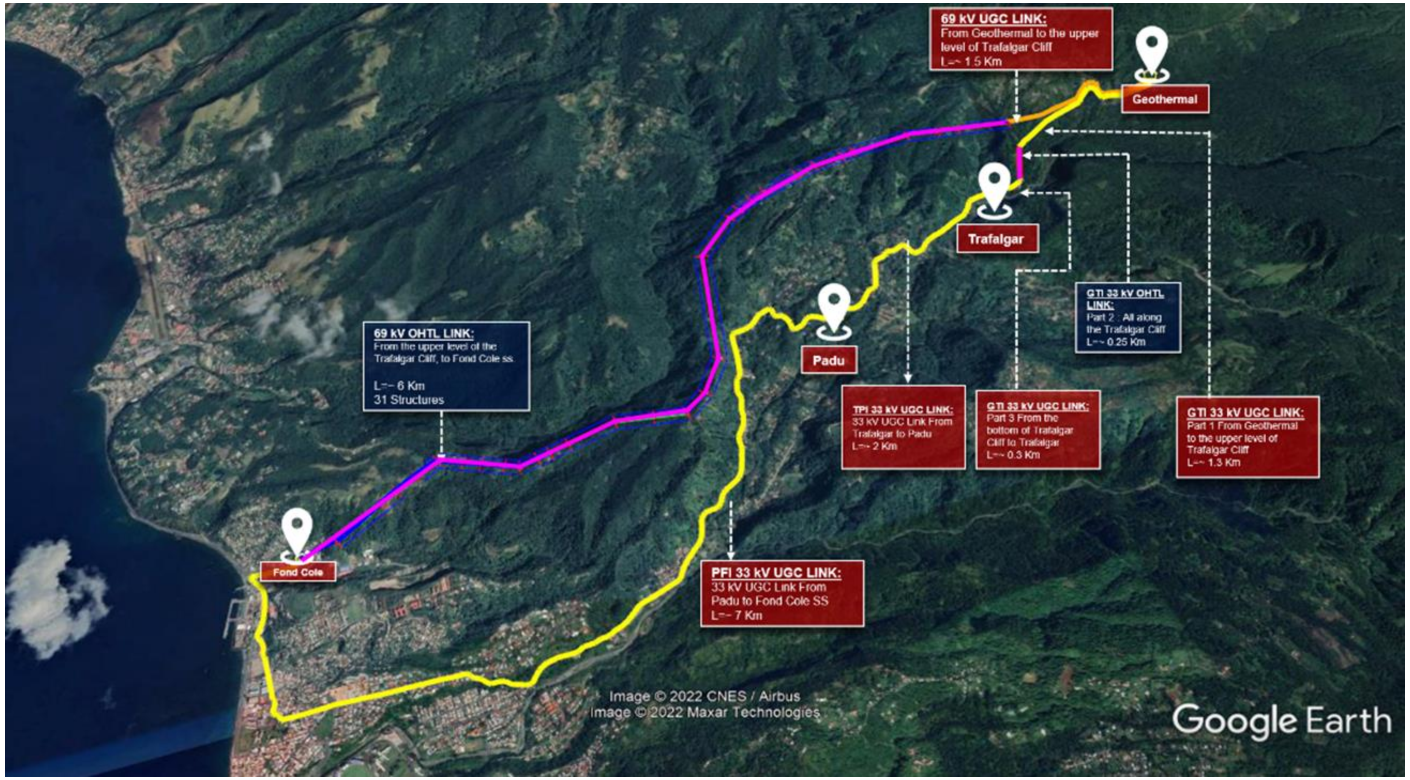
> 10 MW

Reinjection Well (RV-I2) 2023

Good Injectivity

Transmission Network

- Financed by World Bank loan
- Environmental and Social assessments published
- Tender issued for construction
- Site visit with bidders conducted Dec 5th 2023
- Expect mobilization of contractor in ~ 4 months



Power Plant

- Contracts signed December 5, 2023
  - Finance and Construct
  - Sell power to DOMLEC
- Power plant commissioning 24 months after the agreements become effective

Power Plant (cont'd)

Introduction to Ormat Technologies Inc.

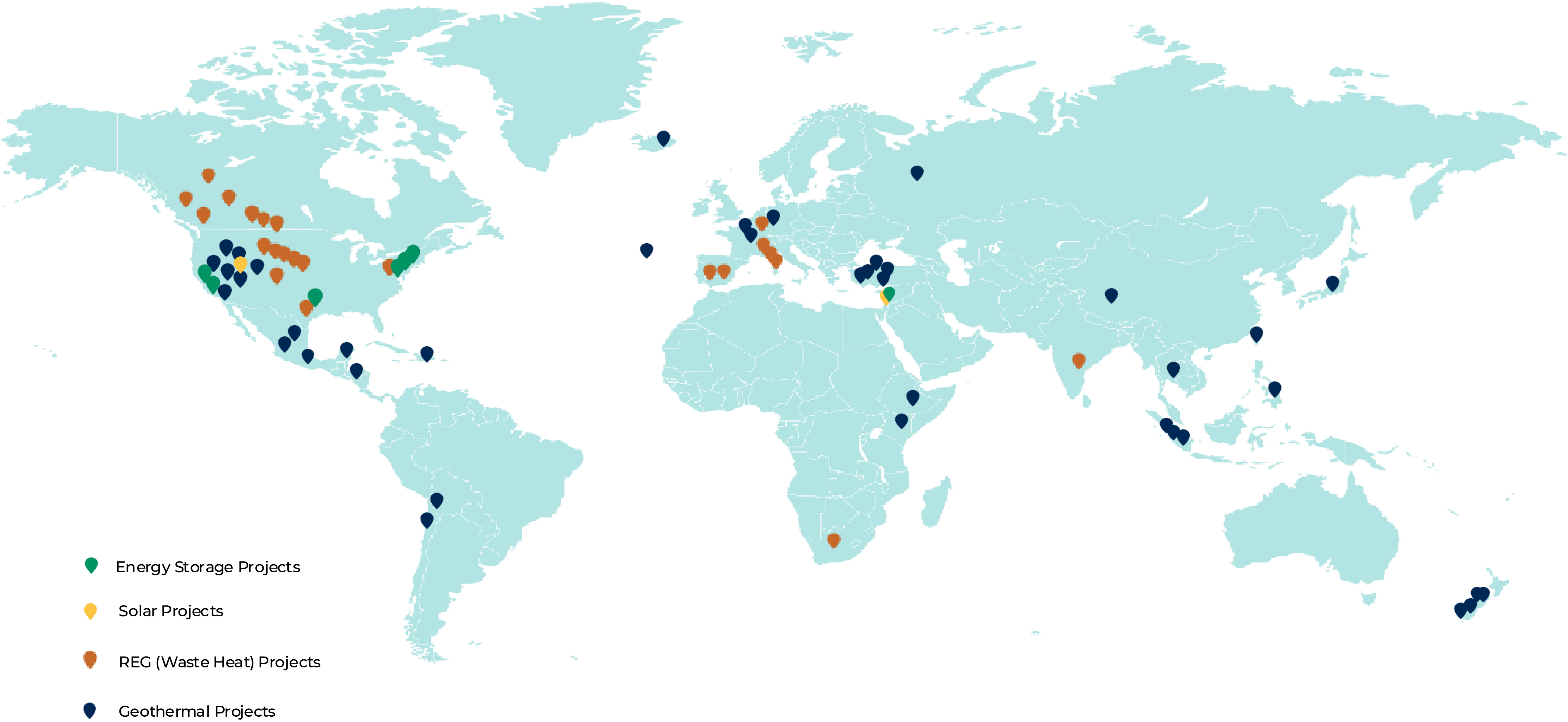
ORMAT TECHNOLOGIES

ORMAT

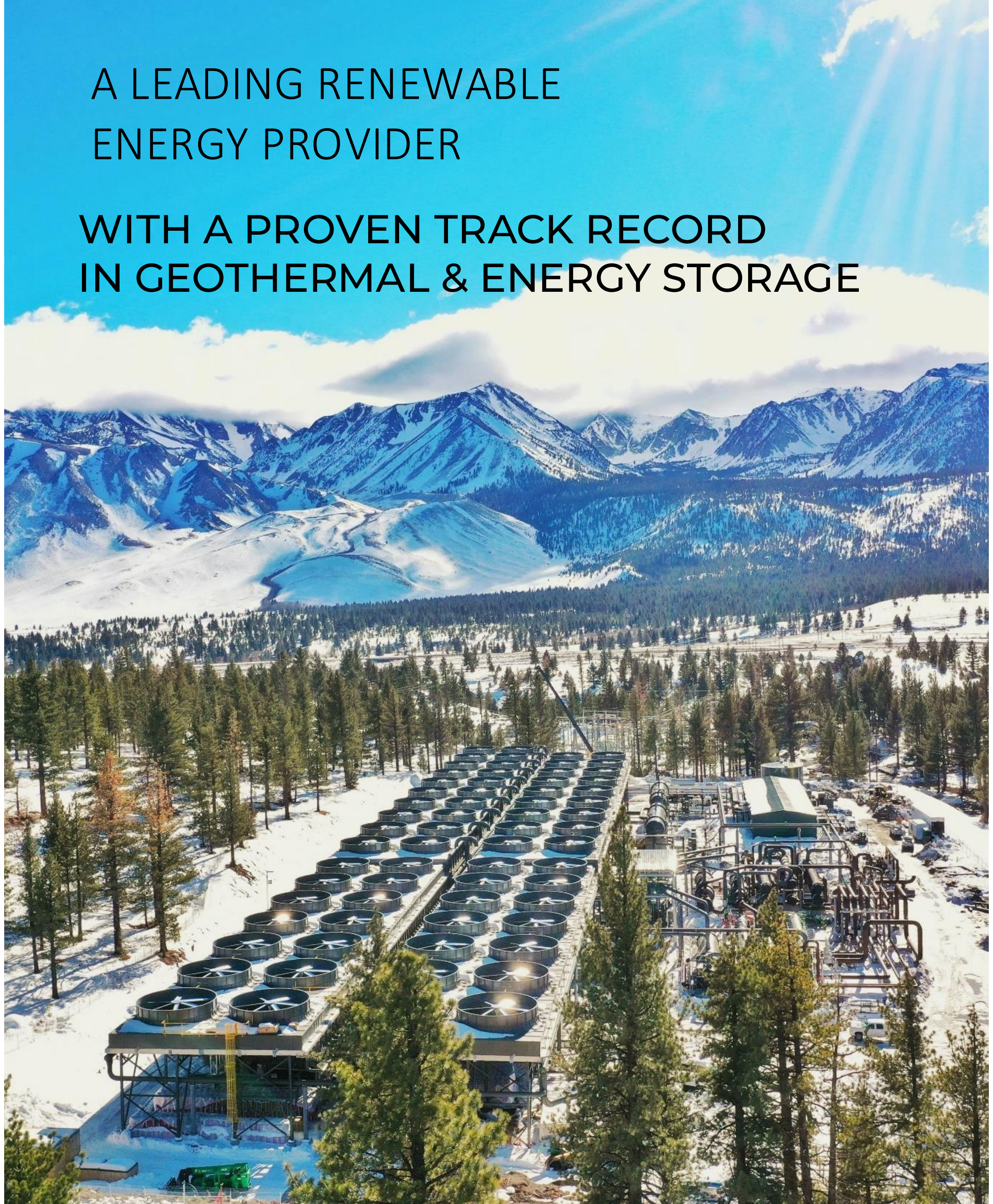
ROSEAU – DECEMBER 11TH, 2023

OPERATIONAL GROWTH

Meeting the Needs of Customers worldwide



COMPANY OVERVIEW



Over
58
Years of experience

Own & operate
~1.28GW
Geothermal, Storage, Solar PV & REG[1]

1,480
Employees

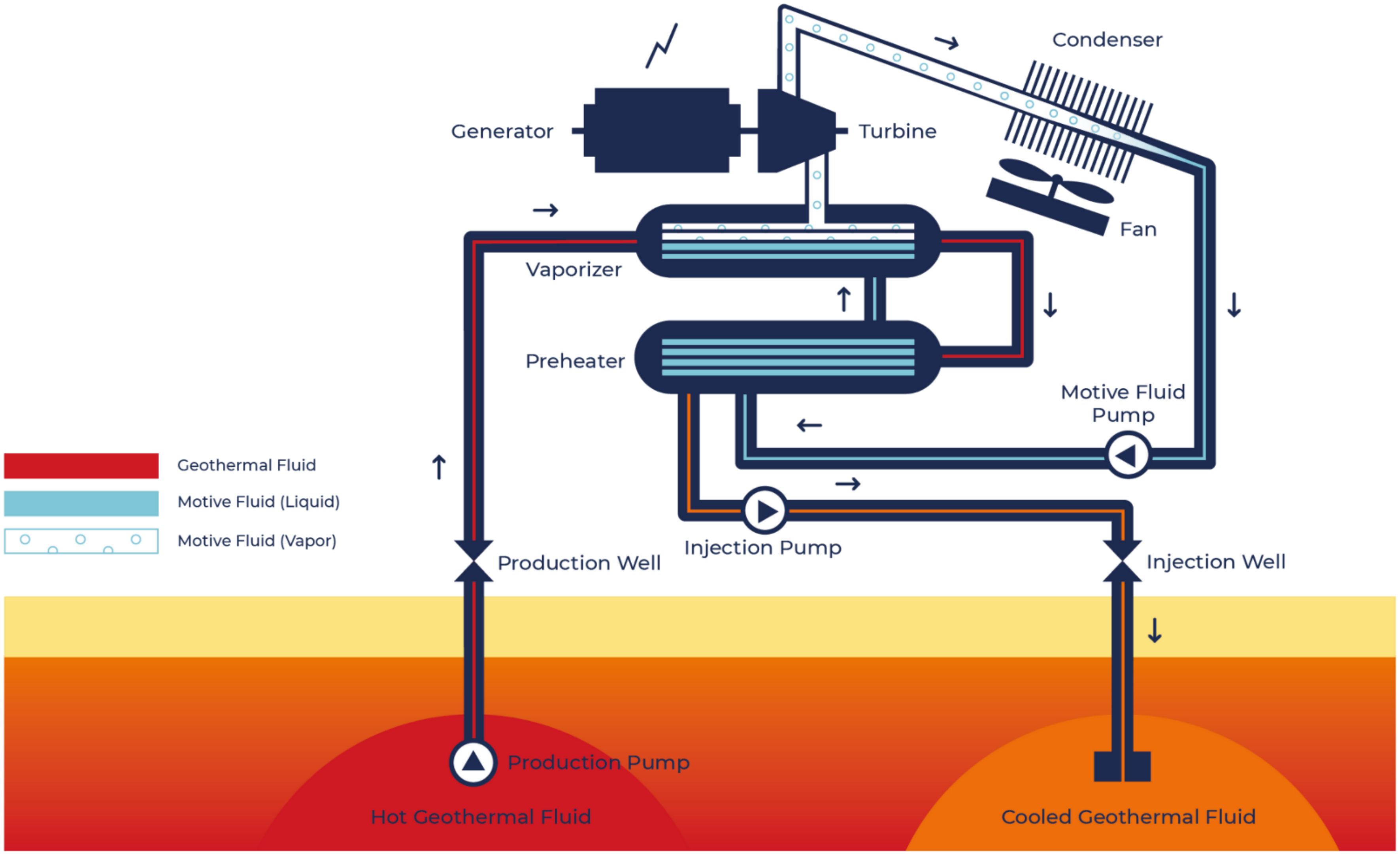
33
Powerplants owned & operated worldwide

~3.2GW
Supplied worldwide

ORA
Listed on NYSE since 2004

(1) REG – Recovered Energy Generation

WHAT IS THE GEOTHERMAL BINARY CYCLE?



SIMILAR POWERPLANT - DORA 2 - TURKEY

PROJECT EXPECTED SCHEDULE

Engineering
- Define the detailed design of the powerplant

Civil works
- Includes grading, soil preparation, foundations and more
- Expected around July 2024

Manufacturing
- Turbines, heat exchangers, Air-cooled condensers, etc
- LLI launched; Onsite construction and in parallel to civil works

Construction
- Arrival of equipment around February 2025
- Mechanical, electrical, civil constructions

Testing & Commissioning
- Tests of interconnections, equipment, turbine, resource etc
- Commissioning expected around January 2026

Operations
- Regular operations with trained staff

Geothermie Bouillante - Guadeloupe

Bouillante 1

Bouillante 2

THANK YOU

RAPHAEL SWERDLOW

Next Steps

- Power Plant
  - Engineering/design
  - Payment for new lands (reinjection route)
  - Mobilization and commencement of construction
- Transmission
  - Acquisition/lease of lands (Laudat to Fond Cole)
  - Award of engineering, procurement and construction contract
  - Mobilization and commencement of construction

Prepare to provide services to contractors over a two year period

Next Update

Community update before the commencement of construction

Thank You

If you have any questions …

Office: 448 6178/9

Allan: 275 7392

Website: https://www.geodominica.dm/

Appendix

RV-I2 Access Road
Reinjection Pipeline Route
New RV-P2 Access Road
Power Plant Site
RV-P2
RV-I2 well pad
WW-P1
Drilling Water Supply Lines
Water Source
Google Earth
Image © 2022 Maxar Technologies
Image © 2022 CNES / Airbus
N
400 m

ERM

APPENDIX E DISASTER AND CLIMATE CHANGE RISK AND VULNERABILITY ASSESSMENT

Disaster and Climate Change Vulnerability Risk Assessment

Including Disaster Risk and Emergency Management Plans

PREPARED FOR
Caribbean Development Bank &
Inter-American Development Bank

DATE
9 August 2024

REFERENCE
0741066

SIGNATURE PAGE

Disaster and Climate Change Vulnerability Risk Assessment

Including Disaster Risk and Emergency Management Plans

0741066

Venkat S. Kolluru

Venkat Kolluru
Technical Consulting Director

Dr. Ricardo Calvo
Partner

ERM, Inc.
1776 I St. NW
Washington, D.C. 20006

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
CDB	Caribbean Development Bank
CIP	Climate Impact Platform
DGDC	Dominica Geothermal Development Company Ltd
DRMP	Disaster Risk Management Plan
ERM	Environmental Resources Management, Inc.
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Safety Management Plan
FMEA	Failure Mode and Effect Analysis
GoDC	Government of the Commonwealth of Dominica
IDB	Inter-American Development Bank
km	Kilometer
m	Meter
MW	Megawatt
RPN	Risk Priority Number

EXECUTIVE SUMMARY

In 2023, the Caribbean Development Bank (CDB) received a request to finance a Geothermal Project in Roseau Valley, Dominica, using resources from the Sustainable Energy Facility[1], which the Inter-American Development Bank (IDB) is also considering supporting. The Project consists of a 10 MW binary-cycle Geothermal Power and associated facilities that will be designed, constructed, and operated by the private company Ormat Technologies Inc (through their subsidiary, Geothermal Power Company of Dominica (2023) Ltd, hereafter, "Ormat.") Ormat has the support of Dominica Geothermal Development Company (DGDC, a government agency), who has acquired land for the Project and currently leads Stakeholder Engagement. As the Project has had changes in developer and Project design, the CDB and IDB retained Environmental Resources Management, Inc (ERM) to update various components to account for changes in the Project approach, scope, and design, as well as to validate that the critical assumptions and recommendations within the existing documentation remain relevant. This study details the update to the Disaster Risk Management Plan (DRMP).

This update to the DRMP included a reevaluation of the hazard risks using the methodology presented in IDB's *Disaster and Climate Change Risk Assessment Methodology for IDB Projects.* This included a screening and classification of the hazard risks to the project area, a quantitative assessment of the proposed and implemented mitigation measures, and the development of updated DRMPs for the various hazards determined. Nine hazards were initially identified for the project site: earthquake, volcanic, landslide, hurricane, flooding, extreme heat, extreme cold, drought/water scarcity, and wildfires. Each of these hazards was evaluated for the risk presented to the project through four different time frames and two climate scenarios. The two climate scenarios considered were SSP1-2.6 and SSP5-8.5 and the four time frames were: baseline, 2030, 2050, and 2080.

The initial risk analysis was conducted without considering any planned or existing mitigation measures, providing a clear view of the worst-case risks for each hazard. This analysis was applied across the project's various assets and components. Out of the nine identified hazards, six were classified as moderate to high risk at least once during the assessment period, including earthquakes, volcanic activity, landslides, hurricanes, flooding, and extreme heat.

The risk analysis was then reevaluated with the integration of both planned and implemented mitigation measures, which significantly reduced the risk levels for all hazards to low, except for hurricanes and heat stress. These two hazards were mitigated to moderate levels, yet their frequency remains high and cannot be altered by any mitigation measures. Despite this, the consequences of these hazards are now deemed insignificant due to the robust mitigation strategies in place. ~~Additionally, the facility's design, which accommodates temperatures substantially higher than 130°C (designed for geothermal heat), ensures that heat stress does not pose a risk to operations. However, other specific design details were unavailable at the time of reporting.~~

[1] FP020: Sustainable Energy Facility for the Eastern Caribbean | Green Climate Fund

ORMAT, the design team, has implemented stringent standards that exceed baseline requirements to ensure the structural integrity of the project under extreme conditions. For hurricanes, the design accommodates wind speeds up to 155 knots, consistent with 2030 estimates. Facilities are built to withstand temperatures of 137°C, surpassing projected levels. Additionally, ORMAT has designed equipment with G factors ranging from 0.1 to 0.29, appropriate for the moderate to low seismic risk in the project area.

As most mitigation measures were incorporated during the design phase by ORMAT, it is recommended that ORMAT develop and seek approval from DGDC for the necessary Disaster Risk Management Plans (DRMPs) to ensure continued operational resilience.

1. INTRODUCTION

In 2023, the Caribbean Development Bank (CDB) received a request to finance a Geothermal Project in Roseau Valley, Dominica, using resources from the Sustainable Energy Facility[2] (SEF), which the Inter-American Development Bank (IDB) is also considering supporting. The Project consists of a 10 MW binary-cycle Geothermal Power and associated facilities that will be designed and constructed by the private company Ormat Technologies (through their subsidiary, Geothermal Power Company of Dominica (2023) Ltd, hereafter, "Ormat."), with support from the Dominica Geothermal Development Company Ltd. (DGDC), a special-purpose vehicle with its own board, created in 2017. The DGDC is 100% owned by the Government of the Commonwealth of Dominica (GoCD) and equity is transferred from GoCD to the DGDC under a subsidiary agreement. The DGDC acquired the land required to construct the current Project as well as land for prior drilling of exploratory and injection wells, activities that were concluded by another contractor in 2012-2013, followed by further testing in 2019. In December 2023, Ormat signed a concession agreement with the GoDC to construct and operate the Power Plant and associated facilities for 25 years, making Ormat the developer of the Power Plant. As the Project has had changes in developer and Project design, the CDB and IDB retained Environmental Resources Management, Inc. (ERM) to update various components to account for changes in the Project approach, scope, and design, as well as to validate that the critical assumptions and recommendations within the existing documentation remain relevant.

This update includes supplemental management measures required to align with the CDB and IDB's standards, which includes an updated Disaster Risk Management Plan (DRMP).

1.1 PURPOSE AND OBJECTIVES

This 2024 DRMP updates the previous 2021 DRMP and aligns the risk analysis with the methodology highlighted in IDB's *Disaster and Climate Change Risk Assessment Methodology for IDB Projects*[3].

1.2 PROJECT DETAILS

As described in the 2024 Environmental and Social Impact Assessment (ESIA), there are several components to the Project. Some of them have been carried out/constructed in previous years through other developers, while others are yet to be constructed.

The Project will have the following main components:

1. 10 MW binary-cycle power plant (2 turbines of 5 MW each)
2. Wells and pads (already drilled):
    a. Two production wells (already drilled and flow tested): WW-P1 and RV-P2.
    b. One injection well (already drilled and injection tested): RV-I2.
    c. Exploration well WW-03 will also be used for production

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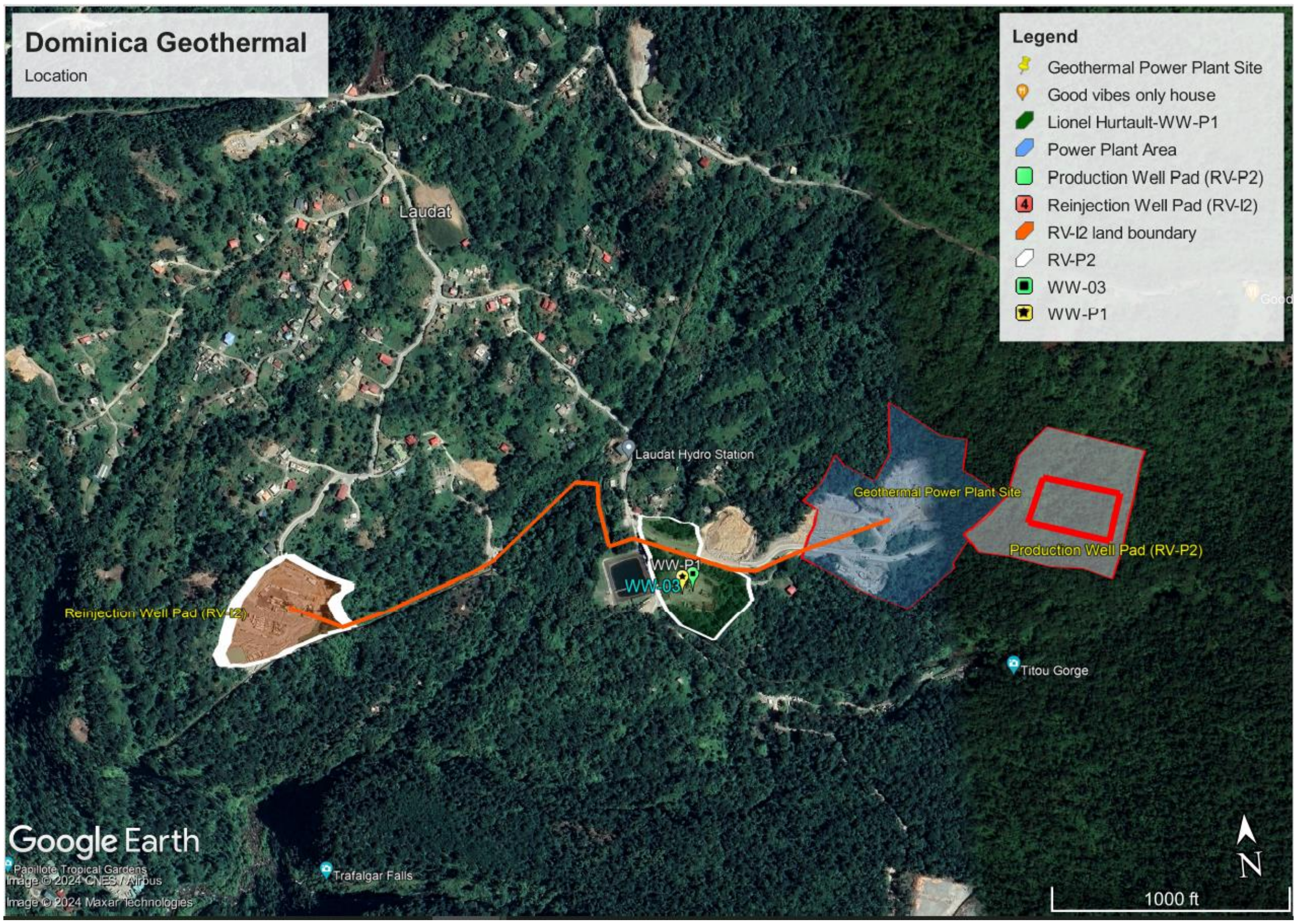
[2] FP020: Sustainable Energy Facility for the Eastern Caribbean | Green Climate Fund
[3] Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams (iadb.org)

3. A 1.2 km reinjection pipeline is to be constructed (no changes since the 2020 ESIA)
4. Additional facilities (all of which are outside of the scope of the funding scope but are not constructed yet):
   a. New Transmission Lines (TL) segments of 33 kV and 69 kV (to replace segments of the existing 11 kV TL. This will be done by a different developer for DOMLEC)
   b. A 5 MW battery storage system – (to be constructed for DOMLEC)
   c. Office building and material facilities

The layout of the project site is shown in Figure 1-1.

FIGURE 1-1 PROJECT FOOTPRINT AND LAYOUT



Source: ERM, 2024

1.3 LIMITATIONS

Following the 2021 DRM plan, several limitations are encountered and must be taken into consideration:

a) The DRM Plan is limited to only natural hazards. Any other hazards are beyond the scope of this Plan.

b) The DRM Plan is concerned only with the risks to the geothermal power plant areas. No cascading effects were considered beyond the project area.

c) The DRM Plan is limited by the data that is currently available on hazards, exposure, and vulnerabilities. For example, although some hazard maps for Dominica have been produced, the extent to which they can be useful for hazard/risk analysis of the project site is limited by the scale of those maps.

d) No site additional site-specific studies were undertaken outside of the previous studies completed (i.e. Flooding study completed in 2018 for the Jacobs ESIA)

2. APPROACH AND METHODOLOGY

The approach used in developing this DRM Plan is based on understanding disaster risk as the interaction between hazards and the characteristics that make people and places exposed and vulnerable. The approach and methodology used for this study were based on the methodology and documentation presented in IDB's *Disaster and Climate Change Risk Assessment Methodology for IDB Projects.*

2.1 APPROACH

The approach employed for this DRM Plan is, therefore,

a) to identify and classify those natural hazards that are likely to impact the geothermal power plant site.

b) to examine the extent of exposure and vulnerability of the plant site to each natural hazard.

c) define the general hazard risks associated with each of the identified hazards.

d) to determine the worst-case impacts caused by the combination of the natural hazards and exposure/vulnerability for the key assets and asset components of the geothermal power project.

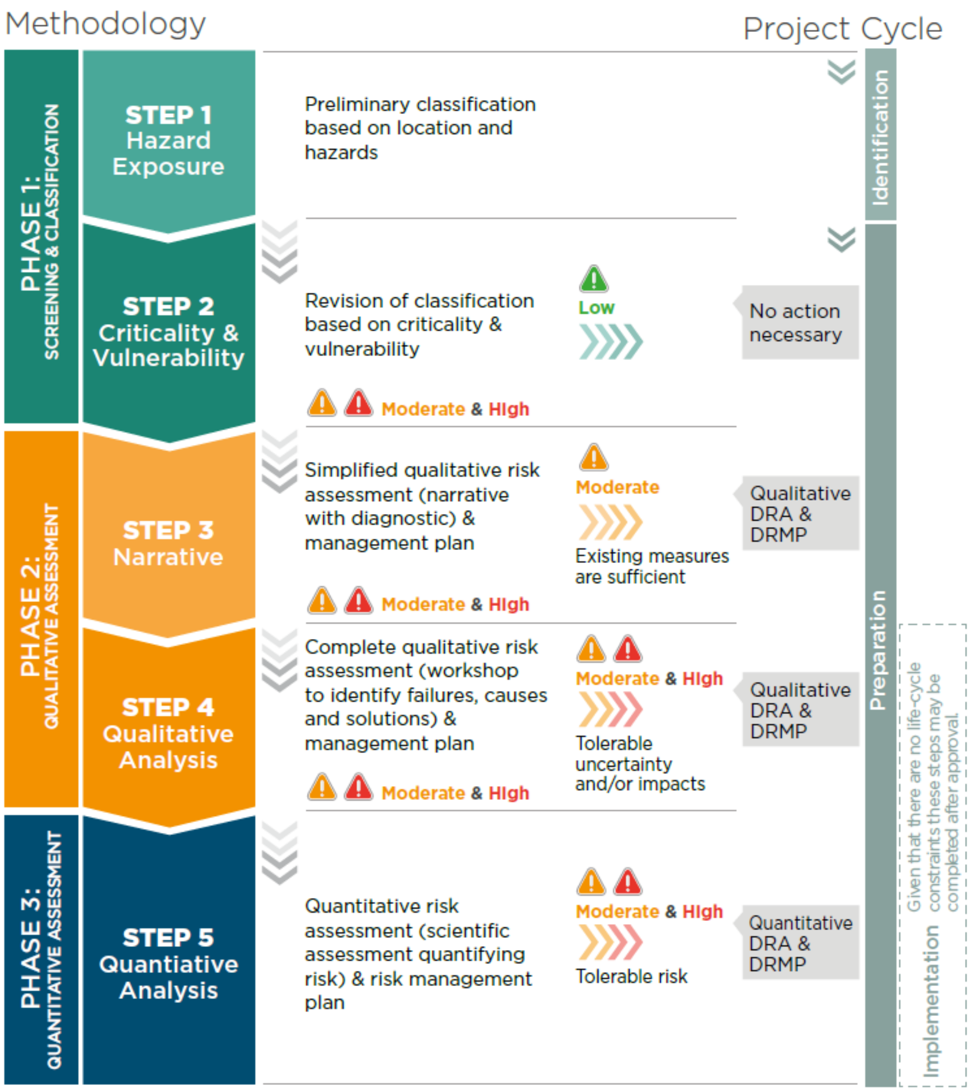
e) redefine the hazard risks for the various assets and asset components to determine which key elements might require additional mitigation measures to assist in reducing the hazard risks.

f) design the response measures to address moderate and high-risk hazard/asset/asset component combinations. When disaster risks are identified, the DREM Plan provides recommendations on disaster preparedness and disaster mitigation actions.

2.2 METHODOLOGY FOR DISASTER RISK ASSESSMENT

ERM utilized the methodology developed in IDB's *Disaster and Climate Change Risk Assessment Methodology for IDB Projects* technical document to produce this assessment. An overview of the methodology is shown in Figure 2-1. In this assessment, Steps 1 through 4 were completed. A recommendation on Phase 3/Step 5 will be made in Phase 2. This phase is only to be conducted if it applies to a specific feature of the operation that requires a quantitative assessment according to the results of Step 4 about high- or medium-risk operations and elements (e.g. structural, systems, utilities, etc.).

FIGURE 2-1 IDB DISASTER AND CLIMATE CHANGE RISK ASSESSMENT FRAMEWORK



Notes: Should the assessment be carried out after board approval, a legal condition might be included in the loan contract for it to be conducted.

Source: IDB, 2019

Phase 1 of the methodology, which includes Steps 1-2, is the screening and classification of hazards step. This includes a preliminary classification based on location and hazards (Step 1), which is followed by a revision of the classification to account for criticality and vulnerability (Step 2). For this Phase, IDB's hazard screening and classification tool, ERM's Climate Impact Platform tool, previous ESIA studies, and regional data sources related to geophysical hazards to develop a hazard risk classification for the Project. ERM's Climate Impact Platform tool will provide data on the hazards for climate change scenarios SSP1-2.6 and SSP5-8.5 and for time horizons baseline, 2030, 2050, and 2080.

The result of Phase 1 is the development of a risk matrix showing the consequence vs frequency for the three timeframes and various hazards. The natural hazards included in this assessment are:

- Earthquake.
- Volcanic.
- Landslide.
- Hurricane.
- Flooding.
- Extreme Heat.
- Extreme Cold.
- Drought/Water Scarcity; and
- Wildfire.

Phase 2 of the methodology, which includes Steps 3-4, is the qualitative assessment of the project. This includes a risk assessment and management plan. First, (Step 3), a simplified approach is taken, with additional information related to previously developed ESMPs to reflect on the adaptive capacity of the Project. Other supporting documents on design and other studies completed as part of 2018 and 2021 ESIAs will be carefully reviewed during this phase. The aim is to document how and to what extent thought has been given to disaster and climate change risk management issues. After the simplified approach is completed, a more detailed assessment (Step 4) will be taken to further strengthen the existing adaptation measures or develop new ones. This will include performing a failure mode evaluation analysis (FMEA) to list all the types, causes, and consequences (various infrastructures in the project and the surrounding environment and communities) of failures that may happen to the project due to the occurrence of geophysical and climate change hazards. Resulting from Phase 2 are updated natural hazard risk matrices and DRMPs.

3. HAZARD PROFILES

As stated in Section 2.2, Phase 1 of the IDB methodology includes a screening of hazards for the project location. This screening is completed using various sources including previous studies for the project, IDB's screening and classification tool, ERM's Climate Impact Platform (CIP), regional hazard data, and local hazard data. IDB's screening and classification tool provides a basic coverage of key hazards that could be in the project area, including their hazard levels. The maps produced by this tool are included in Appendix A. ERM's CIP utilizes a variety of sources to compile risk levels associated with various hazards for the selected time frames and climate change scenarios. Regional and local hazard data included hazard mapping completed by various agencies. These sources provide both the hazard level and the probability for a variety of different hazards. Those considered during this study are:

- Earthquake
- Volcanic
- Landslide
- Hurricane
- Flooding
- Extreme Heat
- Extreme Cold
- Drought/Water Scarcity, and
- Wildfires.

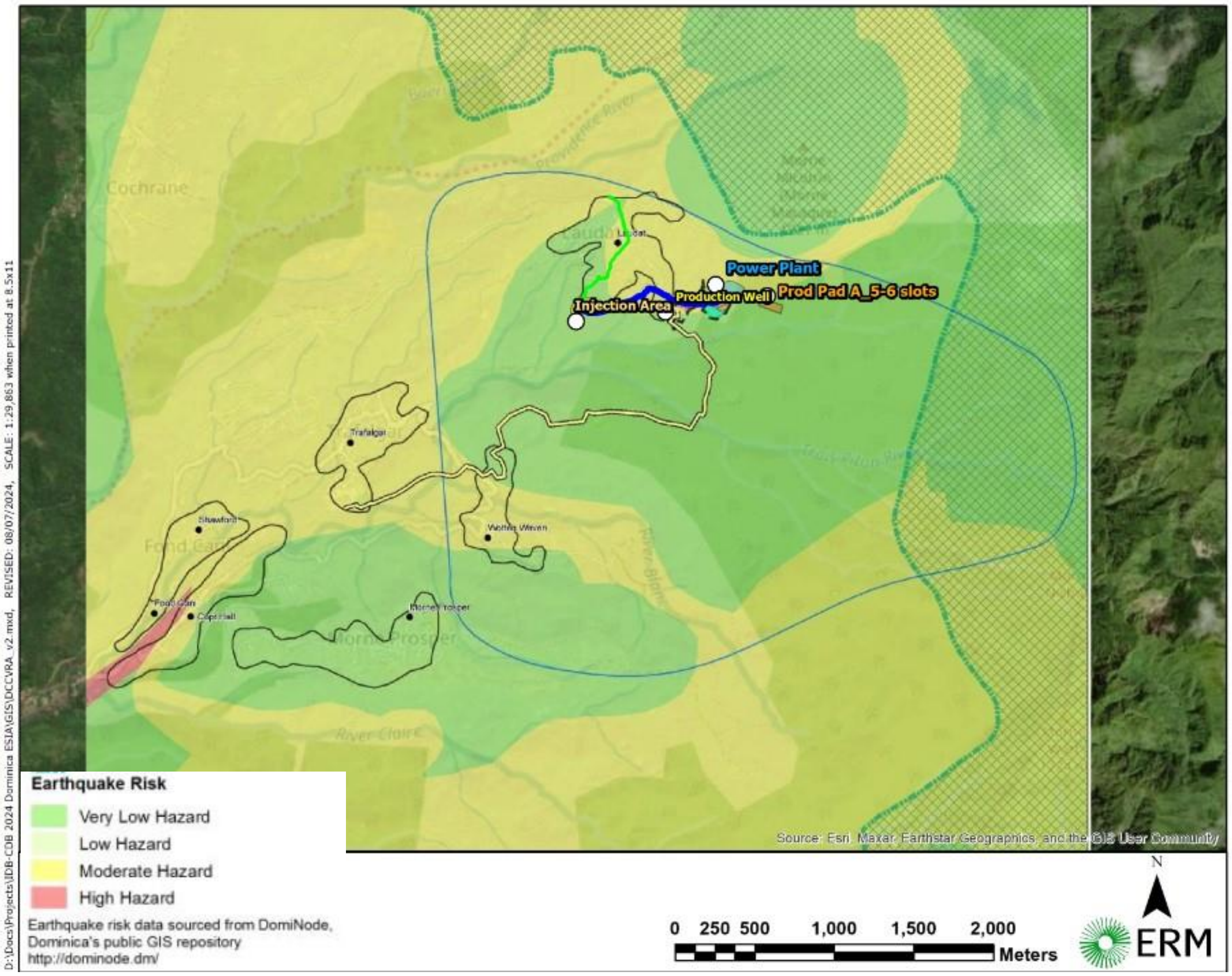
These hazards were assessed in multiple time frames, including future projections to evaluate the impact of climate change on the risk posed. The time frames included were the baseline, 2030, 2050, and 2080. For the future projections, two different climate scenarios were considered: SSP1-2.6 (optimistic) and SSP5.8.5 (pessimistic). There were two main sources of projected future hazard data. These were ERM's CIP and the World Bank's Think Hazard Profile for Dominica[4]. While ERM's CIP includes specific data about the selected climate scenarios and time frames, Think Hazard provides more general statements about the potential future concerning the hazards. All the information found is compiled and used to develop a hazard value that is applied during the risk assessment.

3.1 EARTHQUAKE

According to the 2018 ESIA for the project location, the hazard level of earthquake is classified as moderate to very low in the Roseau Valley. This can be seen in Figure 3-1, where most of the project is located within the low-hazard level area while the injection pipeline route overlays a small portion of the moderate hazard area (Jacobs 2018). This level of risk is also seen from the Think Hazard source, where almost all of Dominica is classified as a medium risk for earthquake hazard, as shown in Figure 3-2. Per Think Hazard (https://thinkhazard.org/en/report/71-dominica/EQ), earthquake hazard in Dominica is classified as medium according to the information that is currently available. This means that there is a 10% chance of potentially-damaging earthquake shaking in your project area in the next 50 years. From Dominica's Physical Planning Division[5], the earthquake hazard level, according to the earthquake hazard map, in the project area ranges from very low to moderate, as shown in Figure 3-3. The earthquake hazard map produced by IDB's screening and classification tool also indicates a moderate risk level.

[4] https://thinkhazard.org/en/report/71-dominica
[5] https://physicalplanning.gov.dm/land-use-and-development/maps

FIGURE 3-1 EARTHQUAKE HAZARD MAP – 2018 ESIA

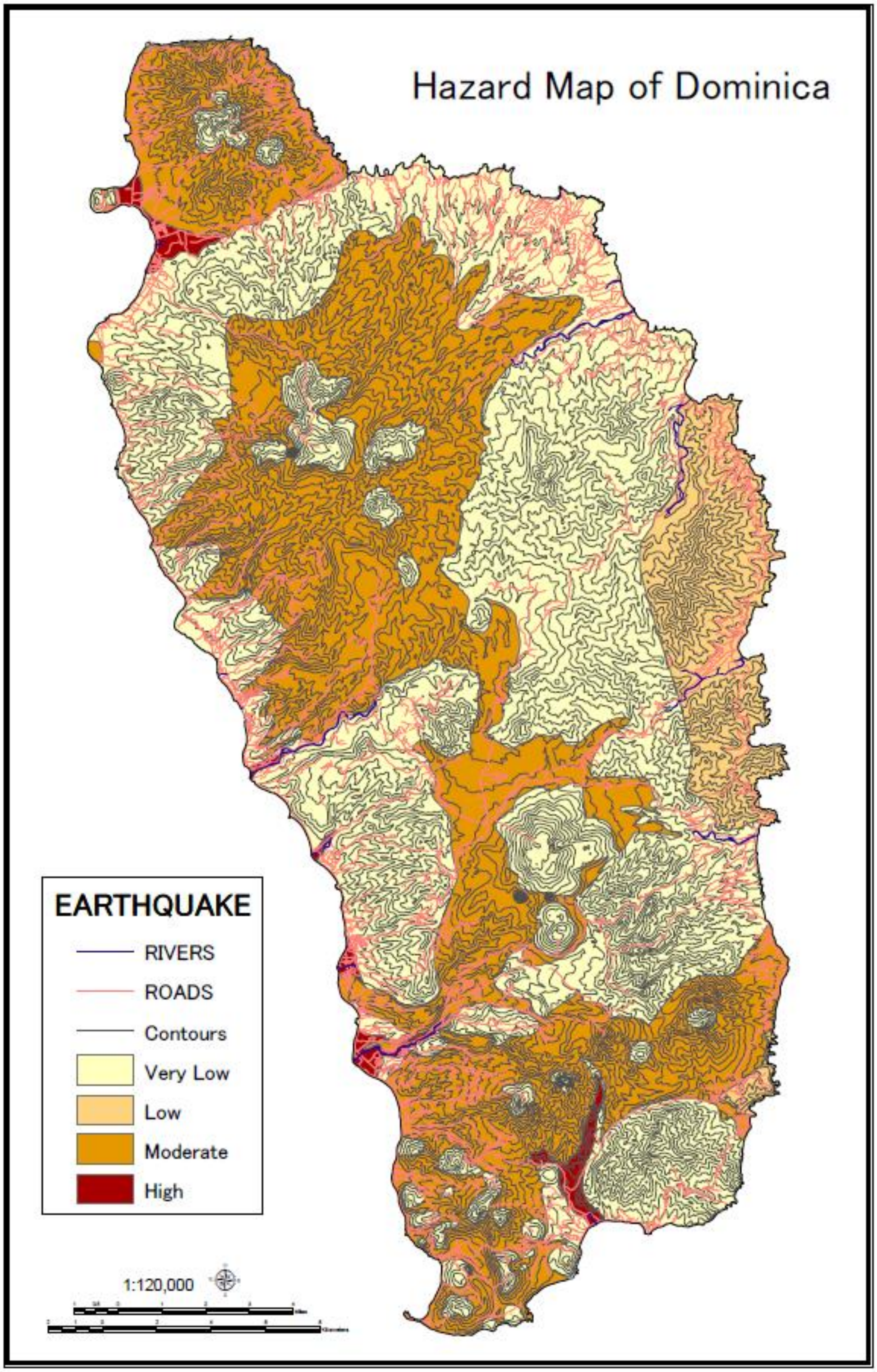


Source: Jacobs 2018

FIGURE 3-2 EARTHQUAKE HAZARD MAP FROM THINK HAZARD

Source: Think Hazard: Dominica

FIGURE 3-3 EARTHQUAKE HAZARD MAP FROM PHYSICAL PLANNING DIVISION



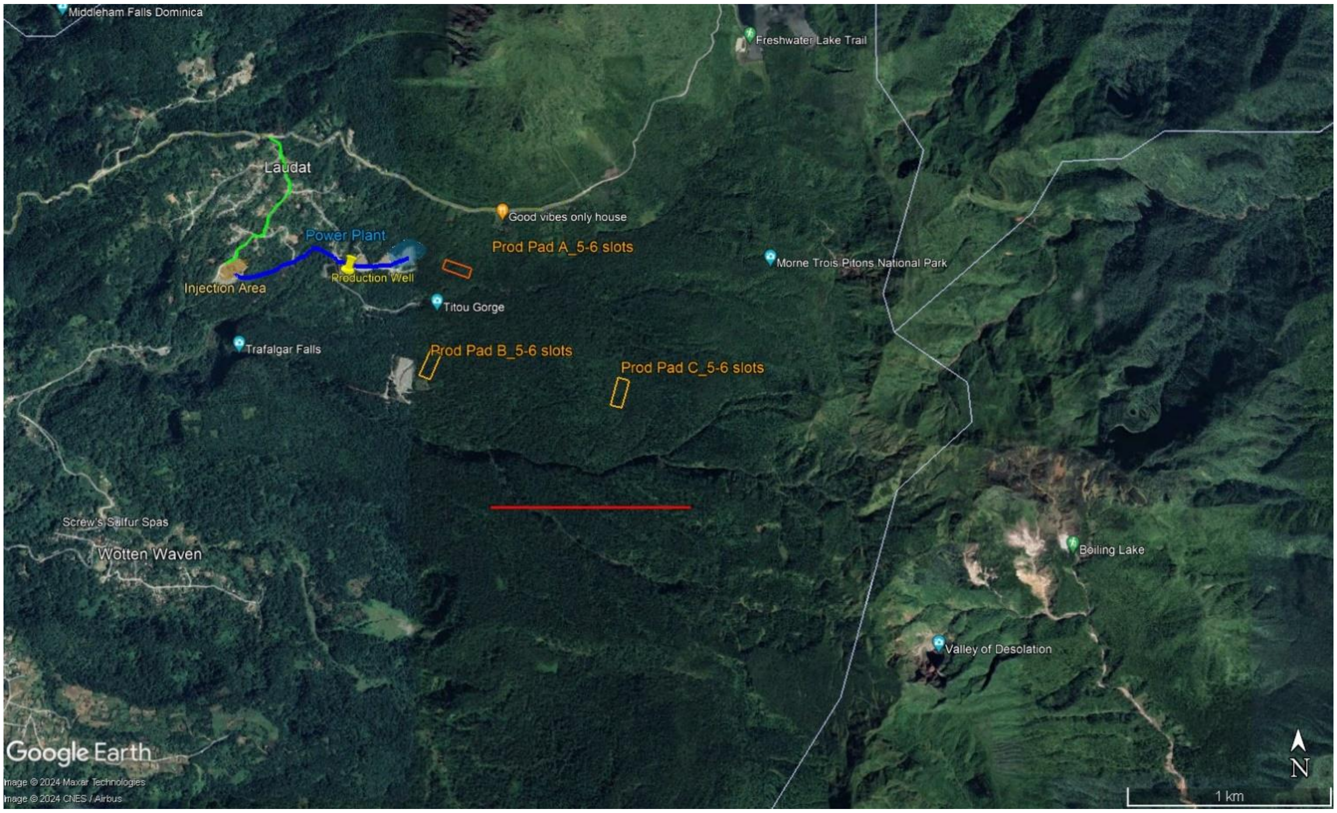
Source: Physical Planning Division Hazard Map

From the 2021 DRMP, the earthquake risk was listed as higher; indicating the site is in the moderate/high seismic activity zone. It was estimated that the expected magnitudes would vary from an average of 2.5 M to peaks of 5 M. The experts also determined because of the geothermal operations that will be conducted in areas that are also tectonically active, there will be difficulty in distinguishing between any geothermal-induced and naturally occurring events (DGDC 2021). Due to most of the sources indicating at least a moderate hazard level, it was determined that for this project a moderate hazard level should be considered.

3.2 VOLCANIC

The islands of the eastern Caribbean, also known as the Lesser Antilles, are comprised of many volcanic islands. Most of these islands have one volcanic center, but Dominica is different, having a total of nine volcanic centers. The large number of volcanic centers makes it possibly the highest concentration of active volcanoes in the world. These Pleistocene cover the majority of Dominica and are dated from about 400,000 to 500,000 years old. For recent eruptions, the most recent magmatic eruption occurred from Morne Patates about ~500 years ago, and two phreatic eruptions from the Valley of Desolation have occurred more recently, in 1880 and 1997. This is key to note as the Valley of Desolation is the closest active volcano to the project site at approximately 3 km southwest, as shown in Figure 3-4. Various volcanic earthquakes and geothermal activity, like sulfur outlets, hot springs, geysers, and the Boiling Lake (also shown in Figure 3-4.), indicate that the island is still underlain by an active magma reservoir system. Since the island is still underlain by the active system, it is estimated that future eruptions are highly likely, possibly within the next 100 years and the Boiling Lake and the Valley of Desolation are classified as being at high risk of volcanic eruption (Lindsay et al. 2005; Jacobs 2018).

FIGURE 3-4 VALLEY OF DESOLATION LOCATION COMPARED TO PROJECT FOOTPRINT

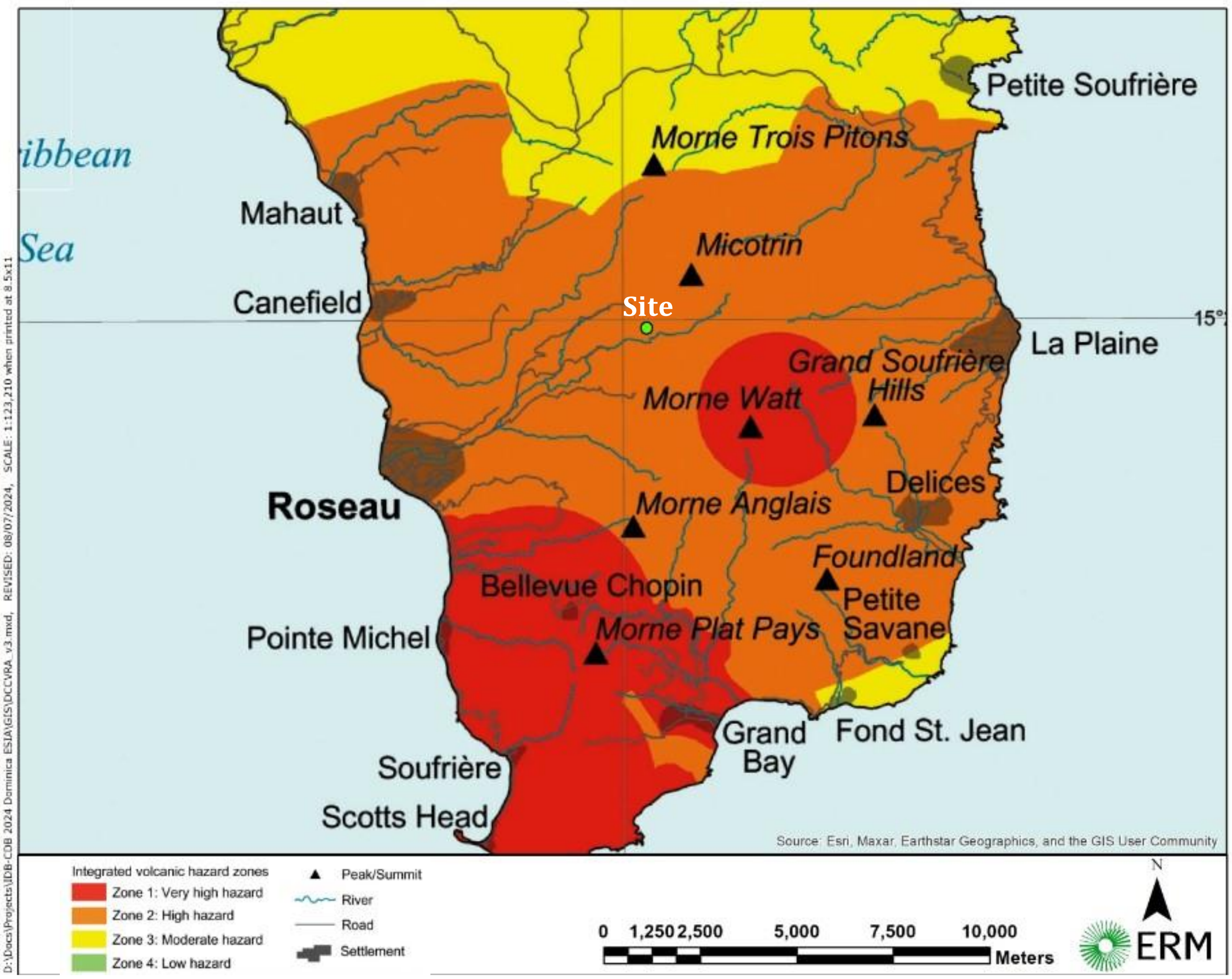


Source: Google Earth

For the development of the volcanic hazard maps presented in the Volcanic Atlas of the Lesser Antilles, various most likely scenarios were considered for the multitude of volcanic centers and then combined to form an integrated volcanic hazard map for all of Dominica. The following scenarios, described in order of potential occurrence, are considered for the volcanic hazard map. The most likely volcanic activity considered was a phreatic eruption from the craters of the Valley of Desolation. It is estimated that an eruption of that nature would be relatively small and would only affect the area directly surrounding the vent. The most likely scenario for a magmatic eruption is a dome-forming eruption from within the Plat Pays volcanic complex. This type of eruption will probably generate dome-collapse pyroclastic flows, pyroclastic surges, and lapilli and ash falls. Lahars may also be generated at times of heavy rainfall during and after the eruption. This eruption may continue for many years and would affect large areas of southern Dominica. The next scenario looks back at a previous eruption for what could potentially occur for a Plinian eruption from the Wotten Waven caldera, which is west of the project site. A Plinian eruption occurred in Dominica about 30,000 years ago, during which large volumes of dacitic ash and pumice erupted. This scenario is considered one of the least likely yet most devastating scenarios. Pyroclastic surges resulting from the collapse of a Plinian column would affect most of the island except for the far north. Some other possible scenarios for Dominica include explosive magmatic eruptions from Morne Anglais or Morne Plat Pays and dome-forming eruptions from Micotrin or Morne aux Diables (Lindsay et al. 2005).

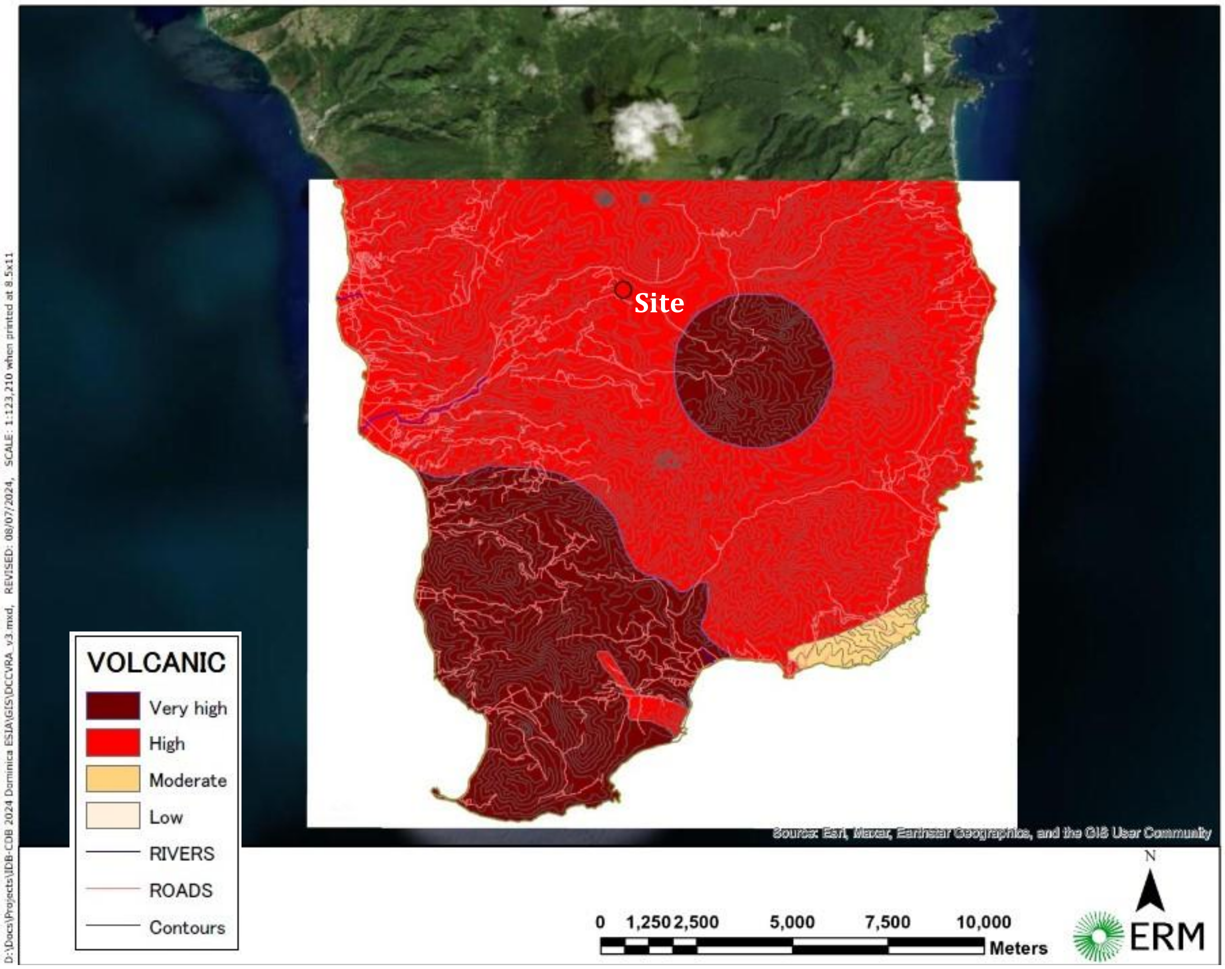
The resulting integrated hazard map is shown in Figure 3-5. This map presents a higher potential for the volcanic hazard for the project (Lindsay et al. 2005). The same level of risk for the volcanic hazard has been provided by both the Physical Planning Division Hazard Maps, shown in Figure 3-6, and the IDB's screening and classification tool. It is key to note that the 2021 DREM plan considered the volcanic risk as low largely due to the consideration of only the pre-construction phase (DGDC 2021). Due to the high possibility of an eruption occurring within the next 100 years, the probability of the volcanic hazard was considered high.

FIGURE 3-5 VOLCANIC HAZARD MAP - VOLCANIC HAZARD ATLAS OF THE LESSER ANTILLES



Source: Lindsay et al. 2005

FIGURE 3-6 VOLCANIC HAZARD MAP – PHYSICAL PLANNING DIVISION HAZARD MAP



Source: Physical Planning Division Hazard Map

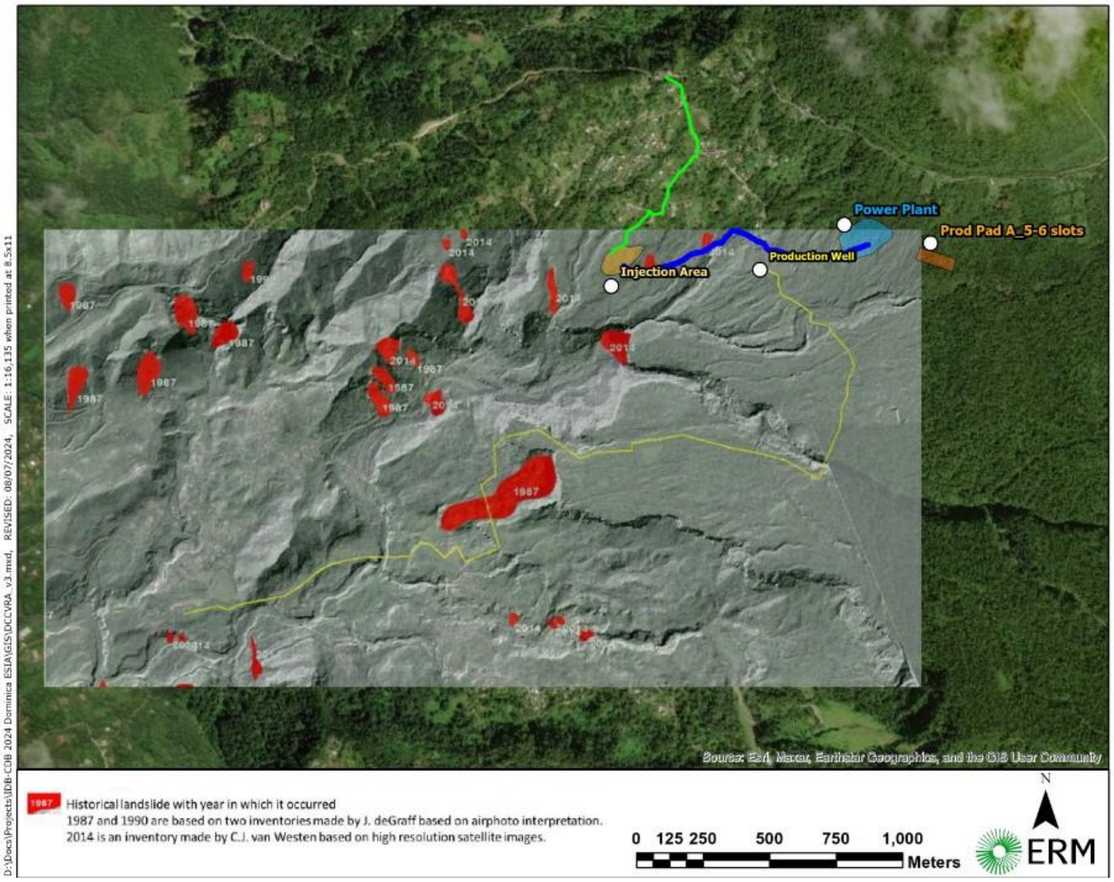
3.3 LANDSLIDE

Throughout Dominica, especially in the steeper areas with higher rainfall levels, landslides represent a potential hazard. As part of the Caribbean Handbook on Risk Information Management (CHARIM) project for Dominica[6], a landslide hazard analysis was completed. This included a landslide inventory map to look at previous landslides (Figure 3-7) and a landslide susceptibility map (Figure 3-8). In the vicinity of project site, some historical landslides have occurred and low to moderate hazard is identified. Near to the injection well location a landside occurred during 2014, and another occurred during the same year near the injection pipeline route. This indicates that there is higher potential associated with those areas as opposed to areas that have not experienced a landslide recently. The susceptibility map indicates that most of the project site is located within the lower hazard area. However, the injection pipeline route passes over a

[6] https://www.cdema.org/virtuallibrary/index.php/charim-hbook/country-data/countrydocs-dom/dominica-maps

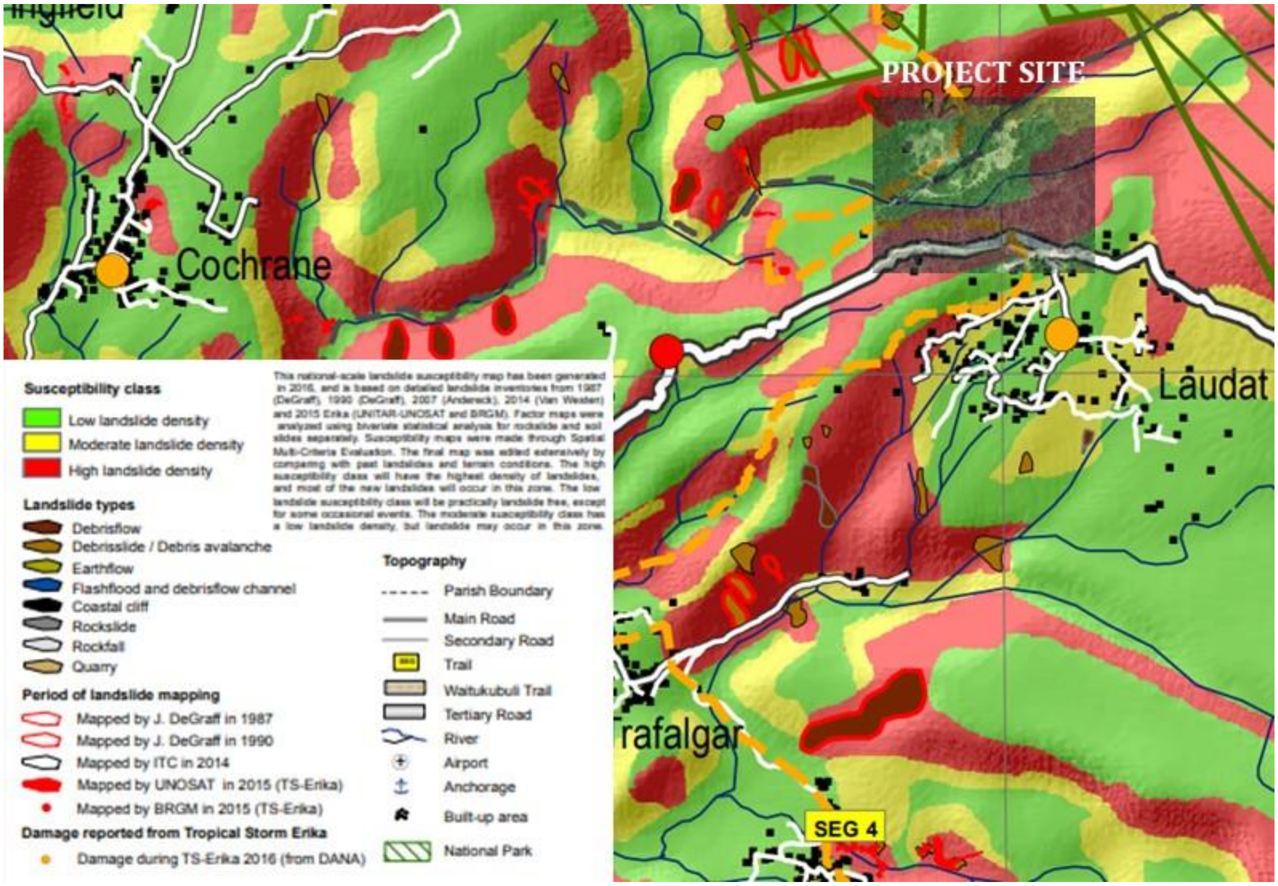
moderate hazard area. There are high-hazard areas located north and south of the project site (Figure 3-9).

FIGURE 3-7 HISTORICAL LANDSLIDE INVENTORY MAP - CHARIM



Source: CHARIM

FIGURE 3-8 LANDSLIDE SUSCEPTIBILITY MAP WITH PROJECT SITE SUPERIMPOSED



Source: CHARIM and Google Earth (for project site)

For the future time frames that included climate change scenarios, ERM's CIP and Think Hazard were utilized for this project. ERM's CIP tool indicated a moderate risk level for rainfall-induced landslides for all the time frames. This was determined based on the number of days with a potential chance of a rainfall-induced landslide event, which is detailed in Table 3.1. it was developed using the antecedent rainfall index (weighted summation of daily rainfall amounts using 7 days) and landslide susceptibility (based on slope, faults, geology, forest loss, and road networks). Think Hazard also indicated a moderate risk level, and suggested that climate change impacts are likely to alter slope and bedrock stability through changes in precipitation and/or temperature. From this, and the CIP results, it was determined that the probability of landslides could increase in the future.

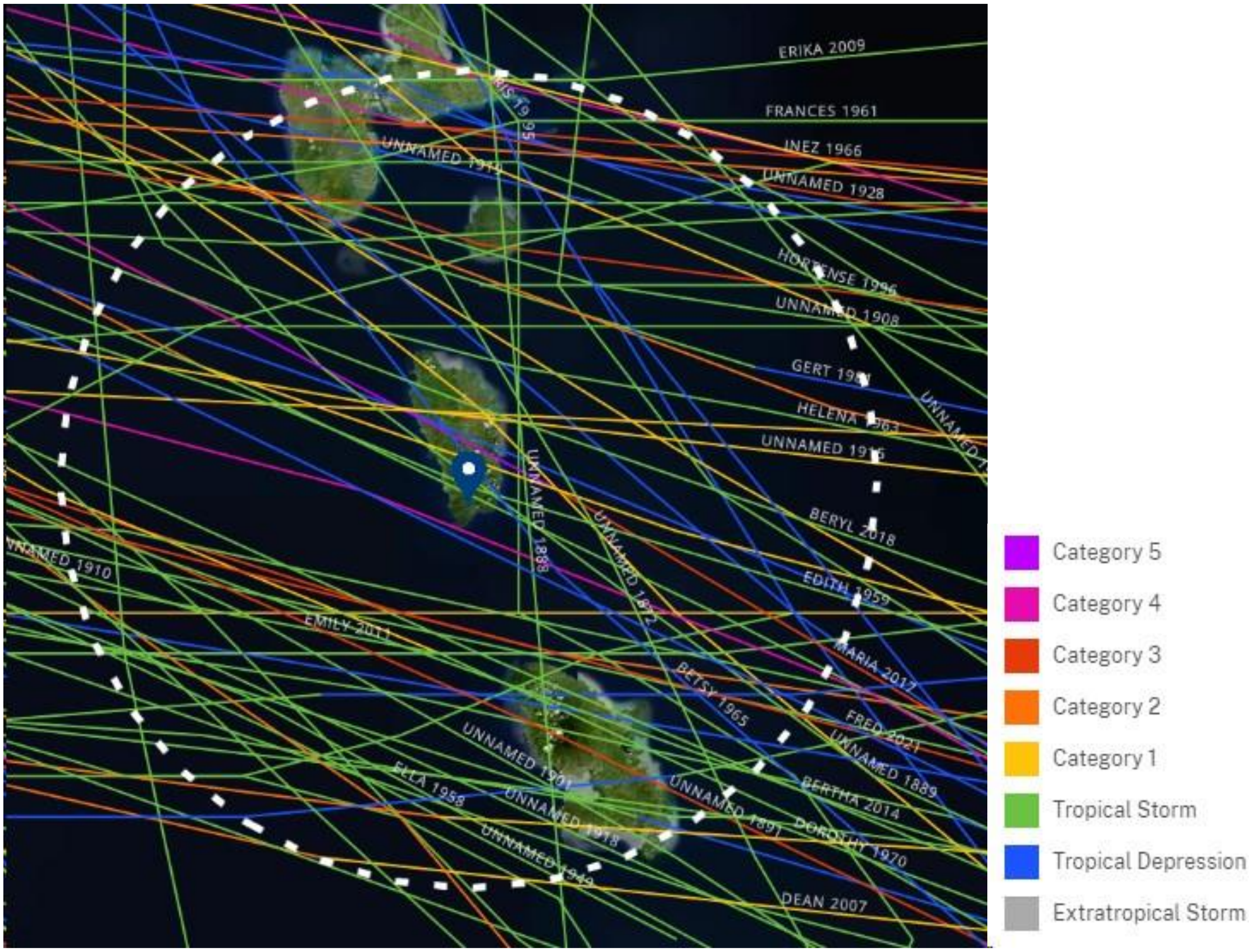
TABLE 3.1 ESTIMATED NUMBER OF DAYS WITH A POTENTIAL CHANCE OF A LANDSLIDE EVENT – ERM'S CIP TOOL

Climate Change Scenario	Baseline	2030	2050	2080
SSP1-2.6	30	32	29	31
SSP5-8.5	30	31	26	18

3.4 HURRICANE

As one of the most hurricane-prone regions in the world, the Caribbean can experience major events that can lead to fractured infrastructure, thousands of people impacted, and the need for additional funding for the government to aid in the countries' recovery. It's noted that on average one major hurricane hits Dominica every 15 years. These events have been well documented, resulting in a comprehensive history. Some tropical systems of note (storms and hurricanes) that have impacted Dominica since 1979, include David (1979), Gert (1981), Gilbert (1988), Hugo (1989), Iris (1995), Marilyn (1995), Hortense (1996), Lenny (1999), Dean (2007) and Maria (2017). A couple of these events are noted as extreme wind events like Hurricane David (1979) and Hurricane Maria (2017) category 5 and 5+ respectively. The paths of some of these events are shown in Figure 3-9 (84 storms between 1851 and 2023).

FIGURE 3-9 HISTORICAL HURRICANE PATHS



Source: [Historical Hurricane Tracks (noaa.gov)]

Due to the potential severity and frequency, the 2021 DREM plan listed the hazard level as high. The risk level provided by IDB's screening and classification tool is of the same category at a high level. ERM's CIP lists a very high level of risk for the hurricane hazard. Think Hazard did not have tropical cyclone data included for Dominica but had it for Guadeloupe, an island directly north of Dominica. The hazard level for tropical cyclones is also at a high level. Overall, the baseline risk and probability for the hurricane hazard are ranked at a high level.

This risk level is kept constant throughout the future time frames, as it has been noted that there is growing evidence that the frequency of hurricanes in the Caribbean will be increasing in the future, as well as a potential increase in intensity (DGDC 2021). Also considering ERM's CIP tool's results, which illustrated a very high level of risk for all time frames and climate scenarios. This included an analysis of the maximum potential wind speed, which is shown in Table 3.2. The hurricane hazard level for all future time frames was kept at a high level.

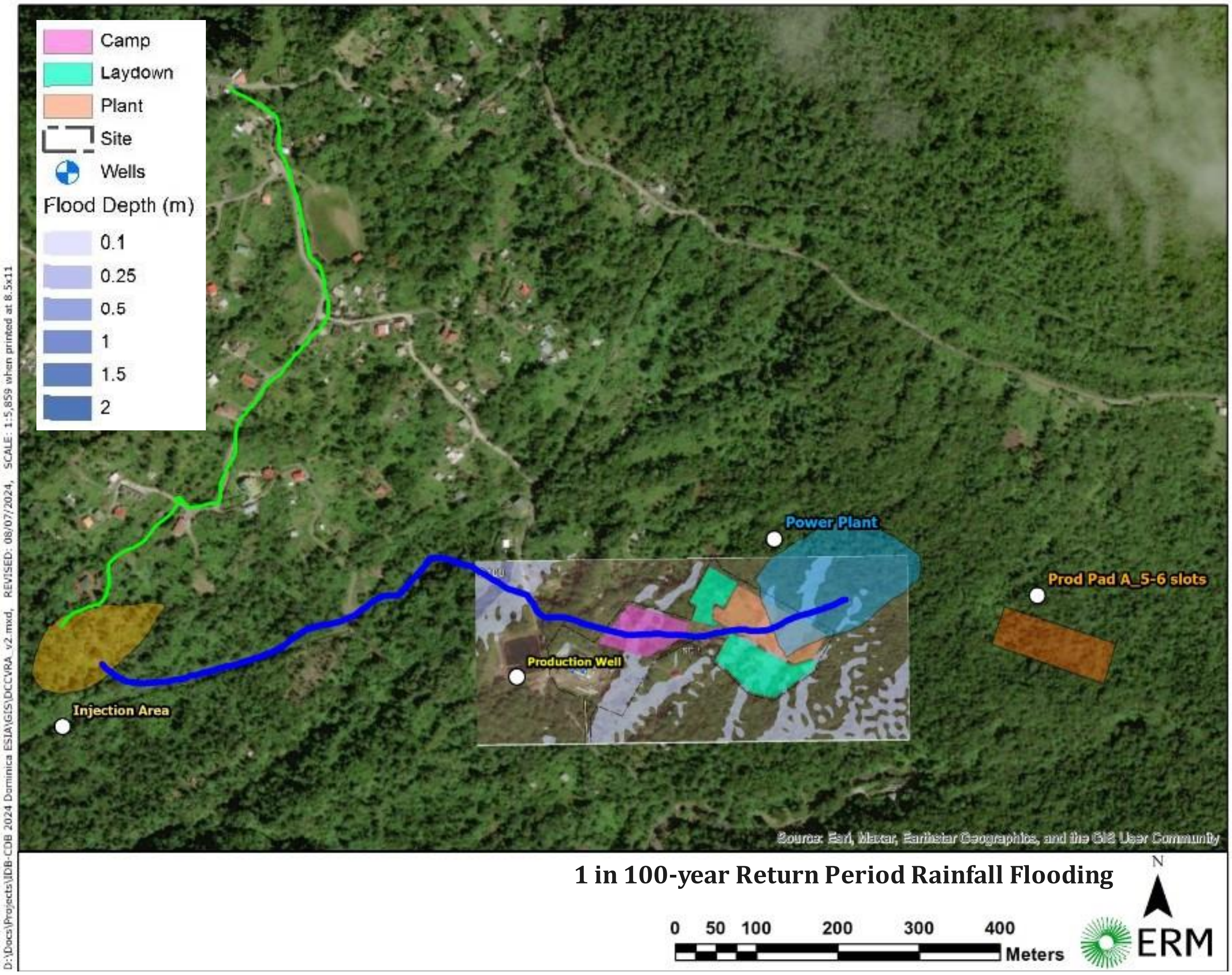
TABLE 3.2 ESTIMATED MAXIMUM HURRICANE WIND SPEED IN KNOTS – ERM'S CIP TOOL

Climate Change Scenario	Baseline	2030	2050	2080
SSP1-2.6	145.00	152.42	153.41	153.78
SSP5-8.5	145.00	152.91	156.87	164.29

3.5 FLOODING

In the Roseau Valley floods, including flash floods, can occur in many streams and are usually a result of rapid run-off after an intense storm. These conditions are similar to those that are favorable for rainfall-induced landslides. Detailed in the 2018 ESIA, a hydrological flooding assessment was completed during the exploration phase of the development. The Roseau River was represented along with a 33.2 km^2 catchment. Included in the analysis were a 10-year return period storm and a 100-year return period storm. It was noted that the tropical environment and steep gradients lead to the promotion of high-velocity flood events with a significant erosive force that may put infrastructure at risk during large events. The 100-year storm results of this study were overlayed on the current project layout to assess the potential flood depths within the project site (Figure 3-10). The injection pipeline seems to have the area of the largest depths, up to 0.5 m, while the power plant area would experience depths around 0.1-0.2 m. These areas of flooding are relatively small with a smaller magnitude, thus indicating a low to moderate risk level. This level is similar to what was documented in the 2021 DREM plan. The extreme level of flooding experienced is considered as the worst-case occurred during Tropical Storm Erika (2015) and Hurricane Maria. Thus, it was determined that there is relatively low flood susceptibility for most of the project area.

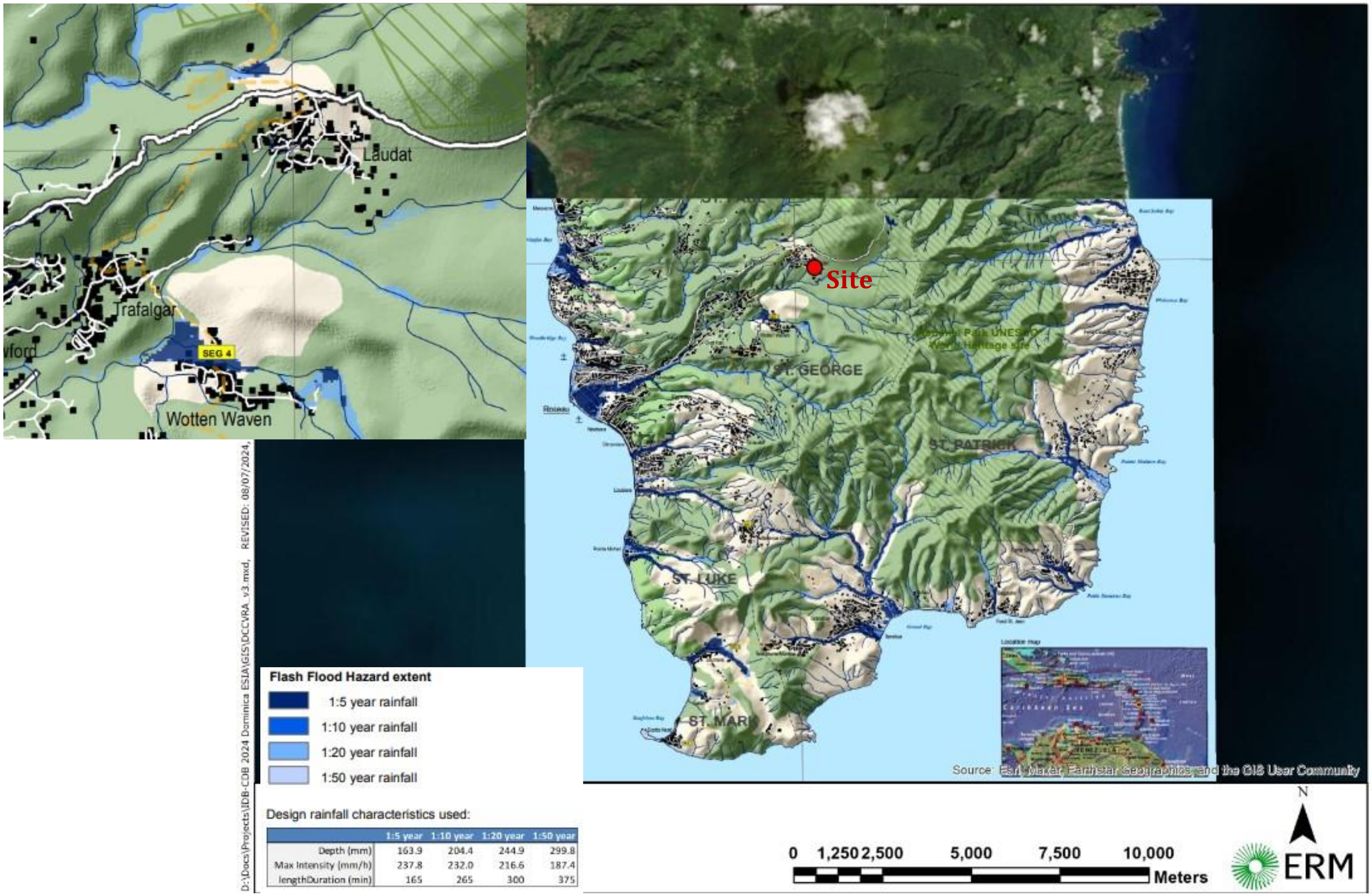
FIGURE 3-10 HYDROLOGIC STUDY 100-YEAR STORM FLOODING RESULTS



Source: Jacobs 2018

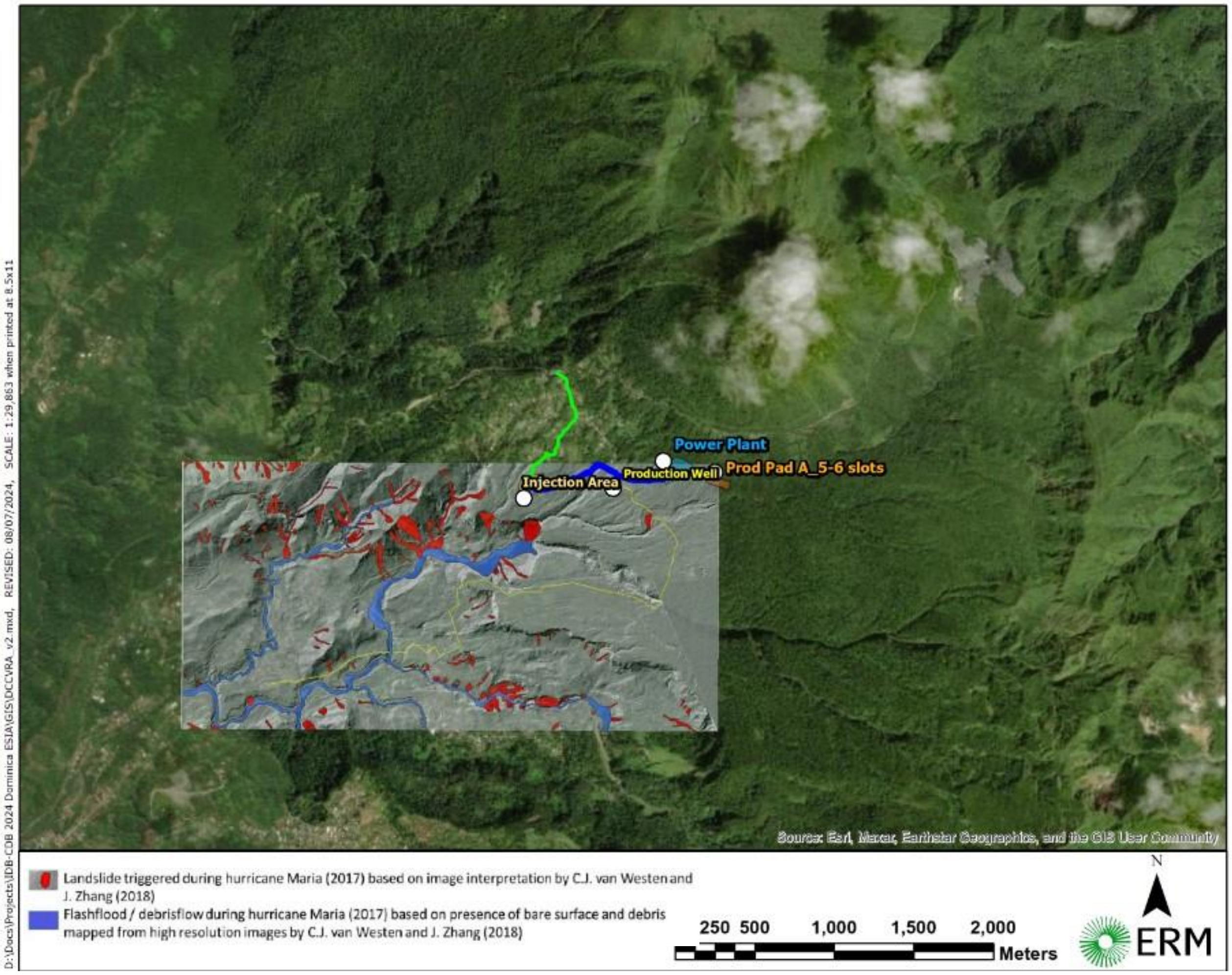
As part of the CHARIM project in Dominica, a flash flood hazard map was developed (Figure 3-11). This map indicates the project area is largely outside of the flash flood hazard, but there is some noted 1 in 20-year flooding located nearby. Figure 3-11 shows that the site was outside the flooding and debris field of Hurricane Maria. This is indicative of a moderate hazard level, with the potential to increase level because of climate change. ERM's CIP tool for all timeframes and climate change scenarios indicated a very low hazard risk level. As part of the CIP tool, riverine flooding was mapped for the 100-year and 500-year events (Figure 3-13). These showed minimal impact on the project, with only one of the well pads experiencing around 0.2 m of flood waters. Overall, the flooding hazard for the project site was ranked as a moderate risk during baseline and a low risk for all others.

FIGURE 3-11 FLASH FLOODING HAZARD MAP - CHARIM



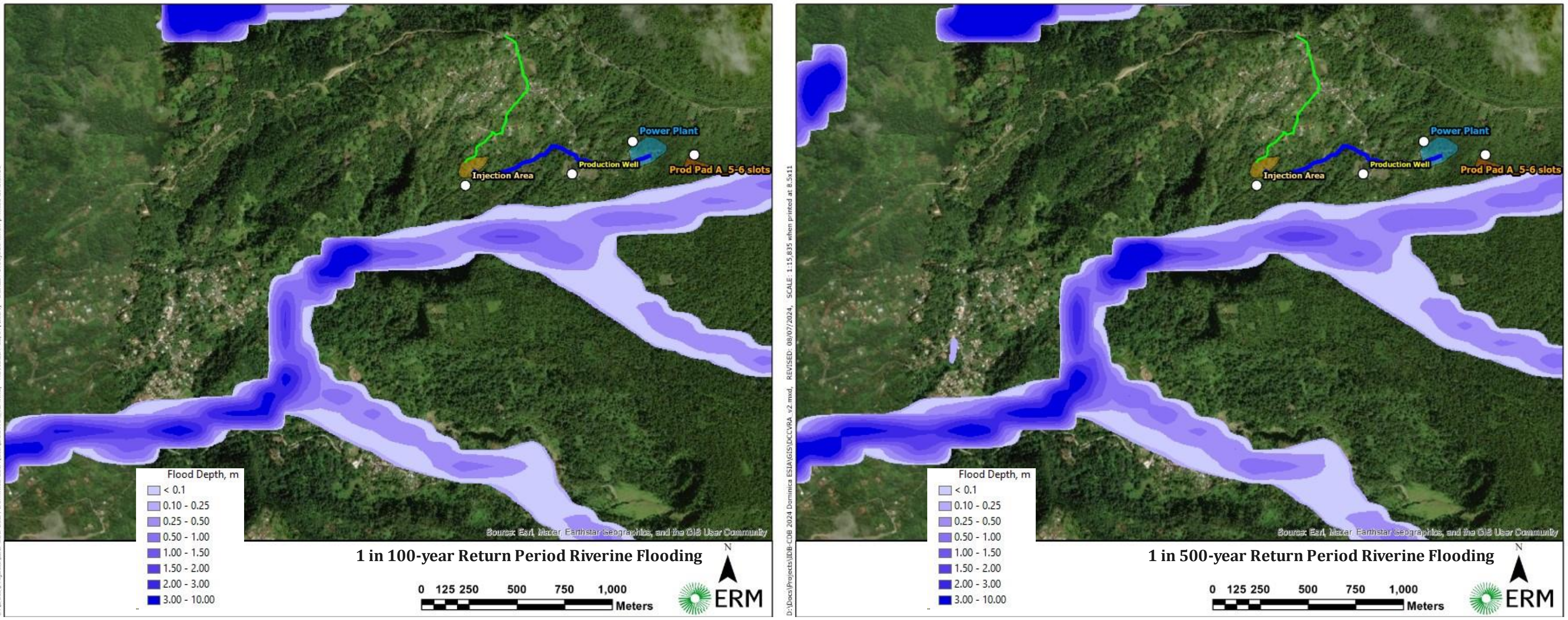
Source: CHARIM

FIGURE 3-12 COMBINED FLOODING AND DEBRIS MAP FROM HURRICANE MARIA



Source: Jacobs 2018

FIGURE 3-13 RIVERINE FLOODING HAZARD MAP – 100-YEAR AND 500-YEAR RETURN PERIODS



Source: ERM CIP Tool/FATHOM Global Flood Maps[7]

[7] [Fathom | Global Flood Hazard Mapping & Water Risk Intelligence]()

3.6 EXTREME HEAT

For the extreme heat hazard, ERM's CIP and Think Hazard were utilized for this project. ERM's CIP tool indicated a high-risk level for the baseline timeframe and a very high hazard level during all other time frames. This was determined based on the estimated warm spell duration in days, with a warm spell defined as the annual number of days contributing to unusually warm events where 6 or more consecutive days experience a maximum temperature greater than the 90th percentile of a 5-day running window surrounding that day of the year based on the historical period. Table 3.3 details the estimated warm spell durations for all time frames and climate change scenarios. Think Hazard indicated a low risk level for Dominica overall. For the climate change impact, it is suggested that it is virtually certain that there will be more frequent hot temperature extremes over most land areas during the next fifty years, but it is key to note that warming will not be regionally uniform. It is estimated that there will be an increase in the next fifty years in Dominica, but it will be much lower than the worldwide average. From this, and the CIP results, it was determined that the probability of extreme heat could increase in the future.

TABLE 3.3 ESTIMATED WARM SPELL DURATION IN DAYS – ERM'S CIP TOOL

Climate Change Scenario	Baseline	2030	2050	2080
SSP1-2.6	132	290	315	293
SSP5-8.5	132	317	362	366*

* 2080 is a leap year; hence 366 days

3.7 EXTREME COLD

The extreme cold hazard was analyzed using data from ERM's CIP tool. It indicated a very high-risk level for baseline, a low risk level for 2030, and a very low risk level for all other time frames. This was determined based on the estimated day duration of a cold spell, with a cold spell defined as the annual number of days contributing to unusually cold events where 6 or more consecutive days experience a minimum temperature of less than the 10th percentile of a 5-day running window surrounding that day of the year within the historical period. This is detailed in Table 3.4 for all time frames and both climate change scenarios. From the CIP results, it was determined that the probability of cold spells would largely decrease in future time frames.

TABLE 3.4 ESTIMATED COLD SPELL DURATION IN DAYS – ERM'S CIP TOOL

Climate Change Scenario	Baseline	2030	2050	2080
SSP1-2.6	12	1	0	0

Climate Change Scenario	Baseline	2030	2050	2080
SSP5-8.5	12	0	0	0

3.8 DROUGHT/WATER SCARCITY

The analysis for the drought/water scarcity hazard considered data from ERM's CIP tool and the World Resources Institute (WRI) Aqueduct tool[8]. ERM's CIP tool indicated a low risk level for drought/water scarcity conditions for the baseline and 2050 time frames. Data for the time frames of 2030 and 2080 were not available. The hazard level was determined based on the estimated water stress level, which is detailed in Table 3.5. WRI Aqueduct tool also indicated a low risk level for the baseline, 2030 and 2050 but shows a slightly increased water stress level from low to moderate in 2080 (Figure 3-14). This suggests that climate change impacts in 2080 are likely to increase the potential of drought/water scarcity in the area. From this, and the CIP results, it was determined that the probability of drought/water scarcity could slightly increase in the 2080 time frame. This could pose a low-level impact on the fire protection systems (firefighting tank) and potable water usage during operations. Overall, the hazard level for drought/water scarcity was ranked as very low for the baseline, 2030, and 2050 and low for 2080.

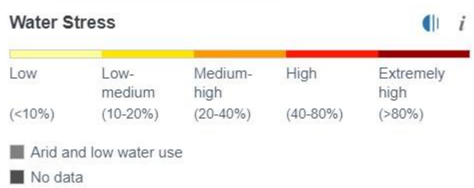
TABLE 3.5 ESTIMATED WATER STRESS LEVEL – ERM'S CIP TOOL

Climate Change Scenario	Baseline	2030	2050	2080
SSP1-2.6	Low (<10%)	No Data	Low (<10%)	No Data
SSP5-8.5	Low (<10%)	No Data	Low (<10%)	No Data

[8] https://www.wri.org/applications/aqueduct/water-risk-atlas/

FIGURE 3-14 WATER STRESS HAZARD MAP – WRI AQUEDUCT TOOL (ALL SCENARIOS)

Baseline 2030 2050 2080



Source: WRI Aqueduct tool

3.9 WILDFIRES

For the wildfire hazard, ERM's CIP and Think Hazard were utilized for this project. ERM's CIP tool indicated a low risk level for all of the time frames. This was determined based on the number of days with fire-permitting climatic conditions, which was zero for all climate change scenarios and time frames. Think Hazard also indicated a very low risk level, shown in Figure 3-15, and suggested that climate change impacts are hard to determine. This is due to model projections being inconsistent in their estimates of changes in rainfall. There may be a chance of increasing probability if the projected future rainfall is low; however, for these areas, as evidenced by rainfall-induced landslides, rainfall is not expected to decrease. From this, and the CIP results, it was determined that the probability of wildfires would remain very low for all time frames.

FIGURE 3-15 WILDFIRES HAZARD MAP – THINK HAZARD

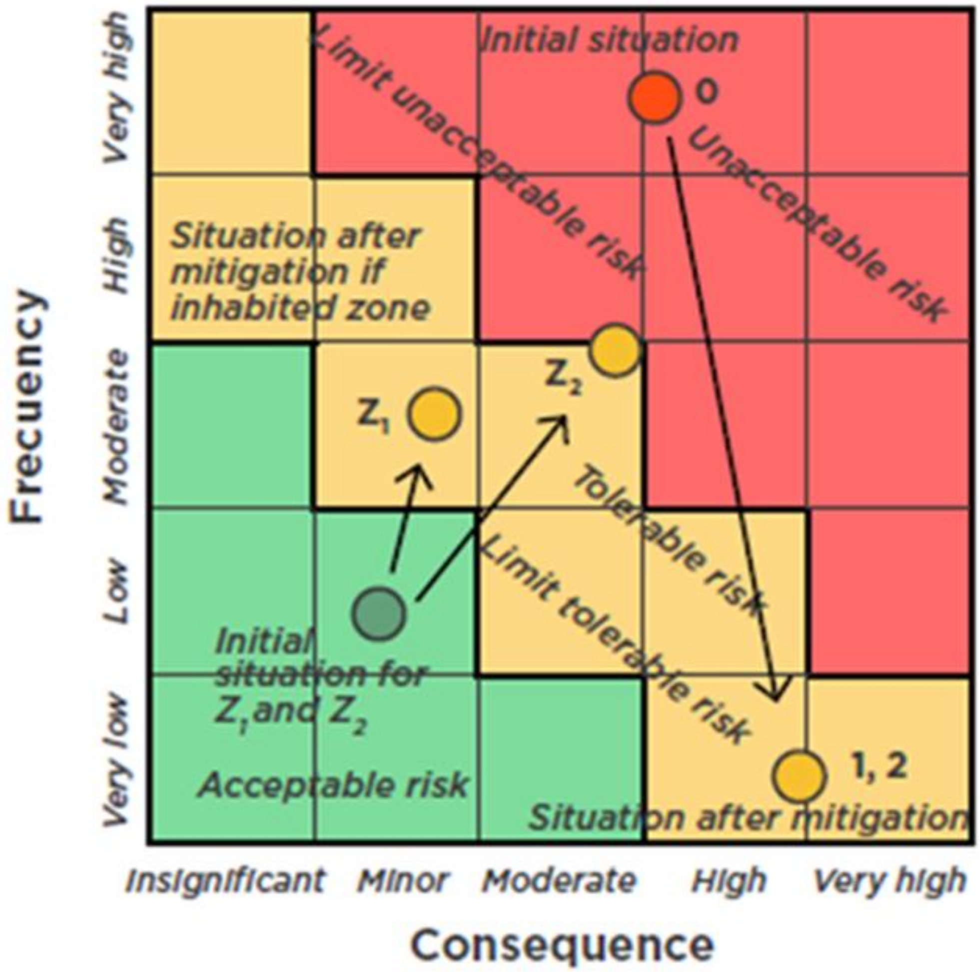
Source: Think Hazard: Dominica

4. DISASTER RISK PROFILES

Disaster risk profiles were developed based on two key components: frequency and consequence. The frequency component focuses on the hazard itself: the level of threat posed by that hazard in general and the probability of the hazard occurring. This examines the potential impact of the hazard in the project – not necessarily directly to the project. These values were based on what was determined during the hazard screening and are documented in Section 3. To look at the aspect where the project is examined, the consequence is considered. This component includes the exposure of the project to the hazard and the vulnerability of the project to the hazard. Combining both components establishes a risk value for that hazard pertaining directly to the project.

The risk values themselves are based on a 5x5 matrix that is divided into three risk levels: low, moderate, and high. An example of a risk matrix is shown in Figure 4-1. For this study, the matrices were developed for four different time frames: baseline, 2030, 2050, and 2080. This allowed for the inclusion of a risk analysis based on the projected future hazard risks.

FIGURE 4-1 EXAMPLE FREQUENCY VS CONSEQUENCE RISK MATRIX



Source: IDB, 2019

The risk analysis is for the various assets and asset components (if applicable). It is first completed not considering any mitigation measures the project may have planned or already incorporated into the facility. This allows for the development of a general understanding of what the worst-case risks for each hazard are. Once the mitigation measures both known and planned are considered, these risk values are then reevaluated, reducing the consequences of the hazards where applicable. With the reduction of the hazard consequences, the risks will also reduce. Depending on the reevaluation of risk with the mitigation measures considered, if some hazard risks are still within the moderate or high-risk zones, recommendations of disaster risk management measures will be made. This will provide examples of what other mitigation measures could be incorporated to bolster the current plans to ensure the proposed risks are reduced.

4.1 ASSETS AND ASSET COMPONENTS OF THE PROJECT

The project footprint includes six main assets:

- Plant

- Facilities
- Pipelines
- Injection Well
- Production Wells, and
- Access Road

Of the six assets, two have other components that need to be considered. These are the plant and the facilities. The plant includes:

- Turbine Generator
- Heat Exchangers
- Recuperators
- Condensers
- Pumps (feed, wells, ponds, firefighting system)
- Storage Tanks
- Transformers
- Emergency Generator
- Water Tank and Distribution System
- Firefighting Tank and System
- HVAC System
- Oil System
- Substation

The facilities include:

- Security Building and Parking
- Brine Ponds
- Electrical/Control Building
- Septic Tank and Leach Field
- Machine Shop
- Warehouse

Each asset and asset component will be assessed during the hazard risk assessment.

4.2 GENERAL RISK ASSESSMENT

As the general risk assessment did not consider any mitigation measures that the project may have (or have planned), the risk matrices were identical for all assets and asset components. There was some slight variation when analyzing the different time frames. Figure 4-2 shows the general risks based on each time frame while Figure 4-3 through Figure 4-5 shows the general risks based on each hazard considered. For all time frames, three of the hazards (extreme cold, drought/water scarcity, and wildfires) are low risk. The flooding hazard is a moderate risk for the baseline time frame but then moves to a low risk for all other time frames. In all time frames, landslide, earthquake, and volcanic hazards are ranked at a moderate risk. Extreme heat is first ranked at a moderate risk in the baseline but then moves into a high risk for all other time frames. The hurricane hazard is ranked as a high risk for all the time frames.

FIGURE 4-2 GENERAL RISK MATRIX FOR PROJECT – TIME FRAME BASED

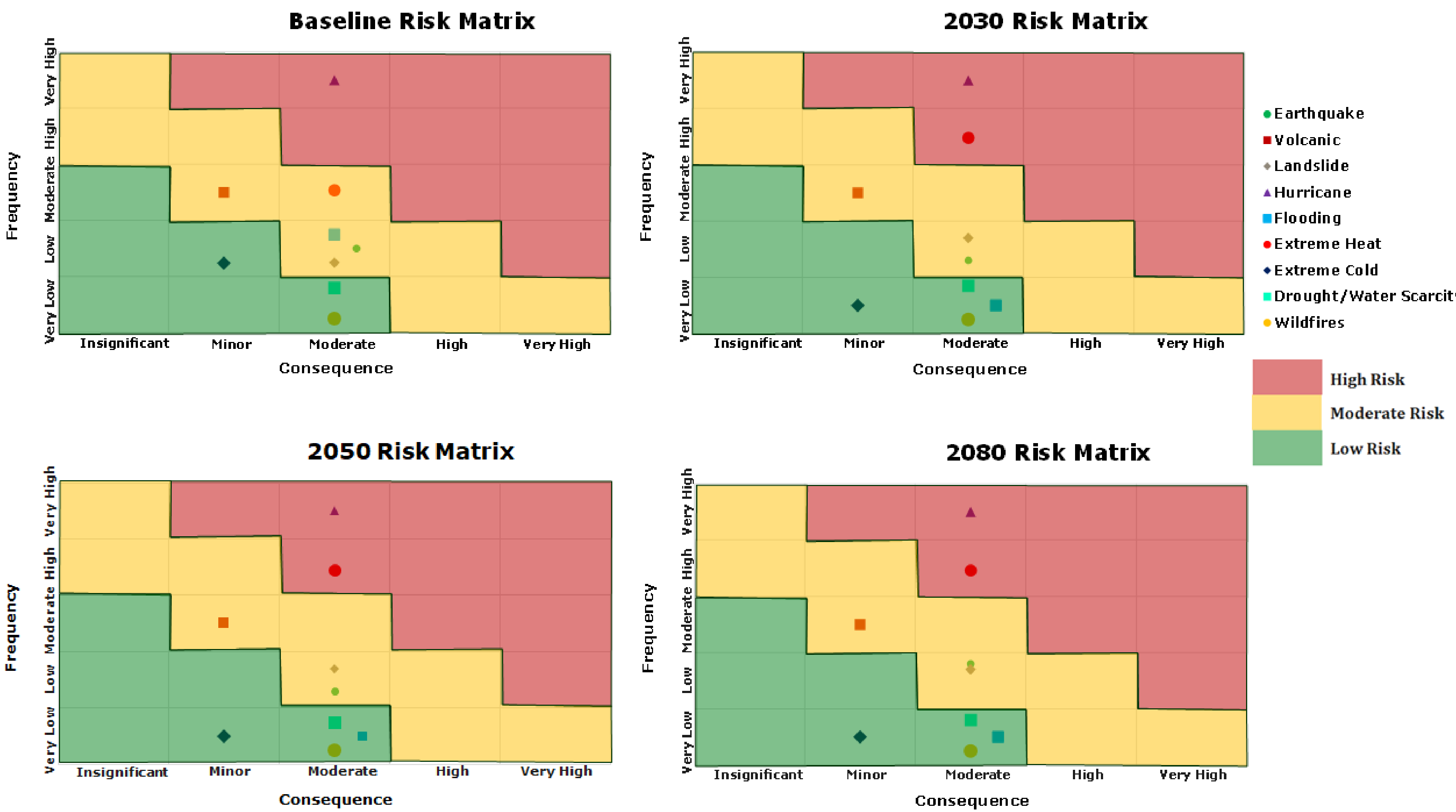


FIGURE 4-3 GENERAL RISK MATRIX FOR PROJECT WITHOUT MITIGATION MEASURES – HAZARD BASED: EARTHQUAKE, VOLCANIC, LANDSLIDE, AND HURRICANE HAZARDS

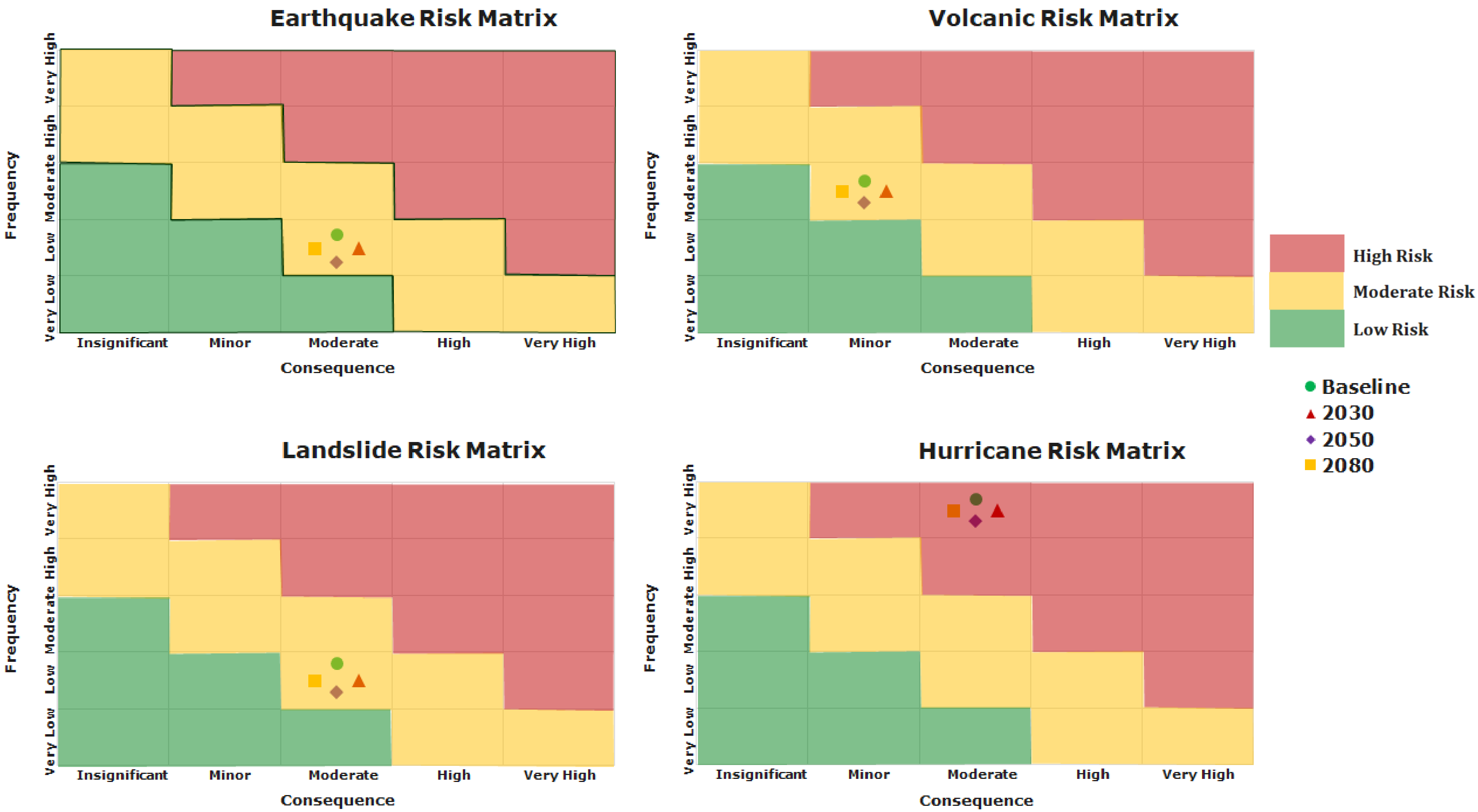


FIGURE 4-4 GENERAL RISK MATRIX FOR PROJECT WITHOUT MITIGATION MEASURES – HAZARD BASED: FLOODING, EXTREME HEAT, EXTREME COLD, AND DROUGHT/WATER SCARCITY HAZARDS

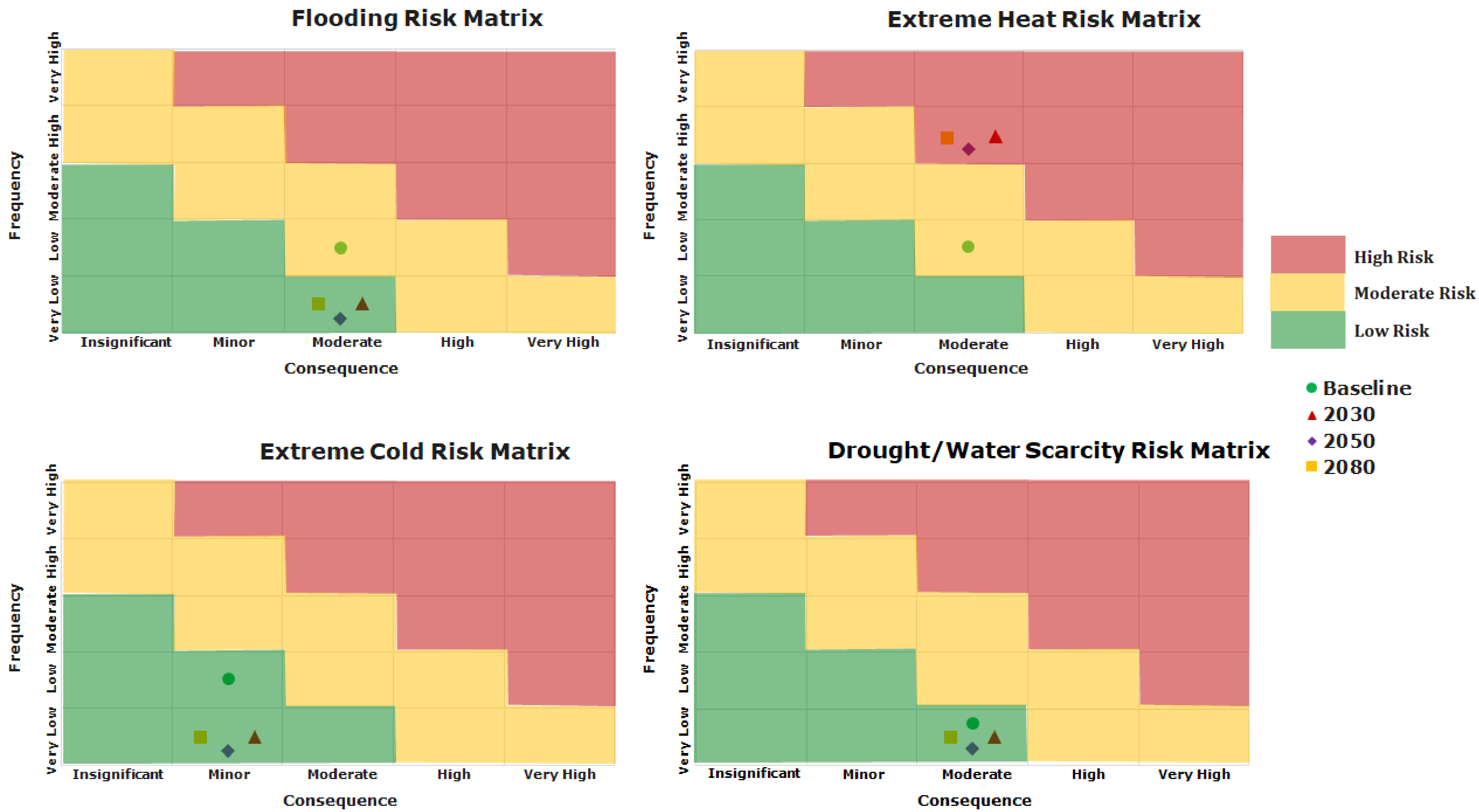
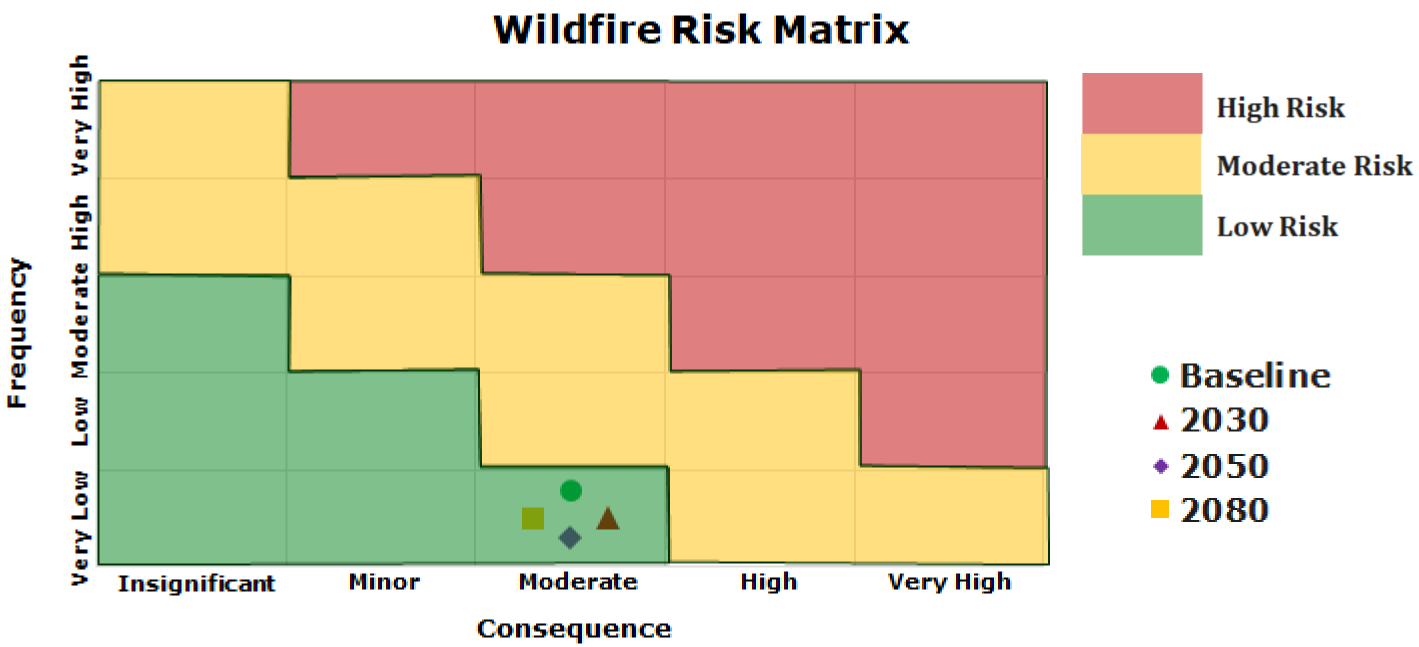


FIGURE 4-5 GENERAL RISK MATRIX FOR PROJECT WITHOUT MITIGATION MEASURES – HAZARD BASED: WILDFIRE HAZARD



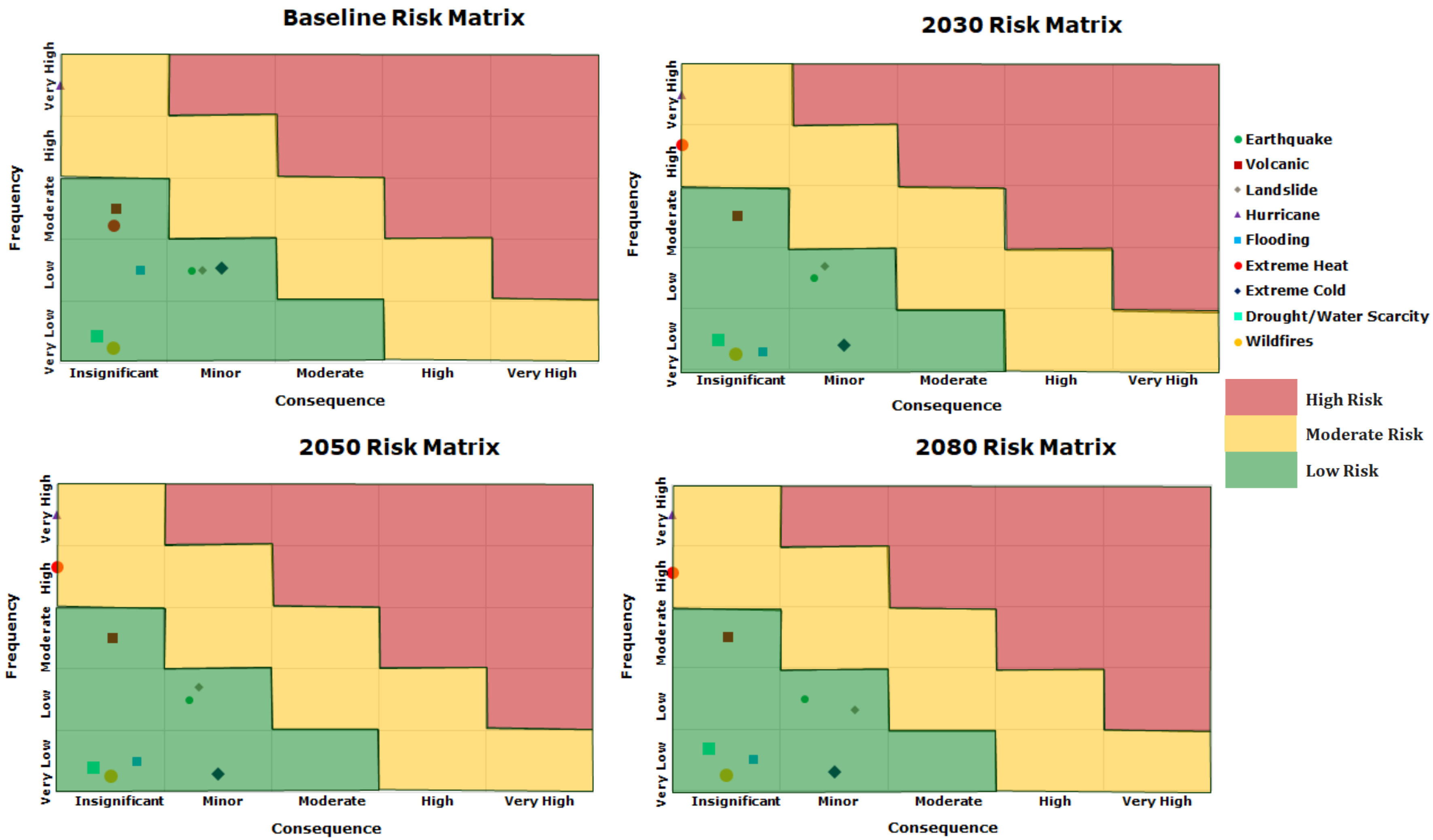
4.3 REEVALUATED RISK ASSESSMENT FOR WORST-CASE ASSET/ASSET COMPONENTS

The risk assessment detailed in Section 4.2 was modified after consideration of the mitigation measures that are planned or already in place for the project. These mitigation measures consisted of structural and non-structural measures, ranging from the addition of sheds for key asset components to the implementation of Environmental and Safety Management Plans (ESMPs). Each asset and asset component were assessed for the risks posed by the hazards that ranked from moderate risk to high risk, at any time frame, during the general risk assessment. These hazards were:

- Earthquake
- Volcanic
- Landslide
- Hurricane
- Flooding, and
- Extreme Heat

Each asset and asset component (if applicable) was assessed for all types of mitigation measures that could be applied. This included an analysis of the various ESMPs and consultation with the design team for consideration of the structural measures. Details of all the applicable mitigation measures are detailed in Section 4.4. By including a consideration of the measure, the risks for the different hazards for the various assets were reduced. To examine the results of the reassessment, the entire project was evaluated to keep the analysis similar to the general risk assessment found in Section 4.2. For each time frame the maximum frequency and consequence for each hazard were extracted and are shown in Figure 4-6. It is key to note that the maximum frequency and maximum consequence might not occur for the same asset or asset component combination. From these matrices, the hurricane hazard shows a very high maximum frequency, but the maximum consequence is noted to be minor. Extreme heat also gets to a very high maximum frequency, but it has a maximum consequence of insignificant. The volcanic hazard has a maximum frequency of moderate and the maximum consequence is minor.

FIGURE 4-6 MAXIMUM FREQUENCY AND CONSEQUENCE MATRIX FOR THE PROJECT, INCLUDING MITIGATION MEASURES, SHOWN ACROSS TIME FRAMES OF BASELINE, 2030, 2050, AND 2080



After considering the project, individual components and frequency/consequence combinations were assessed. With the reduction, the assets and asset components with the highest risks are listed in Table 4.1. The updated risk matrices for all the assets are shown in Figure 4-7, Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-11 for injection/production wells, pipelines, access road, plant, and facility assets, respectively. Since both well assets (injection and production) have similar mitigation measures, the hazard risks are identified as identical. Once the mitigation measures were considered, only the hurricane hazard risk remained within the moderate risk zone. While the frequency of the hurricane hazard remains high, the exposure of the asset to the hazards is essentially zero after considering the mitigation measures for all the assets. Due to this, the hurricane hazard for all the assets will not be considered as a moderate risk. It is key to note that while the extreme heat hazard for 2030-, 2050-, and 2080 time frames remain in the moderate risk zone as well, the design of the project assets included an extreme ambient heat consideration; thus, making the consequence of extreme heat insignificant. Based on the discussion with ORMAT during the FMEA workshop, various elements within the assets will be designed to withstand the geothermal temperature of 120F and hence consequence of extreme heat will be insignificant.

TABLE 4.1 MODERATE AND HIGH-RISK HAZARDS FOR VARIOUS ASSETS AFTER MITIGATION MEASURES CONSIDERATION

Asset	Asset Component	Hazard	Risk
Injection Well	N/A	Hurricane, Extreme Heat	Moderate
Production Wells	N/A	Hurricane, Extreme Heat	Moderate
Pipeline	N/A	Hurricane, Extreme Heat	Moderate
Access Road	N/A	Hurricane, Extreme Heat	Moderate
Plant	All components combined	Hurricane, Extreme Heat	Moderate
Facility	All components combined	Hurricane, Extreme Heat	Moderate

FIGURE 4-7 INJECTION WELL/PRODUCTION WELLS UPDATED RISK MATRIX

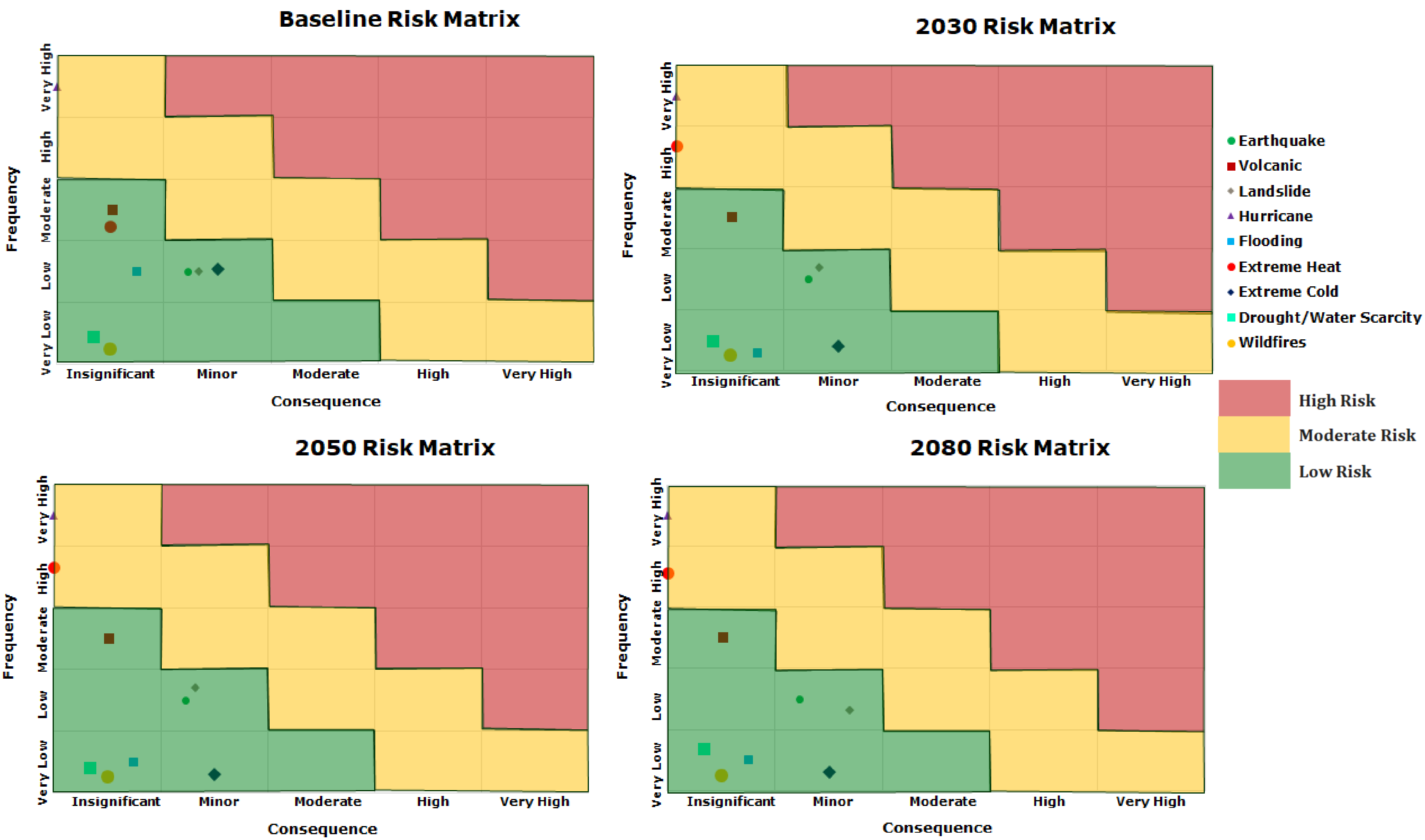


FIGURE 4-8 PIPELINE UPDATED RISK MATRIX

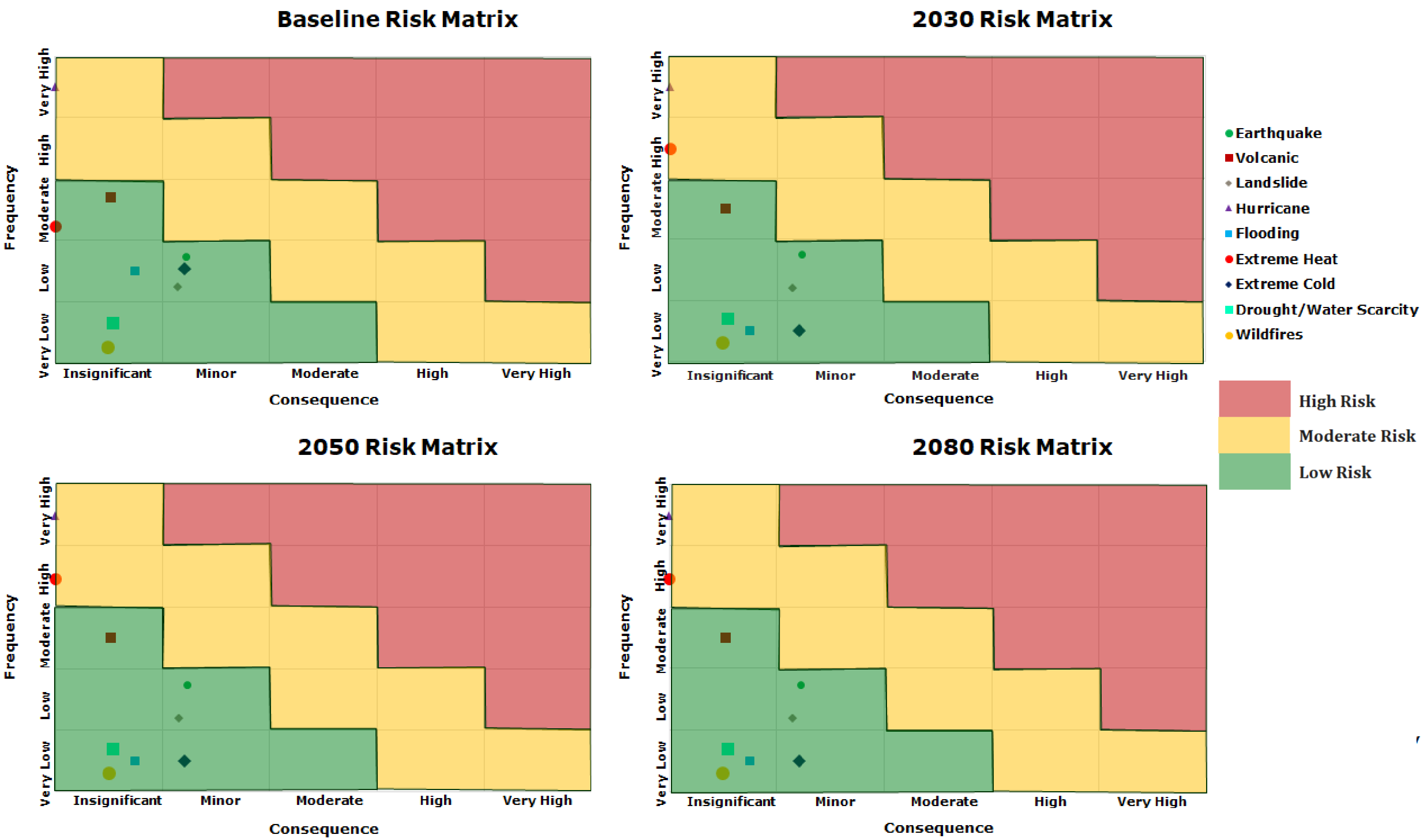


FIGURE 4-9 ACCESS ROAD UPDATED RISK MATRIX

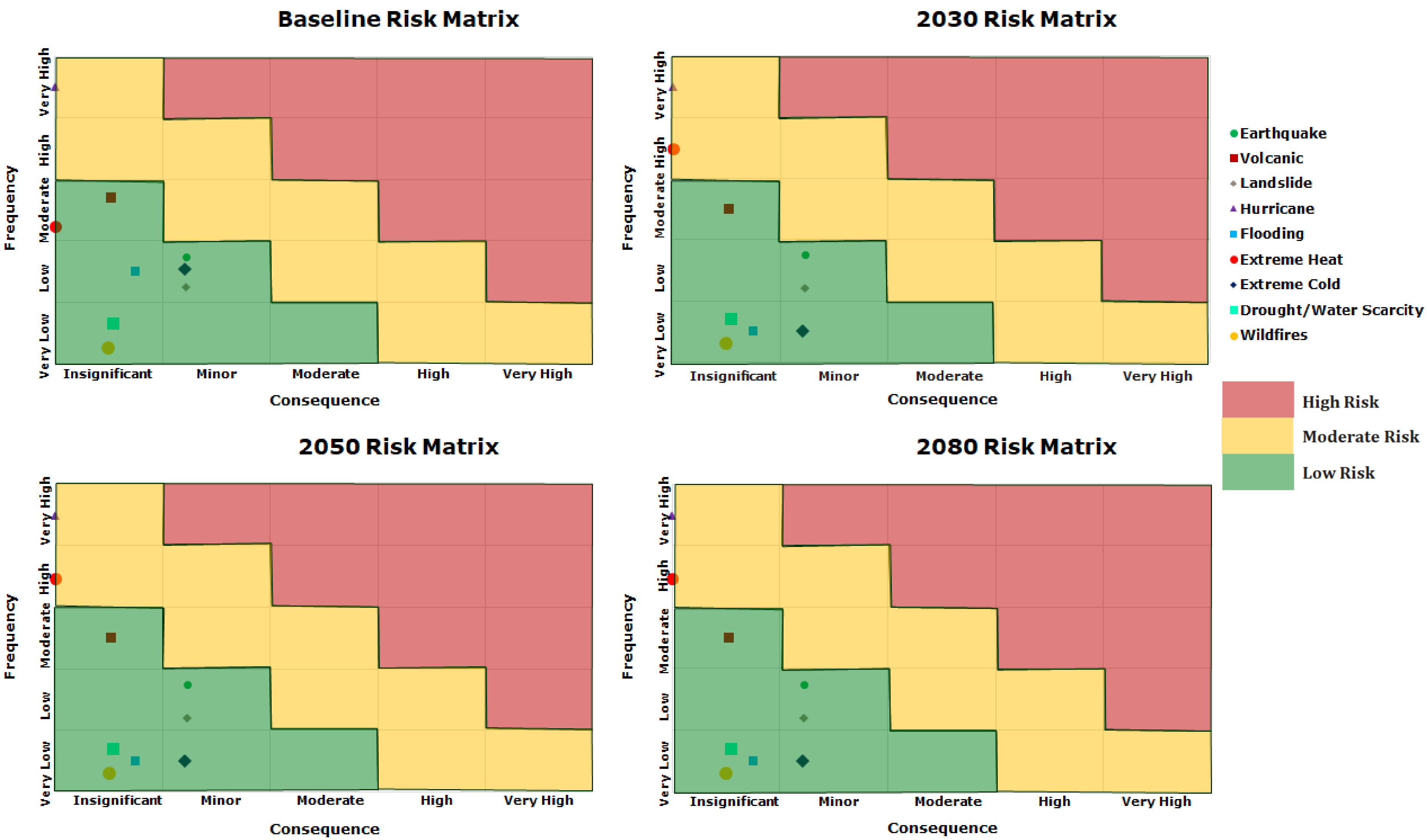


FIGURE 4-10 POWER PLANT UPDATED RISK MATRIX

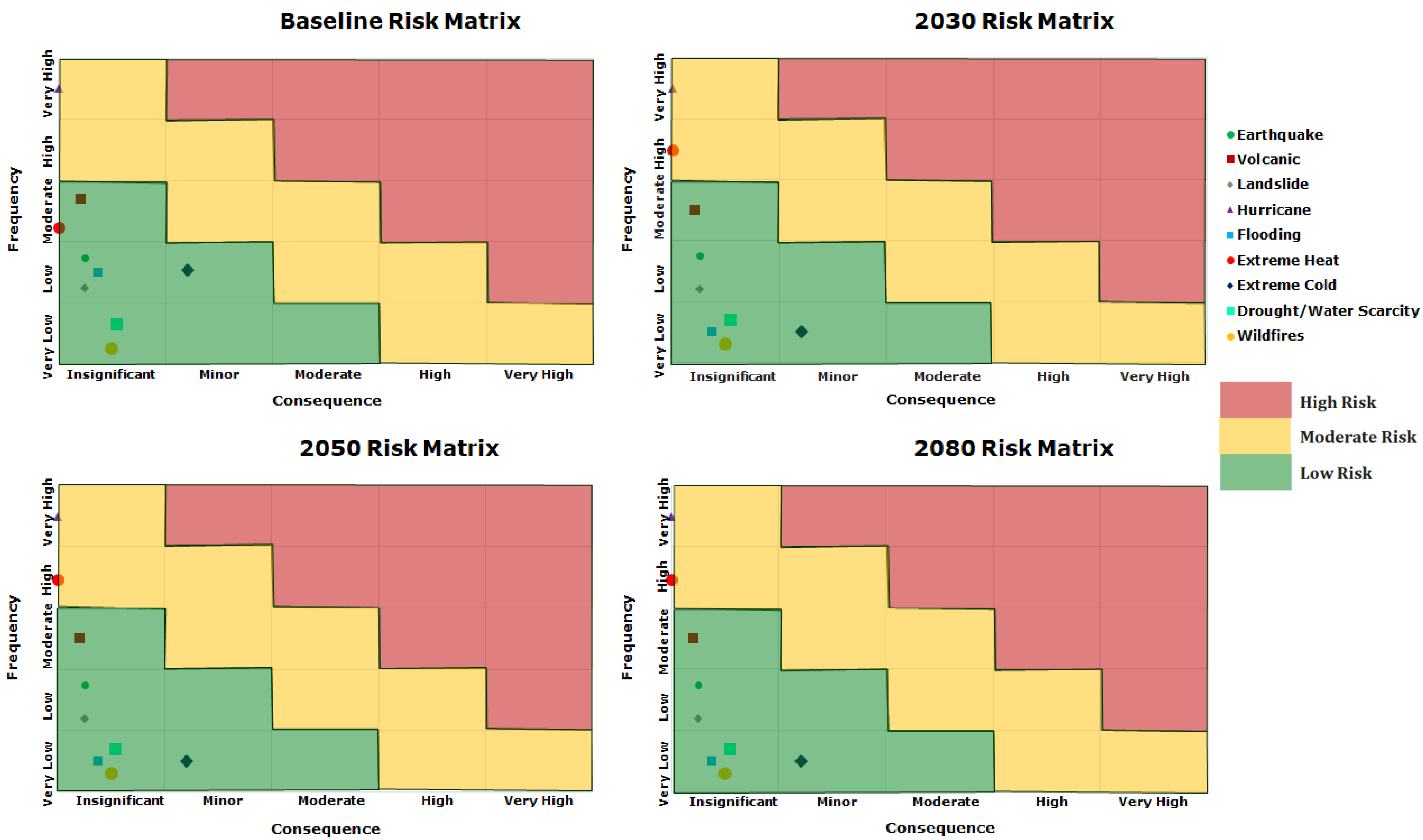
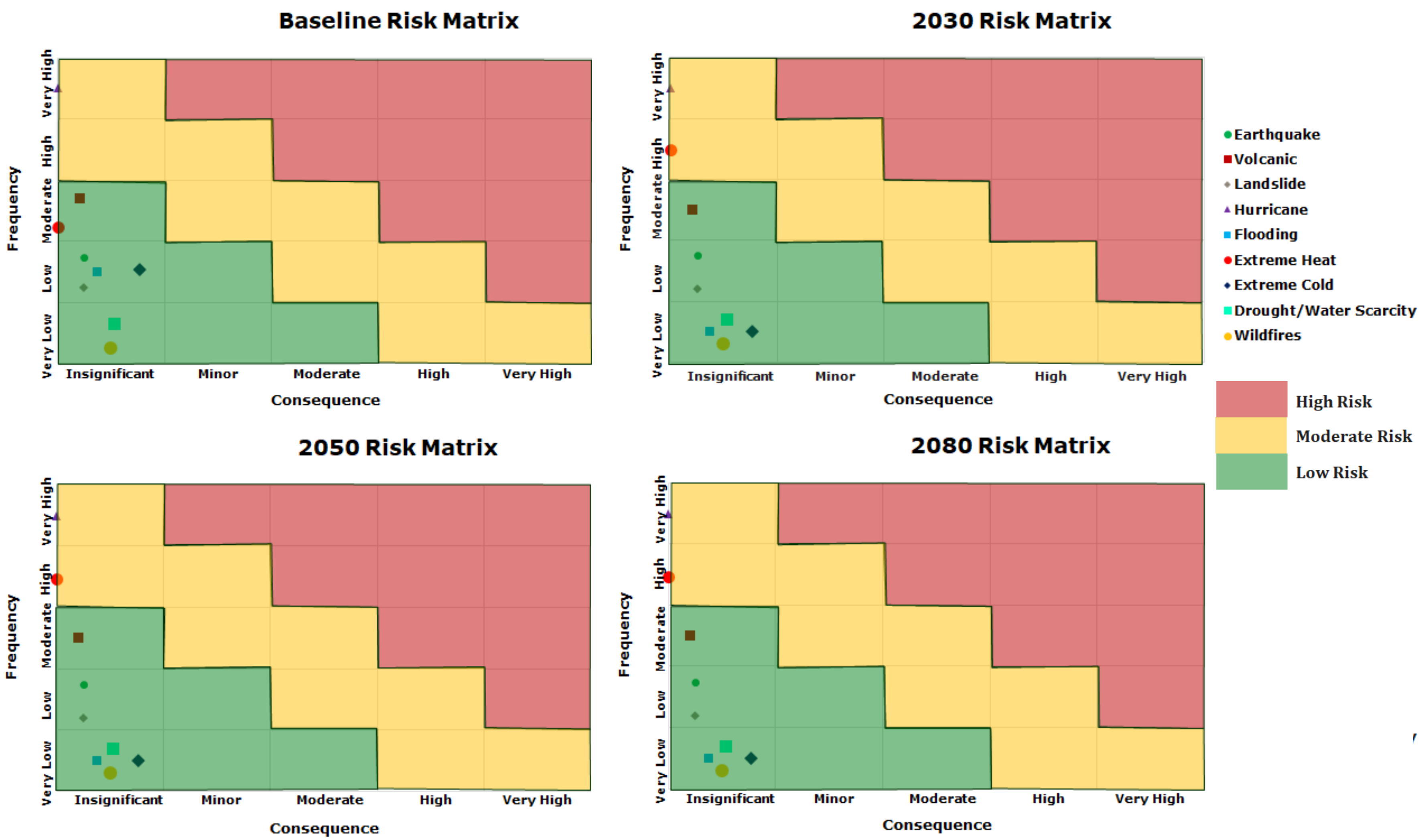


FIGURE 4-11 FACILITIES UPDATED RISK MATRIX



4.3.1 FAILURE MODE AND EFFECT ANALYSIS WORKSHOP

FMEA workshop is normally triggered if the existing measures and DRMPs are not sufficient. ESIA documents of 2018 and 2021 provided many ESMPs and recommended various sensor controls and design standards to mitigate any risk associated with natural hazards. ORMAT and ERM held a Failure Mode and Effect Analysis (FMEA) workshop (virtually via MS Teams) on July 30th and August 1st, 2024.

The workshop followed a systematic analysis method to identify potential failure modes of systems, components, and/or assemblies and determine if the Project's existing adaptive capacity is sufficient to face the potential hazards related to natural disasters and climate change. The FMEA workshop considered all the Project's assets and asset components. The workshop included the input of ORMAT's design & engineering team on how to mitigate the risk of potential failures to an acceptable level and to provide a (disaster) risk assessment of the process's impact on the environment.

The analysis was completed by filling out a specifically formatted table (example shown in Figure 4-12 and Figure 4-13) while consulting design team members. The main components of the failures considered were the:

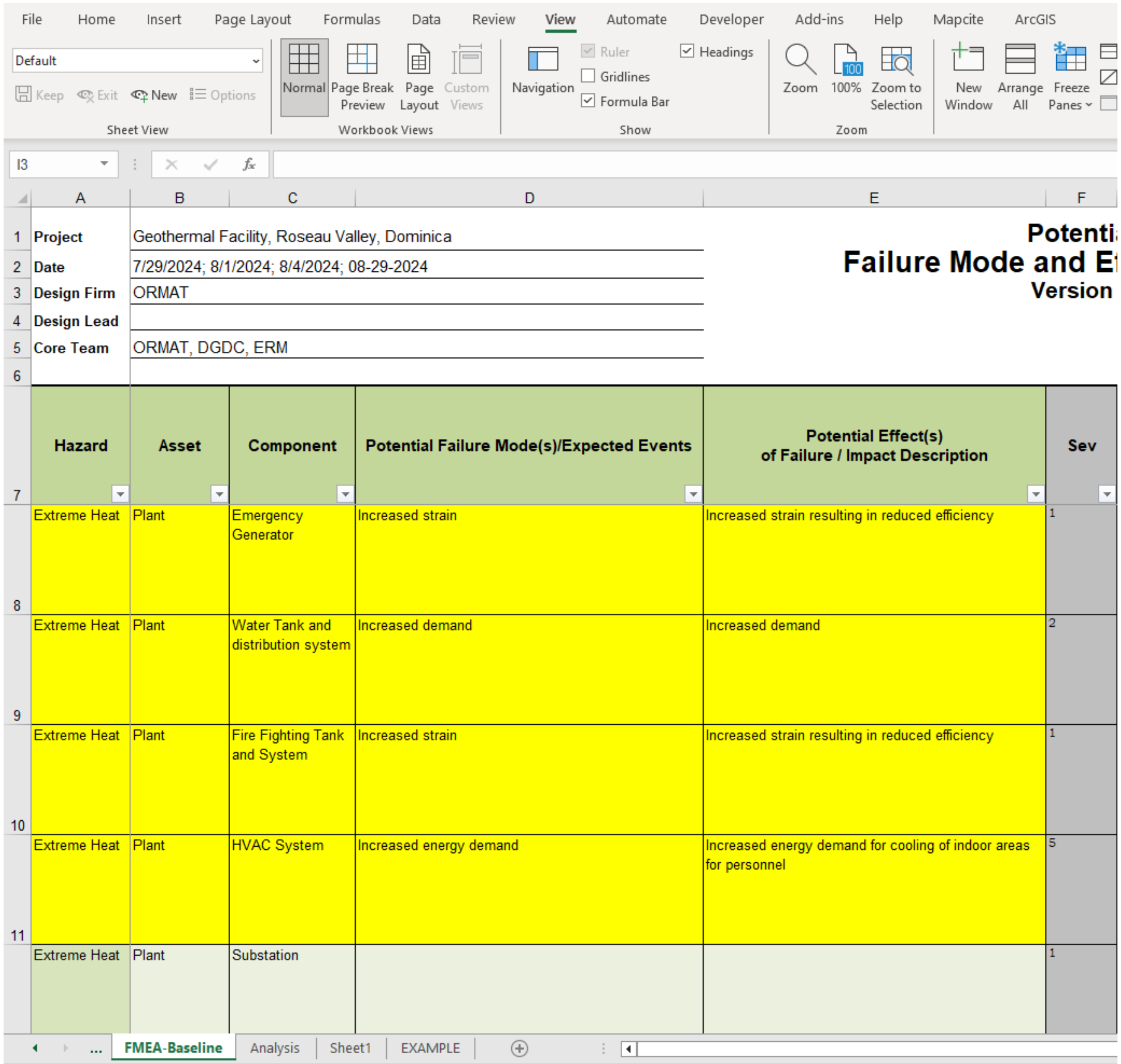
1. Severity
2. Likelihood
3. Detectability

For each of the Project's components, a numerical value is assigned for each failure. These values are based on a range for each of the components which are defined as follows:

- Severity defines the impact on the system of the failure. This can range from None (no effect; value of 1) to Hazardous without warning (value of 10).
- Likelihood is the probability of each failure. This ranges from Remote (failure is unlikely; value of 1) to Very High (failure is almost inevitable; a value of 10).
- Detection is the likelihood of failure detection by design controls. This ranges from Almost Certain (value of 1) detection to Absolute Uncertainty (value of 10) detection.

These three values are then multiplied together to determine a Risk Priority Number (RPN) for each failure type. These RPN values will allow for the development of a matrix depicting the failure probability vs consequences for the various hazards and Project components.

FIGURE 4-12 EXAMPLE OF THE FMEA WORKSHOP SPREADSHEET (FULL DOCUMENT INCLUDED IN APPENDIX C)

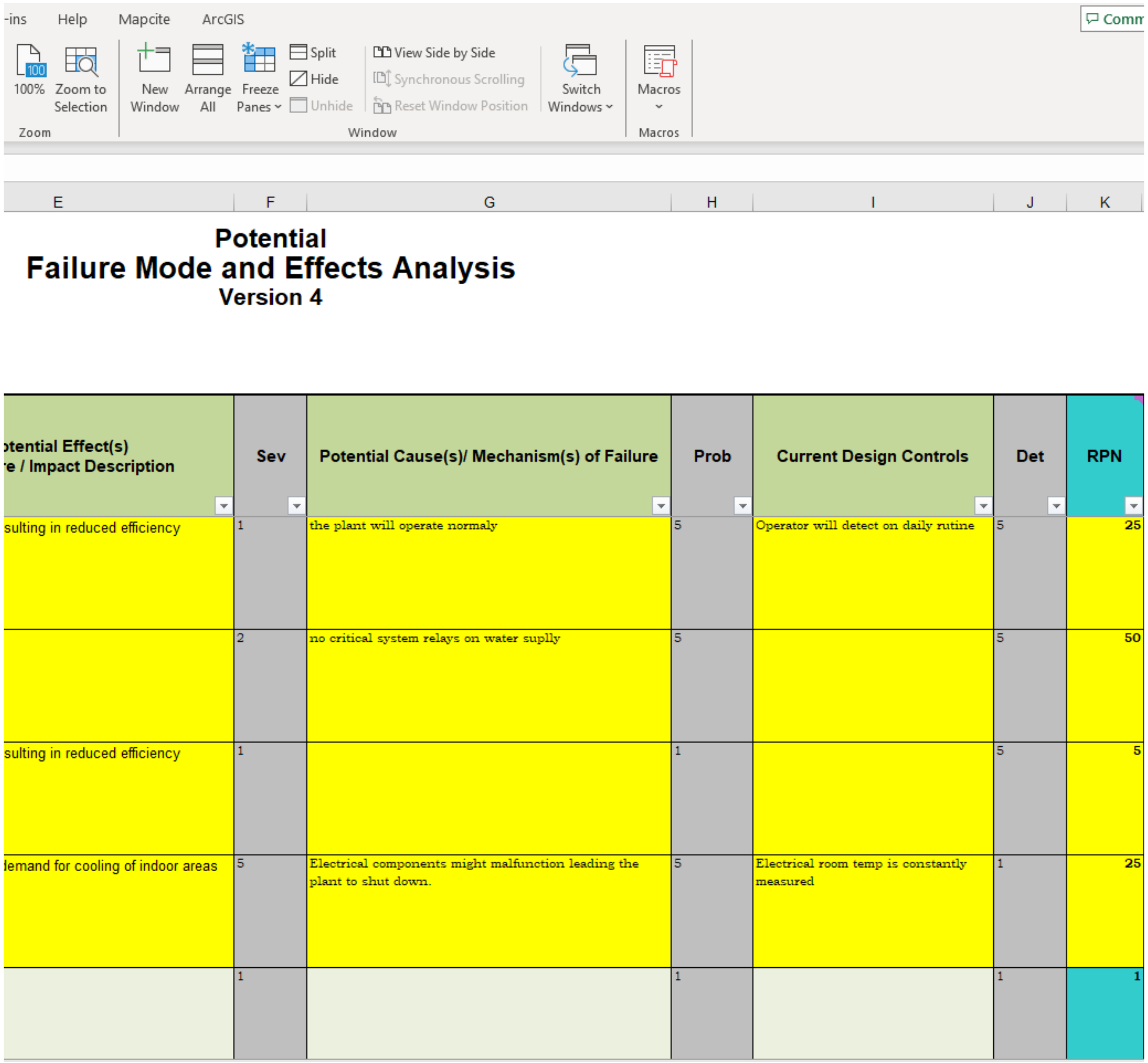


Project	Geothermal Facility, Roseau Valley, Dominica
Date	7/29/2024; 8/1/2024; 8/4/2024; 08-29-2024
Design Firm	ORMAT
Design Lead	
Core Team	ORMAT, DGDC, ERM

Potenti
Failure Mode and E
Version

Hazard	Asset	Component	Potential Failure Mode(s)/Expected Events	Potential Effect(s) of Failure / Impact Description	Sev
Extreme Heat	Plant	Emergency Generator	Increased strain	Increased strain resulting in reduced efficiency	1
Extreme Heat	Plant	Water Tank and distribution system	Increased demand	Increased demand	2
Extreme Heat	Plant	Fire Fighting Tank and System	Increased strain	Increased strain resulting in reduced efficiency	1
Extreme Heat	Plant	HVAC System	Increased energy demand	Increased energy demand for cooling of indoor areas for personnel	5
Extreme Heat	Plant	Substation			1

FIGURE 4-13 EXAMPLE OF THE FMEA WORKSHOP SPREADSHEET (FULL DOCUMENT INCLUDED IN APPENDIX C)



Potential
Failure Mode and Effects Analysis
Version 4

otential Effect(s) e / Impact Description	Sev	Potential Cause(s)/ Mechanism(s) of Failure	Prob	Current Design Controls	Det	RPN
sulting in reduced efficiency	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25
	2	no critical system relays on water suplly	5		5	50
sulting in reduced efficiency	1		1		5	5
lemand for cooling of indoor areas	5	Electrical components might malfunction leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25
	1		1		1	1

Workshop attendees were Venkat Kolluru and Brooke Frazier from ERM and Nir Akirav, Yonatan Valinsky, Avi Navon, Idan Peled, and Amir Junger from ORMAT. The workshop lasted approximately four hours each day and was recorded.

During the workshop, ERM presented a summary of the general hazard risk assessment, focusing on the moderate and high-risk hazards to set the framework for the FMEA process. Then the attendees collaborated to fill out the FMEA spreadsheet. We discussed worst-case scenarios that could happen during each of the noted hazards for each of the Project's components. The discussion addressed the potential failure, the cause of failure, and the ability to detect the failures. While the spreadsheet was not filled out to completion by the end of the second workshop session, enough knowledge about the process, along with the recordings, was provided to the ORMAT team to finalize the FMEA worksheet. To the date of this report, ERM received some information on design specifications related to hazards – the information received is reflected in this report. ERM shared the extreme windspeed values due to climate change for the years 2030, 2050, and 2080.

The data provided in the finalized spreadsheet from the FMEA was post-processed to develop failure probabilities vs consequences matrices for the selected hazards (Figure 4-14 through Figure 4-16). The considered hazards included hurricanes, extreme heat, landslides, volcanoes, earthquakes, and flooding hazards. To examine the results, failure probabilities and consequence values were developed for each main asset of the project. These were determined by taking the maximum values for the failure probability and the consequence. Overall, the assets with the highest failure probability and consequence of any hazards were the plant and the facilities. For all the considered hazards, the maximum failure probability for the plant and facilities was "likely to occur during lifetime". The consequences for all the hazards except flooding were considered as small repairs or maintenance actions needed. For flooding, both the plant and facility had higher consequences, falling under major rehabilitation needed. The results of this analysis influenced the risk reassessment and the development of the DRMPs.

FIGURE 4-14 FAILURE PROBABILITY AND CONSEQUENCE MATRICES FOR SELECT HAZARDS: EARTHQUAKE AND HURRICANE HAZARDS

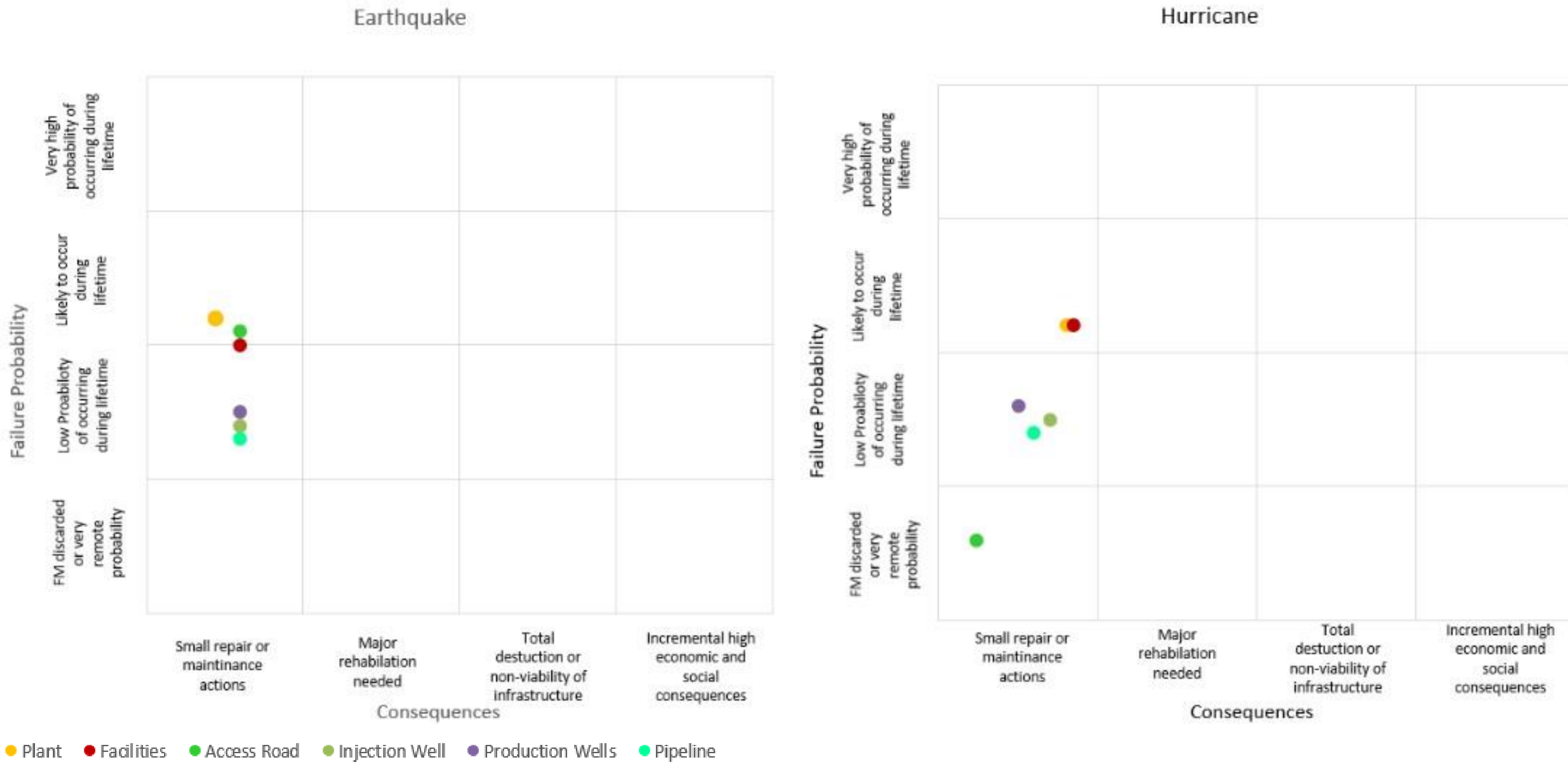


FIGURE 4-15 FAILURE PROBABILITY AND CONSEQUENCE MATRICES FOR SELECT HAZARDS: EXTREME HEAT AND FLOODING HAZARDS

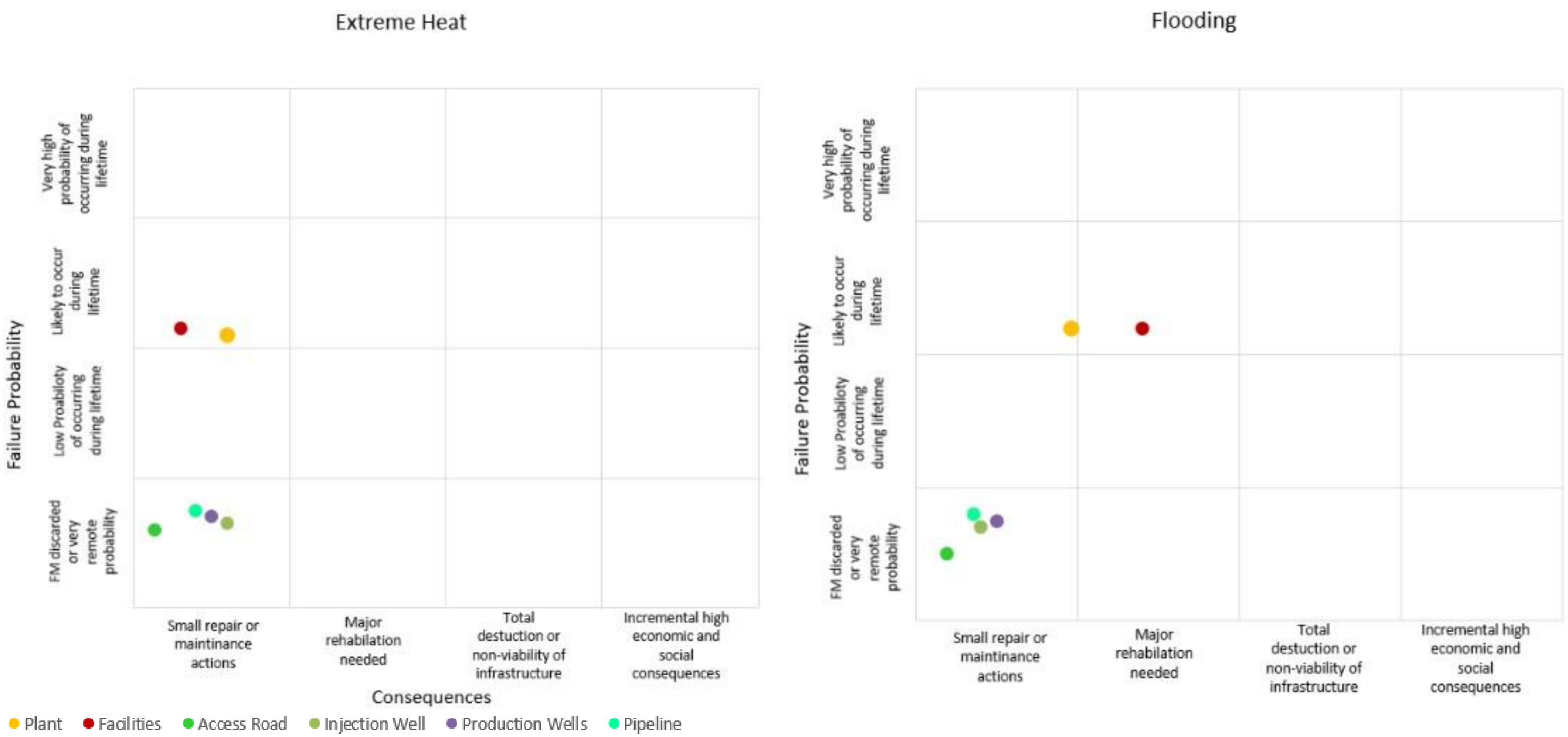
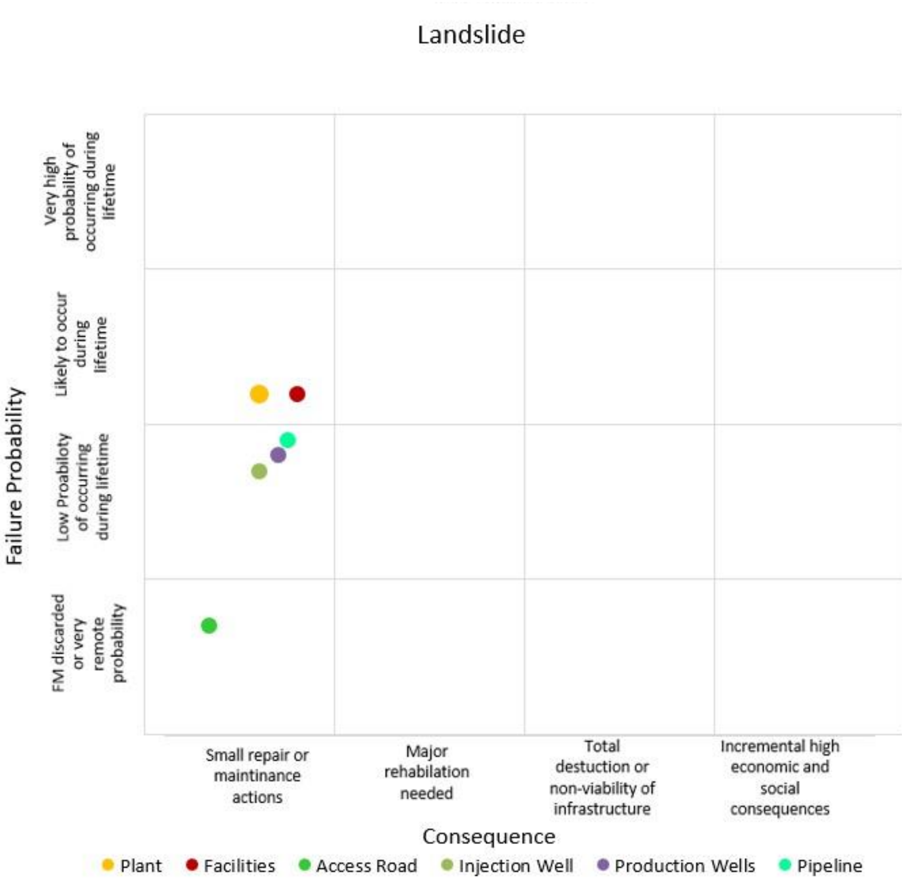
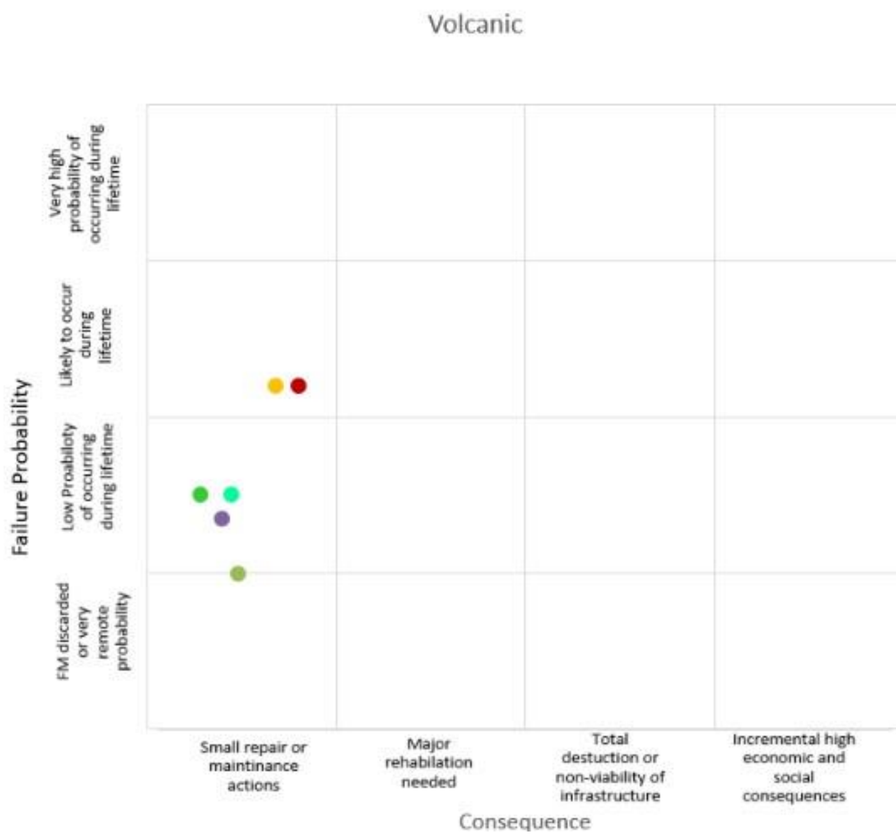


FIGURE 4-16 FAILURE PROBABILITY AND CONSEQUENCE MATRICES FOR SELECT HAZARDS: LANDSLIDE AND VOLCANIC HAZARDS





4.4 SUMMARY OF DGDC'S DISASTER RISK AND EMERGENCY MANAGEMENT (DREM) PLAN – 2021 (PRE-CONSTRUCTION)

DGDC's Disaster Risk and Emergency Management Plan, dated December 2021, focuses on the pre-construction phase. The plan can be accessed at the following link:

https://www.geodominica.dm/publications222/

The DREM Plan covers the geothermal power project sites, which include associated steam fields and reinjection lines:

- WW-P1 and WW-03 are the production wells;
- RV-I2 will be the reinjection well, and
- the areas that will be used for routing the pipelines.

DGDC's analysis concludes that the Risk Level of all the types of hazards for all the assets reviewed (hurricane cat. 5+, earthquake magnitude 5.0, volcanic activity, landslide, flood) is Low during the pre-construction phase.

The DREM establishes the following disaster prevention and mitigation measures (excerpted and summarized):

- Measures to prevent the occurrence of worst-case scenarios
    - Ensure regular visual surveys to detect any problem or any weakness on the wellhead.
    - Regular maintenance of wellheads.
    - Monitoring of surface manifestations in the Wotten Waven area to detect precursory signs of phreatic explosion (specific to well WW-01).
    - Have a stock of spare parts for the main components of the wellhead (for instance, main valves, and side valves) to be able to replace defective (or broken) components.
    - Mainstream disaster risk thinking into the design and the location of future equipment to reduce the likelihood and/or the impact of natural hazards.
    - Ensure seasonal hazard forecasts and scenario planning to anticipate the occurrence of hurricanes and heavy rains which are the main trigger for landslides, rock falls, and floods.
- Measures to manage emergency and crisis situations
    - Prepare procedures of technical intervention in case of emergency (emergency response plan).
    - Have in Dominica equipment and products for controlling fluid discharge at the wellhead (for example pump, barite, water reserve nearby).
    - Prepare a list of local contractors likely to be mobilized in case of emergency (for instance: welding, piping, pumping, crane, diesel supply, civil work).

    - Prepare a list of foreign experts on geothermal wells who can be requested in case of emergency to provide help.
- Measures to build capacities of the DGDC personnel
    - Training with international consultants to learn, develop, and practice emergency response plans (in Dominica or a foreign country).
    - Regular checking and updating of the emergency response plan, the stock of spare parts, the list of contractors and experts, of the equipment for controlling discharge at the wellhead.
- Measures regarding revision of the DREM Plan
    - Expand the focus of the DREM Plan during its next iteration to go beyond natural hazards and to consider cascading effects including those on the environment and the nearby communities.
    - If considered feasible, organize monitoring of seismic activities at locations in and around the project area and discuss findings with the UWI-SRC on a need basis.
    - Recalibrate the impact criteria and indicators for the construction and operational phases.
- Monitoring of the DREM Plan Realization.

5. DISASTER MANAGEMENT MEASURES

Among the nine initial hazards evaluated for this project, only two—hurricanes and extreme heat—remain classified at a moderate risk level after implementing or planning the necessary mitigation measures. Importantly, while both hazards are categorized as moderate, they present minimal consequences (cf. Figures 4.14 and 4.15).

The hurricane hazard, while significant, is being addressed through comprehensive design and preparedness strategies, ensuring that any residual risk is effectively minimized. Likewise, the extreme heat hazard, though still classified as moderate, is being accounted for in the well designs, which incorporate considerations for extreme ambient temperatures.

While extreme heat may not pose a direct threat to the plant's operations, it remains a significant concern for the safety and well-being of personnel. To address this, the Environmental and Social Management Plans (ESMPs) include a robust Occupational Safety Plan specifically designed to protect staff in the event of extreme heat conditions. This plan underscores the project’s commitment to ensuring the safety of all personnel, even under challenging environmental conditions.

Throughout the FMEA workshop, various mitigation measures recommended in the 2018 and 2021 Environmental and Social Impact Assessment (ESIA) reports, as well as the 2018 DGDC's Disaster Risk and Emergency Management Plan (DREMP), were thoroughly discussed. ORMAT confirmed that numerous mitigation strategies have already been integrated into the design and emergency response planning processes. However, the specific details regarding the design specifications, as well as any cost-benefit analyses, are still in progress.

The measures that ORMAT has reportedly implemented and/or committed to and that ERM supports include a range of critical interventions designed to enhance the resilience and safety of the project. These include:

- Land Stabilization and Outreach: Measures aimed at stabilizing the terrain to prevent landslides and erosion, coupled with community outreach to ensure community awareness.
    - During ERM's site visit, we discussed with ORMAT and DGDC the existence of the necessary geotechnical studies to support the design and construction methods to configure and stabilize slopes.
- Flood Mitigation: Engineering solutions and infrastructure designed to manage and reduce the risk of flooding, safeguarding the project and surrounding areas.
    - ORMAT developed stormwater management measures which are being implemented during the grading work. During ERM's site visit, we observed temporary ditches that collect offsite runoff and channel them into a single outfall. ORMAT is monitoring flow and water quality at the outfall.
    - Final design must account for anticipated precipitation levels, using a minimum of a 1 in 50 yrs criterion to manage the moderate risk identified.
- Design Standards: Implementation of stringent design standards that exceed baseline requirements to ensure the structural integrity of the project under extreme conditions. Specifically for the main hazards identified:
    - Hurricanes: Design parameters should conform to, at minimum, anticipated 2030 estimated speeds. ORMAT is designed to be 155 knots, indistinguishable from the estimate of 156 knots (see Table 3.2).
    - Ambient heat: ORMAT is designing the facilities and equipment to withstand 137 degrees Celsius, well above projections.
    - Earthquakes: ORMAT is designing equipment and facilities with G factors in the range of 0.1 to 0.29, which is appropriate for the moderate to very low level of risk in the project area (Silva et al. 2023).
- Use of Non-Combustible Materials: Selection of materials that minimize the risk of fire, enhancing safety and reducing potential damage.
    - ORMAT should be able to document the criteria used for the selection of materials.
- Shields Over Critical Structures: Installation of protective shields designed to guard essential infrastructure against the dual threats of volcanic debris and extreme hurricane wind speeds. These shields are engineered to deflect or absorb impacts from volcanic ash and larger debris, minimizing potential damage. Additionally, they are constructed to withstand high-velocity winds, ensuring that critical structures remain secure and operational during severe weather events.
    - ORMAT will determine whether shields are required during the final design and should be prepared to document the decision process.

- Sensors, Controls, and Monitors: Advanced technological systems provide real-time monitoring and control, enabling prompt responses to any emerging risks.

ERM recommends that ORMAT be prepared to document and demonstrate that the final design aligns with the recommendation in this report.

6. REFERENCES

Dominica Geothermal Development Company Limited (DGDC). 2021. Disaster Risk and Emergency Management (DREM) Plan. December 2021. Second Edition.

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APPENDIX A IDB'S SCREENING AND CLASSIFICATION TOOL MAPS

APPENDIX

BIODIVERSITY MAP

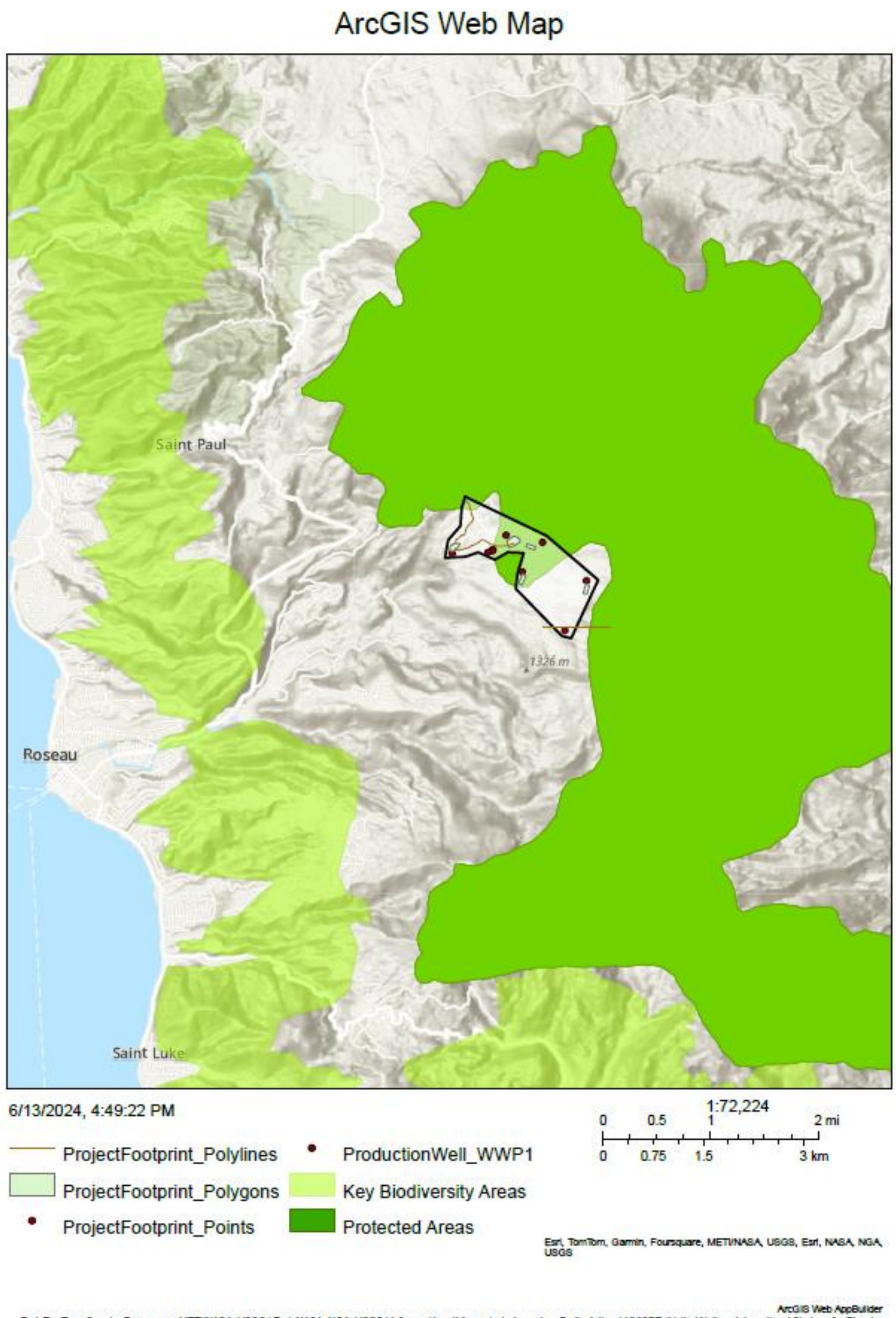
EARTHQUAKE HAZARD MAP

HURRICANE WIND HAZARD MAP

LANDSLIDE HAZARD MAP

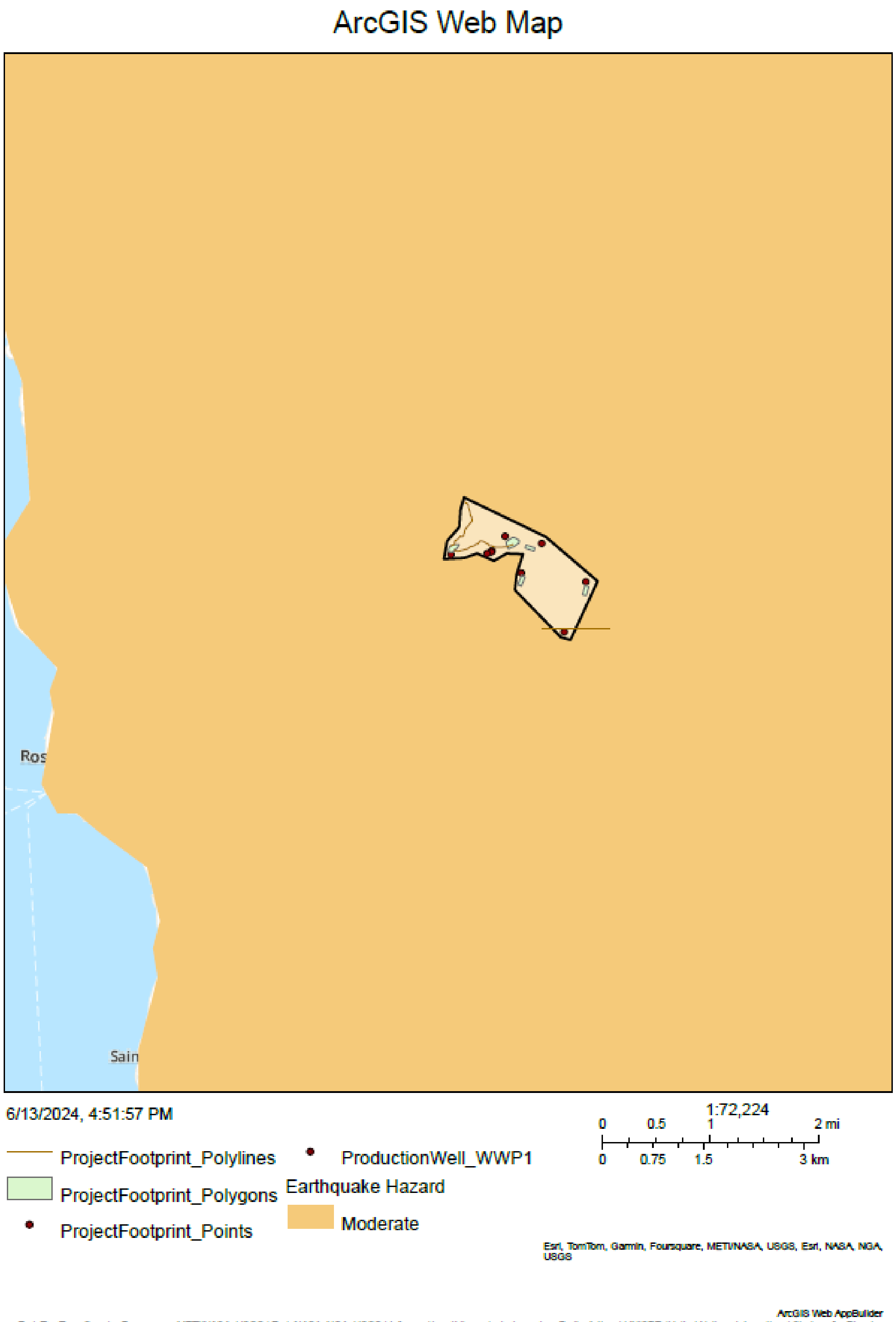
VOLCANIC HAZARD MAP

FIGURE 1 BIODIVERSITY MAP



Source: IDB screening and classification tool

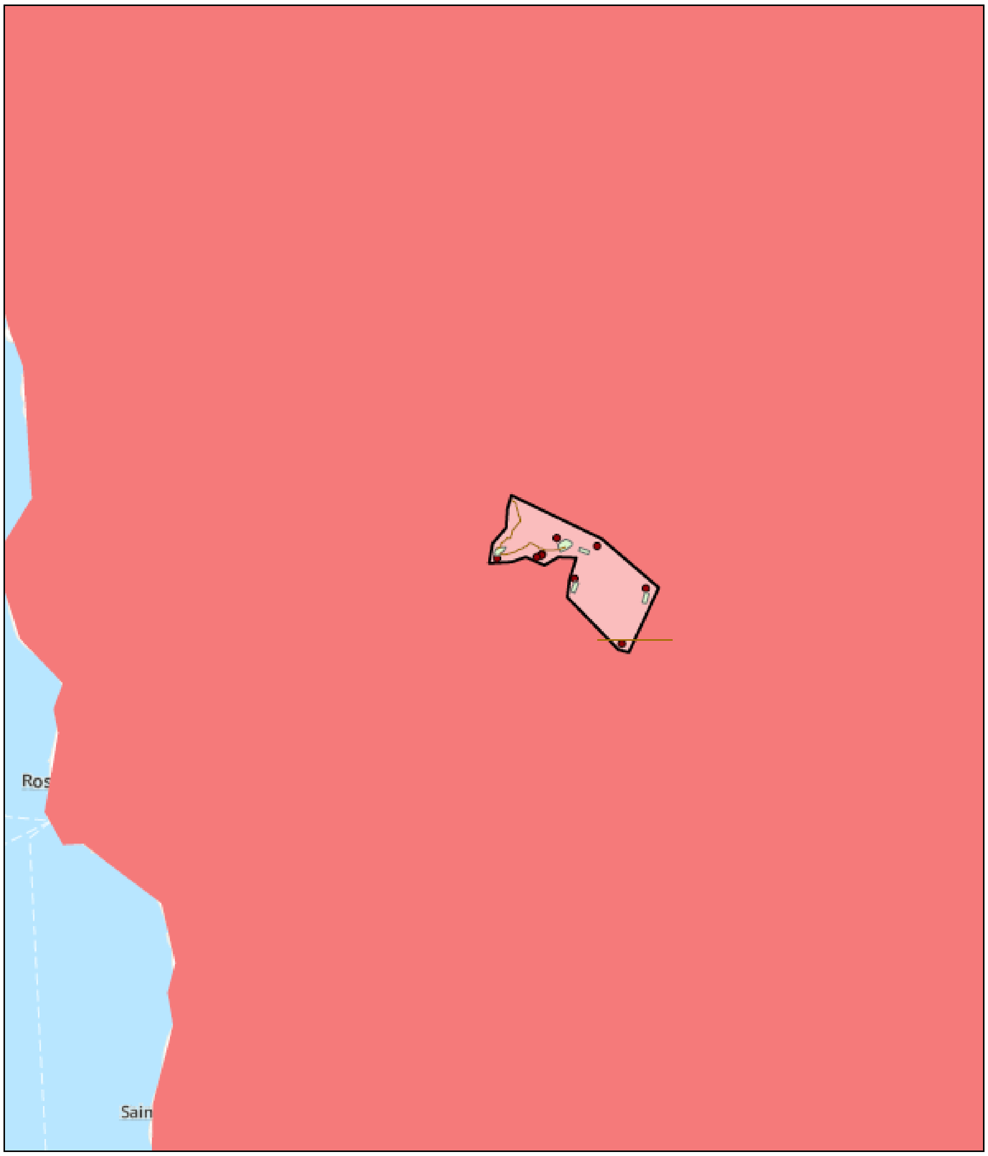
FIGURE 2 EARTHQUAKE HAZARD MAP



Source: IDB screening and classification tool

FIGURE 3 HURRICANE WIND HAZARD MAP

ArcGIS Web Map



6/13/2024, 4:50:53 PM

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

ProjectFootprint_Polylines

ProjectFootprint_Polygons

ProjectFootprint_Points

ProductionWell_WWP1

Hurricane - Wind Hazard

High

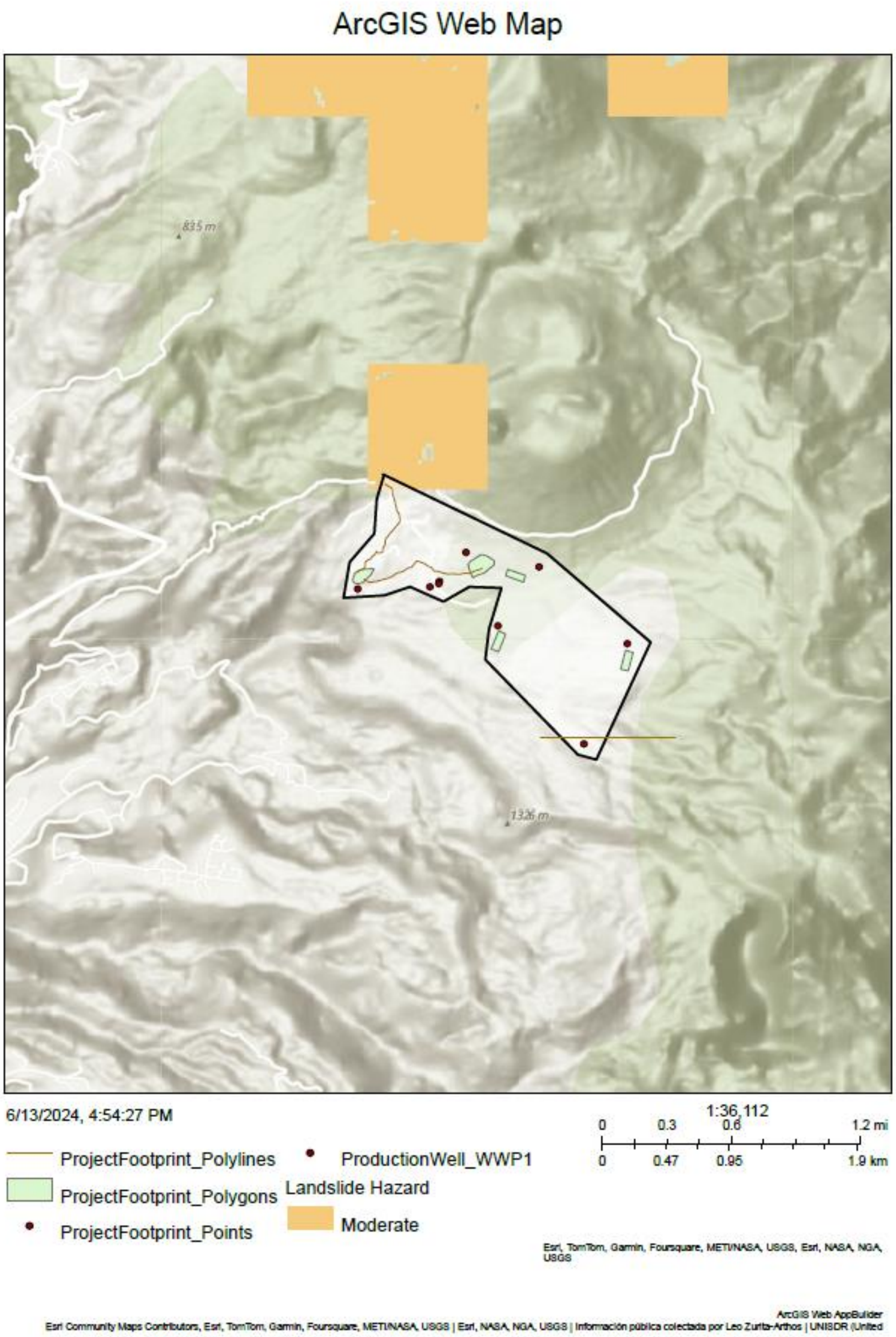
Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS, Esri, NASA, NGA, USGS

ArcGIS Web AppBuilder

Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS | Esri, NASA, NGA, USGS | Información pública colectada por Leo Zurita-Arthos | UNISDR (United Nations International Strategy for Disaster

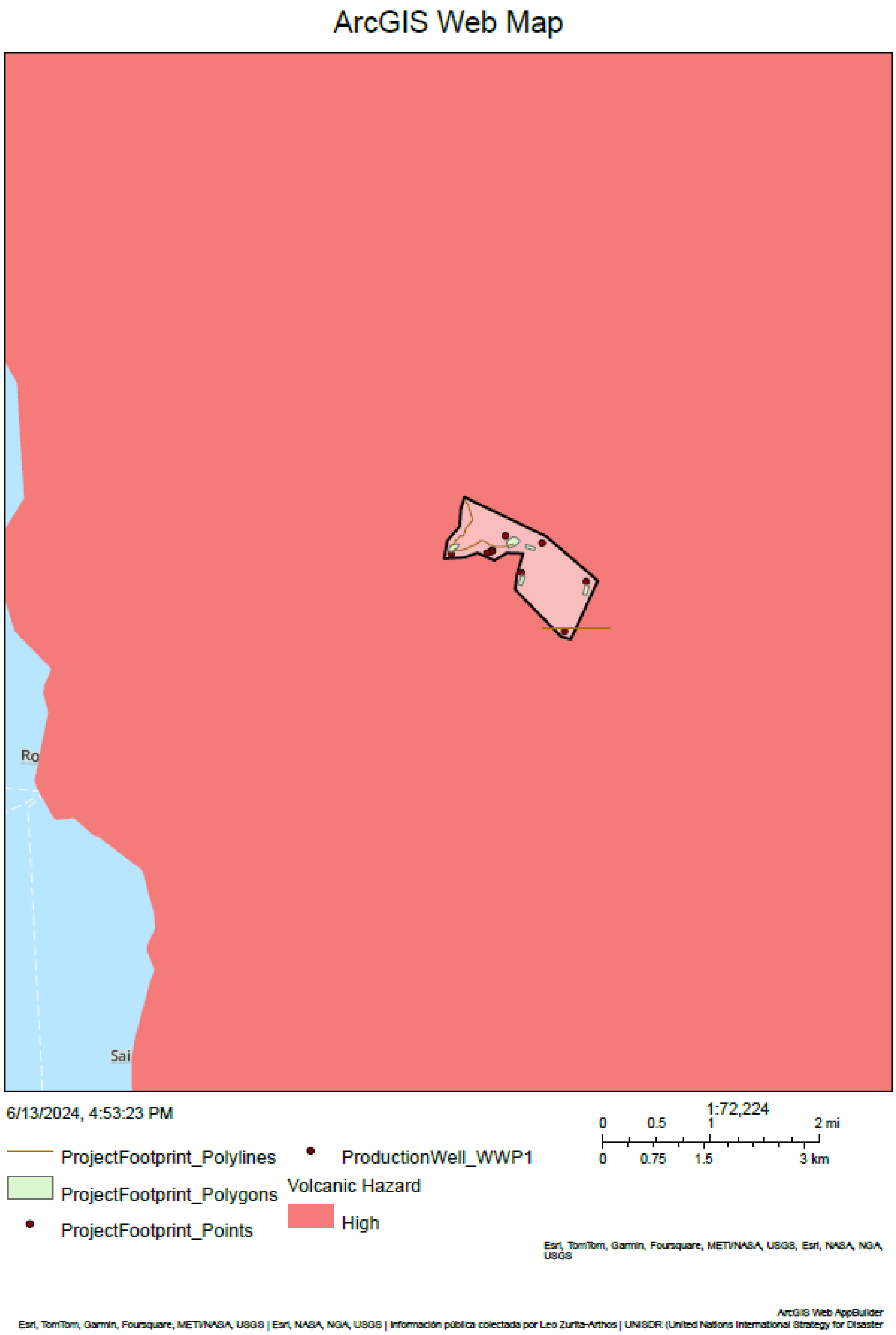
Source: IDB screening and classification tool

FIGURE 4 LANDSLIDE HAZARD MAP



Source: IDB screening and classification tool

FIGURE 5 VOLCANIC HAZARD MAP



Source: IDB screening and classification tool

ERM

APPENDIX B FMEA WORKSHOP AGENDA AND ASSISTANCE REGISTER

2024 Dominica ESIA Update

Scope of work: Disaster and Climate Change Vulnerability Assessment (DCCVRA)

Workshop on Failure Mode Evaluation Analysis

Goal: Identification of failures, causes, and solutions to strengthen the quality risk assessmentand DRMP.

Date: July 30, 2024 (Session 1) and August 1, 2024 (Session 2)

Participants

Name	Role	Company
Venkat Kolluru	Facilitator	ERM
Brooke Frazier	Scribe	ERM
Amir Jungen	Project Manager	Ormat
Yonatan Valinsky	Product Engineer	Ormat
Idan Peled	Product Engineering Department Manager	Ormat
Avi Navon	Product Engineer	Ormat
Nir Akirav	Finance	Ormat

Agenda for Session 1

1) Introduction of Workshop Participants (9.00 am to 9.15 am)
2) Overview of the workshop procedure (9.15 am to 9.30 am)
3) IDB’s DCCVRA Framework (9.30 am to 10 am)
4) Background and Update on Phase 1 and Phase 2 (10 am to 10.30 am)

a. Presentation of Phase 1: Screening and Classification of Hazards[9]

b. Presentation of Phase 2: Qualitative Assessment

5) Presentation of Failure Model Evaluation Tool (10.30 am to 10.45 am)

a. See Appendix A

6) Break (10.45 am to 11 am)
7) Run the workshop (11 am to 1 pm)

a. Finalize list of failures, modes, effects, causes, and detectability

b. Obtain Risk Priority number (RPN)

8) End Workshop

Agenda for Session 2

1) Introduction of Workshop Participants (9.00 am to 9.15 am)
2) Overview of the workshop procedure (9.15 am to 9.30 am)
3) IDB's DCCVRA Framework (9.30 am to 10 am)
4) Background and Update on Phase 1 and Phase 2 (10 am to 10.30 am)

a. Presentation of Phase 1: Screening and Classification of Hazards[1]

b. Presentation of Phase 2: Qualitative Assessment

5) Presentation of Failure Model Evaluation Tool (10.30 am to 10.45 am)

a. See Appendix A

6) Break (10.45 am to 11 am)
7) Run the workshop (11 am to 1 pm)

a. Finalize list of failures, modes, effects, causes, and detectability

b. Obtain Risk Priority number (RPN)

8) End Workshop

[9] Hazards for all Project components (production and injection wells, injection pipeline, power plant and access roads)

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APPENDIX C FMEA WORKSHOP SPREADSHEET

Project	Geothermal Facility, Roseau Valley, Dominica
Date	7/29/2024; 8/1/2024; 8/4/2024
Design Firm	ORMAT
Design Lead	
Core Team	ORMAT, DGDC, ERM

Potential
Failure Mode and Effects Analysis
Version 4

Hazard	Asset	Component	Potential Failure Mode(s)/Expected Events	Potential Effect(s) of Failure / Impact Description	Sev	Potential Cause(s)/ Mechanism(s) of Failure	Prob	Current Design Controls	Det	RPN	Recommended/Included Action(s)	Responsibility & Target Completion Date	Mitigation Measure Effects: Actions Taken	Mitigation Measure Effects: Updated Sev	Mitigation Measure Effects: Updated Prob	Mitigation Measure Effects: Updated Det	Mitigation Measure Effects: Final RPN
Extreme Heat	Plant	Emergency Generator	Increased strain	Increased strain resulting in reduced efficiency	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25				1	1	1	1
Extreme Heat	Plant	Water Tank and distribution system	Increased demand	Increased demand	2	no critical system relays on water suplly	5		5	50				1	1	1	1
Extreme Heat	Plant	Fire Fighting Tank and System	Increased strain	Increased strain resulting in reduced efficiency	1		1		5	5				1	1	1	1
Extreme Heat	Plant	HVAC System	Increased energy demand	Increased energy demand for cooling of indoor areas for personnel	5	Electrical components might malfunction leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25				1	1	1	1
Extreme Heat	Plant	Substation			1		1		1	1				1	1	1	1
Extreme Heat	Facilities	Security Building and Parking Lot	Increased energy demand	Increased energy demand for cooling of indoor areas for personnel	1		1		5	5				1	1	1	1
Extreme Heat	Facilities	Brine Ponds			1	No effect	1		1	1				1	1	1	1
Extreme Heat	Facilities	Electrical/Control Building	Increased energy demand	Increased energy demand for cooling of indoor areas for personnel	3	Electrical components might malfunction leading the plant to shut down.	5	Electrical room temp is constantly measured	1	15				1	1	1	1
Extreme Heat	Facilities	Septic Tank and Leach Field			1		1		5	5				1	1	1	1
Extreme Heat	Facilities	Machine Shop			1		1		2	2				1	1	1	1
Extreme Heat	Facilities	Warehouse			1		1		5	5				1	1	1	1
Extreme Heat	Production Wells	N/A	Increased strain	Increased strain resulting in reduced efficiency	1		1		5	5				1	1	1	1
Extreme Heat	Injection Well	N/A	Increased strain	Increased strain resulting in reduced efficiency	1		1		5	5				1	1	1	1
Extreme Heat	Access Road	N/A			1		1		1	1				1	1	1	1
Extreme Heat	Pipeline	N/A			1		1		5	5				1	1	1	1
Extreme Heat	Plant	Turbine Generator	Decrease in power output	No potential failure of turbine due to extreme heat; possible failure of other components or controls due to heat	1	Loss of power to generator, possible reduction of power output	1	Many sensors available - monitor turbines constantly	1	1	**FOR ERM - Evaluate design plans for extreme heat estimates**		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Heat Exchangers	Decrease in power output	Decrease in power output due to decreased efficiency of the cooling systems	1	Loss of power to generator, possible reduction of power output	1	Pressure sensors, temperature sensors for both fluids, Alarms included	1	1	**FOR ERM - Evaluate design plans for extreme heat estimates**		No actions currently needed	1	1	1	1

ERM

Extreme Heat	Plant	Recuperators	Decrease in power output	Decrease in power output due to decreased efficiency of the cooling systems	1	Loss of power to generator; possible reduction of power output	1	Pressure sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included - two power supplies	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Condensers	Decrease in power output	No potential failure of turbine due to extreme heat; possible failure of other components or controls due to heat	1	Loss of power to generator; possible reduction of power output	1	Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Pumps (feed, wells, ponds, firefighting system)	Decrease in power output	Increased strain resulting in reduced efficiency	1	Loss of power to generator; possible reduction of power output	1	Monitor pressure constantly; vibration sensor; temperature sensor	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Storage Tanks	Decrease in power output	No potential failure of turbine due to extreme heat; possible failure of other components or controls due to heat	1	Loss of power to generator; possible reduction of power output	1	Containment system	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Transformers	Decrease in power output	No potential failure of turbine due to extreme heat; possible failure of other components or controls due to heat	1	Loss of power to generator; possible reduction of power output	1	Measures electric currents constantly	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Extreme Heat	Plant	Oil System	Decrease in power output	No potential failure of turbine due to extreme heat; possible failure of other components or controls due to heat	1	Loss of power to generator; possible reduction of power output	1	Pressure sensor, temperature sensor, will trip the turbine to stop;	1	1	FOR ERM - Evaluate design plans for extreme heat estimates		No actions currently needed	1	1	1	1
Flooding	Plant	Emergency Generator	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris, decreased emergency mitigation measures	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25				1	1	1	1
Flooding	Plant	Water Tank and distribution system	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris, contamination of water source	1		1		5	5				1	1	1	1
Flooding	Plant	Fire Fighting Tank and System	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris, contamination of water source	6		2		4	48				1	1	1	1
Flooding	Plant	HVAC System	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris, increasing heat/cold risk to personnel	5	Electrical components will not function leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25				1	1	1	1
Flooding	Plant	Substation	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	6		2		4	48				1	1	1	1
Flooding	Facilities	Security Building and Parking Lot	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Physical damage from debris on structure	1		5		5	25				1	1	1	1
Flooding	Facilities	Brine Ponds	Decreased pond capacity and leaking due to heavy rainfall and compromised drainage in the area above the site	Loss of storage volume, compromised pond resulting in leaking, contamination of brine from flood waters	1	Plant will operate normally. Incase of overfill due to rain water pond can be evacuated with a drain pump.	5	Pond level is constatly monitored	1	5				1	1	1	1
Flooding	Facilities	Electrical/Control Building	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	7	Electrical components will not function and might lead to short circuit. The plant will trip.	1	Vital electrical componnets are in a building but is located 0.5 meter above the surface. Plant will trip if loosing any one of them and in case flooding level will reach 0.5 meter above the surface	5	35				1	1	1	1
Flooding	Facilities	Septic Tank and Leach Field	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Compromised leach field	5		2		4	40				1	1	1	1
Flooding	Facilities	Machine Shop	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	5		2		4	40				1	1	1	1
Flooding	Facilities	Warehouse	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	3		2		4	24				1	1	1	1
Flooding	Production Wells	N/A	Physical damage from debris	Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water. No significant or slight troubles for exploitation (corrosion, damaged gauges)	1		1		5	5				1	1	1	1
Flooding	Injection Well	N/A	Physical damage from debris	Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water. No significant or slight troubles for exploitation (corrosion, damaged gauges)	1		1		5	5				1	1	1	1
Flooding	Access Road	N/A	Physical damage from debris	No potential failure due to flooding; designed for heavy loading, slope stability on sides of road, very large vertical grade (no chance of ponding)	1	No cause of failure	1	No design controls needed	1	1				1	1	1	1

Flooding	Pipeline	N/A	Physical damage from debris	Debris impact damage	1		1		4	4				1	1	1	1
Flooding	Plant	Turbine Generator	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for turbine is low	1	Many sensors available - monitor turbines constantly	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Heat Exchangers	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for Heat Exchangers is low	1	Pressure sensors, temperature sensors for both fluids, Alarms included	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Recuperators	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for Recuperators is low	1	Pressure sensors for both fluids, mechanical pressure switch for high pressure included, Alarms included - two power supplies	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Condensers	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for condensers is low	1	Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included, Alarms included -two power supplies	1	1	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	1	1	1	1
Flooding	Plant	Pumps (feed, wells, ponds, firefighting system)	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris, coverage of pumps by mudflow deposits	1	Impact to reinjection pipeline - probability of failure for Pumps is low	1	Monitor pressure constantly, vibration sensor, temperature sensor	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Storage Tanks	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for Storage Tanks is low	1	Containment system	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Transformers	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for Transformers is low	1	Measures electric currents constantly	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Flooding	Plant	Oil System	Water damage from sustained heavy rainfall and compromised drainage in the area above the site as well as physical damage from debris	Water damage to electrical components, physical damage from debris	1	Impact to reinjection pipeline - probability of failure for Oil System is low	1	Pressure sensor, temperature sensor; will trip the turbine to stop;	1	1	Not needed - not within risk area		No action needed	1	1	1	1
Hurricane	Plant	Emergency Generator	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting inoperability and decreased emergency mitigation measures	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25				1	1	1	1
Hurricane	Plant	Water Tank and distribution system	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	3		4		5	60				1	1	1	1
Hurricane	Plant	Fire Fighting Tank and System	Physical damage from flying debris (trees, roofs, ...)	Physical damage to tank and system increasing fire hazards	3		4		5	60				1	1	1	1
Hurricane	Plant	HVAC System	Physical damage from flying debris (trees, roofs, ...)	Physical damage to system increasing heat/cold risk to personnel	5	Electrical components will not function leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25				1	1	1	1
Hurricane	Plant	Substation	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	3		4		5	60				1	1	1	1
Hurricane	Facilities	Security Building and Parking Lot	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical damage to structure or parking lot resulting in damage to personnel property and increased security risk	1		4		5	20				1	1	1	1
Hurricane	Facilities	Brine Ponds	Debris in ponds	Debris in ponds	2	No major effect	5	Operator should detect on daily rutine	5	50				1	1	1	1
Hurricane	Facilities	Electrical/Control Building	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical damage to structure resulting in halting operations	5	Electrical components might malfunction leading the plant to shut down.	3	Vital electrical components are in a building. Plant will trip if loosing any one of them.	3	45				1	1	1	1
Hurricane	Facilities	Septic Tank and Leach Field	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical damage to tank resulting in leaking	2		4		5	40				1	1	1	1
Hurricane	Facilities	Machine Shop	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical damage to structure, potential injury to personnel	1		4		5	20				1	1	1	1
Hurricane	Facilities	Warehouse	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical damage to structure, potential injury to personnel	1		4		5	20				1	1	1	1

Hurricane	Production Wells	N/A	Physical damage and blockage from flying debris (trees, roofs, ...)	Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		3		5	30				1	1	1	1
Hurricane	Injection Well	N/A	Physical damage and blockage from flying debris (trees, roofs, ...)	Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		3		5	30				1	1	1	1
Hurricane	Access Road	N/A	Physical damage and blockage from flying debris (trees, roofs, ...)	No potential failure due to hurricane; designed for heavy loading, slope stability on sides of road, very large vertical grade (no chance of ponding)	1	No cause of failure	1	No design controls needed	1	1				1	1	1	1
Hurricane	Pipeline	N/A	Physical damage and blockage from flying debris (trees, roofs, ...)	Physical Damage to structure	2		3		5	30				1	1	1	1
Hurricane	Plant	Turbine Generator	Physical damage from flying debris (trees, roofs, ...)	Physical damage to structure resulting in halting operations	6	Debris damage	5	Many sensors available - monitor turbines constantly	1	30	Turbine and generator - protected by Shed	Construction Phase	Included in facility design	2	3	1	6
Hurricane	Plant	Pumps (feed, wells, ponds, firefighting system)	Physical damage from flying debris (trees, roofs, ...)	Physical damage to pumps resulting in halting operations, increase fire risk as pump for firefighting system would be damaged	4	System will operate with some damage but with some degree of reduction;	5	Monitor pressure constantly; vibration sensor; temperature sensor	1	20	Alternative pump availability	Operations Phase	Third pumps on site for backup - stand by pump is available with aux power source	1	5	1	5
Hurricane	Plant	Transformers	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	4	Reduced power production - approximately by half	5	Measures electric currents constantly	1	20	Inside building , two transformers			1	1	1	1
Hurricane	Plant	Oil System	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	4	Debris damage resulting damage to turbine and halting operations	5	Pressure sensor, temperature sensor; will trip the turbine to stop;	1	20	Located under shed		Each turbine system has separate oil system to cool it; back up turbine available	2	5	1	10
Hurricane	Plant	Condensers	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	3	System will operate with some damage but with some degree of reduction	5	Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	15	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	3	5	1	15
Hurricane	Plant	Heat Exchangers	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	1	Rock fall damage	5	Pressure sensors, temperature sensors for both fluids; Alarms included	1	5	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	1	5	1	5
Hurricane	Plant	Recuperators	Physical damage from flying debris (trees, roofs, ...)	Physical damage resulting in halting operations	1	Debris damage	5	Pressure sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included - two power supplies	1	5	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	1	5	1	5
Hurricane	Plant	Storage Tanks	Physical damage from flying debris (trees, roofs, ...)	Physical damage to structure resulting in leaks	1	Debris damage	5	Containment system	1	5	Not needed - not related to direct operations		Not a day to day use - only for maintenance	1	5	1	5
Landslide	Plant	Emergency Generator	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting inoperability and decreased emergency mitigation measures	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25				1	1	1	1
Landslide	Plant	Water Tank and distribution system	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	2		4		5	40				1	1	1	1
Landslide	Plant	Fire Fighting Tank and System	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to tank and system increasing fire hazards	2		4		5	40				1	1	1	1
Landslide	Plant	HVAC System	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to system increasing heat/cold risk to personnel	5	Electrical components will not function leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25				1	1	1	1
Landslide	Plant	Substation	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	2		4		5	40				1	1	1	1
Landslide	Facilities	Security Building and Parking Lot	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure or parking lot resulting in damage to personnel property and increased security risk	1		5		5	25				1	1	1	1
Landslide	Facilities	Brine Ponds	Pond capacity decreases due to rock fall, mudflow and debris flow, and scarp	Loss of storage volume, compromised pond resulting in leaking	3	Plant will operate normally with out the ability to open the brine muffler.	4	Operator should detect on daily rutine	5	60				1	1	1	1
Landslide	Facilities	Electrical/Control Building	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure resulting in halting operations	5	Electrical components might malfunction leading the plant to shut down.	3	Vital electrical componnets are in a building. Plant will trip if loosing any one of them.	3	45				1	1	1	1

Landslide	Facilities	Septic Tank and Leach Field	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to tank resulting in leaking	2		4		5	40				1	1	1	1
Landslide	Facilities	Machine Shop	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure, potential injury to personnel	2		4		5	40				1	1	1	1
Landslide	Facilities	Warehouse	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure, potential injury to personnel	2		4		5	40				1	1	1	1
Landslide	Production Wells	N/A	Physical damage from rock fall, mudflow and debris flow, and scarp	Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		4		5	40				1	1	1	1
Landslide	Injection Well	N/A	Physical damage from rock fall, mudflow and debris flow, and scarp	Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		4		5	40				1	1	1	1
Landslide	Access Road	N/A	Physical damage and blockage from rock fall, mudflow and debris flow, and scarp	No potential failure due to landslide; designed for heavy loading, slope stability on sides of road, very large vertical grade	1	No cause of failure	1	No design controls needed	1	1				1	1	1	1
Landslide	Pipeline	N/A	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to pipeline	2		4		5	40				1	1	1	1
Landslide	Plant	Pumps (feed, wells, ponds, firefighting system)	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to pumps resulting in halting operations, increase fire risk as pump for firefighting system would be damaged	1	Impact to reinjection pipeline - probability of failure for Pumps is low	5	Monitor pressure constantly, vibration sensor, temperature sensor	1	5	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Transformers	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for Transformers is low	1	Measures electric currents constantly	5	5	Inside building , two transformers			1	1	1	1
Landslide	Plant	Turbine Generator	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for turbine is low	1	Many sensors available - monitor turbines constantly; Able to stop turbine in case of injection pipeline impact	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Heat Exchangers	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for Heat Exchangers is low	1	Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Recuperators	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for Recuperators is low	1	Pressure sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included - two power supplies	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Condensers	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for condensers is low	1	Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Storage Tanks	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage to structure resulting in leaks	1	Impact to reinjection pipeline - probability of failure for Storage Tanks is low	1	Containment system	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Landslide	Plant	Oil System	Physical damage from rock fall, mudflow and debris flow, and scarp	Physical damage resulting in halting operations	1	Impact to reinjection pipeline - probability of failure for Oil system is low	1	Pressure sensor, temperature sensor; will trip the turbine to stop;	1	1	Not needed - not within moderate risk area		No action needed	1	1	1	1
Volcanic	Plant	Emergency Generator	Physical damage from rockfall and lahar	Physical damage resulting inoperability and decreased emergency mitigation measures	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25				1	1	1	1
Volcanic	Plant	Water Tank and distribution system	Physical damage from rockfall and lahar	Physical damage resulting in halting operations, contamination of water due to ash fall	4		3		3	36				1	1	1	1
Volcanic	Plant	Fire Fighting Tank and System	Physical damage from rockfall and lahar	Physical damage to tank and system increasing fire hazards	4		3		3	36				1	1	1	1
Volcanic	Plant	HVAC System	Physical damage from rockfall and lahar	Physical damage to system increasing heat/cold risk to personnel	5	Electrical components will not function leading the plant to shut down.	5	Electrical room temp is constantly measured	1	25				1	1	1	1
Volcanic	Plant	Substation	Physical damage from rockfall and lahar	Physical damage resulting in halting operations	4		3		3	36				1	1	1	1

Volcanic	Facilities	Security Building and Parking Lot	Physical damage from rockfall, lahar, and ash	Physical damage to structure or parking lot resulting in damage to personnel property and increased security risk, ash fall coverage over parking lot damaging personnel property	1			3			3	9				1	1	1	1
Volcanic	Facilities	Brine Ponds	Pond size and water quality	Loss of storage volume, contaminated brine due to ash fall	2		No major effect	5		Operator should detect on daily rutine	5	50				1	1	1	1
Volcanic	Facilities	Electrical/Control Building	Physical damage from rockfall and lahar	Physical damage to structure resulting in halting operations	5		Electrical components might malfunction leading the plant to shut down.	3		Vital electrical componnets are in a building. Plant will trip if loosing any one of them.	3	45				1	1	1	1
Volcanic	Facilities	Septic Tank and Leach Field	Physical damage from rockfall and lahar	Physical damage to tank resulting in leaking	3			3			3	27				1	1	1	1
Volcanic	Facilities	Machine Shop	Physical damage from rockfall and lahar	Physical damage to structure, potential injury to personnel	3			3			3	27				1	1	1	1
Volcanic	Facilities	Warehouse	Physical damage from rockfall and lahar	Physical damage to structure, potential injury to personnel	2			3			3	18				1	1	1	1
Volcanic	Production Wells	N/A	Wellhead rupture	Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise Ash fall: Troubles for exploitation	2			3			3	18				1	1	1	1
Volcanic	Pipeline	N/A	Physical damage from rockfall and lahar	Physical damage to pipeline resulting in leaks	2			3			3	18				1	1	1	1
Volcanic	Access Road	N/A	Physical damage from rockfall, lahar, and ash	Physical damage to road resulting in blocked access, restricting access for personnel evacuations	2		Blocked access	3		Communication with local hazard monitoring	1	6				1	1	1	1
Volcanic	Plant	Turbine Generator	Physical damage from rockfall and lahar	Physical damage to structure resulting in halting operations, ash fall coverage	6		Rock fall damage	5		Many sensors available - monitor turbines constantly	1	30	Turbine and generator - protected by Shed	Construction Phase	Included in facility design	2	3	1	6
Volcanic	Plant	Pumps (feed, wells, ponds, firefighting system)	Physical damage from rockfall and lahar	Physical damage to pumps resulting in halting operations, increase fire risk as pump for firefighting system would be damaged, burial of pumps due to ash fall	4		System will operate with some damage but with some degree of reduction;	5		Monitor pressure constantly; vibration sensor; temperature sensor	1	20	Alternative pump availability	Operations Phase	Third pumps on site for backup - stand by pump is available with aux power source	1	5	1	5
Volcanic	Plant	Transformers	Physical damage from rockfall and lahar	Failures of heat exchangers and other components will result in reduced power	4		Reduced power production - approximately by half	5		Measures electric currents constantly	1	20	Inside building , two transformers			1	1	1	1
Volcanic	Plant	Oil System	Physical damage from rockfall and lahar	Physical damage resulting in halting operations	4		Rock fall damage resulting damage to turbine and halting operations	5		Pressure sensor, temperature sensor; will trip the turbine to stop;	1	20	Located under shed		Each turbine system has separate oil system to cool it; back up turbine available	2	5	1	10
Volcanic	Plant	Condensers	Physical damage from rockfall and lahar	Physical damage resulting in halting operations	3		System will operate with some damage but with some degree of reduction	5		Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	15	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	3	5	1	15
Volcanic	Injection Well	N/A	Wellhead rupture	Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise Ash fall, wellhead burying: Troubles for exploitation or abandonment of exploitation	7		Impacts from rock fall	2		Pressure and temperature monitors, electronic connected to control system; including backup power	1	14	Blow out prevention	Construction Phase		1	1	1	1
Volcanic	Plant	Heat Exchangers	Physical damage from rockfall and lahar	Physical damage resulting in halting operations	1		Rock fall damage	5		Pressure sensors, temperature sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included -two power supplies	1	5	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	1	5	1	5
Volcanic	Plant	Recuperators	Physical damage from rockfall and lahar	Physical damage resulting in halting operations	1		Rock fall damage	5		Pressure sensors for both fluids, mechanical pressure switch for high pressure included; Alarms included - two power supplies	1	5	No recommended actions at this time	Construction Phase	Designed under high pressure considerations - high endurance casings used	1	5	1	5
Volcanic	Plant	Storage Tanks	Physical damage from rockfall and lahar	Physical damage to structure resulting in leaks	1		Rock fall damage	1		Containment system	1	1	Not needed - not related to direct operations		Not a day to day use - only for maintenance	1	1	1	1

ERM

Earthquake	Plant	Turbine Generator	Ground displacement	Physical damage to structure resulting in halting operations	3		4		1	12	"The turbine generator foundation shall be designed by the Contractor for dynamic loading as well as static and environmental loading to limit vibration and avoid resonance." Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Heat Exchangers	Ground displacement	Physical damage resulting in halting operations	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Recuperators	Ground displacement	Physical damage resulting in halting operations	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Condensers	Ground displacement	Physical damage resulting in halting operations	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Pumps (feed, wells, ponds, firefighting system)	Ground displacement	Physical damage to pumps resulting in halting operations, increase fire risk as pump for firefighting system would be damaged	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Storage Tanks	Ground displacement	Physical damage to structure resulting in leaks	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Waste Management Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Transformers	Ground displacement	Physical damage resulting in halting operations	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Emergency Generator	Ground displacement	Physical damage resulting inoperability and decreased emergeny migitation measures	1	the plant will operate normaly	5	Operator will detect on daily rutine	5	25	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Water Tank and distribution system	Ground displacement	Physical damage resulting in halting operations	2		4		2	16	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Fire Fighting Tank and System	Ground displacement	Physical damage to tank and system increasing fire hazards	2		4		2	16	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	HVAC System	Ground displacement	Physical damage to system increasing heat/cold risk to personnel	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	

Earthquake	Plant	Oil System	Ground displacement	Physical damage resulting in halting operations	6		2		1	12	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Waste Management Plan Air Emissions Management Plan			1	1	1	
Earthquake	Plant	Substation	Ground displacement	Physical damage resulting in halting operations	1		4		2	8	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan			1	1	1	
Earthquake	Facilities	Security Building and Parking Lot	Ground displacement	Physical damage to structure or parking lot resulting in damage to personnel property and increased security risk	1		4		5	20	"All buildings and sheds shall be designed for expected hurricane loading and other natural hazards and meet Dominica's building code." "Foundations for all buildings, structures and miscellaneous equipment pads shall be selected and designed based on the superimposed loads, and the strength and character of the supporting material as determined by the geotechnical study at site. " Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Facilities	Brine Ponds	Ground displacement	Compromised pond resulting in leaking	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Facilities	Electrical/Control Building	Ground displacement	Physical damage to structure resulting in halting operations	2		4		5	40	"All buildings and sheds shall be designed for expected hurricane loading and other natural hazards and meet Dominica's building code." "Foundations for all buildings, structures and miscellaneous equipment pads shall be selected and designed based on the superimposed loads, and the strength and character of the supporting material as determined by the geotechnical study at site. " Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Facilities	Septic Tank and Leach Field	Ground displacement	Physical damage to tank resulting in leaking	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Facilities	Machine Shop	Ground displacement	Physical damage to structure, potential injury to personnel	2		4		5	40	"All buildings and sheds shall be designed for expected hurricane loading and other natural hazards and meet Dominica's building code." "Foundations for all buildings, structures and miscellaneous equipment pads shall be selected and designed based on the superimposed loads, and the strength and character of the supporting material as determined by the geotechnical study at site. " Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Facilities	Warehouse	Ground displacement	Physical damage to structure, potential injury to personnel	2		4		5	40	"All buildings and sheds shall be designed for expected hurricane loading and other natural hazards and meet Dominica's building code." "Foundations for all buildings, structures and miscellaneous equipment pads shall be selected and designed based on the superimposed loads, and the strength and character of the supporting material as determined by the geotechnical study at site. " Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Production Wells	N/A	Ground displacement	Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan Well Blowout Prevention Plan			1	1	1	

Earthquake	Injection Well	N/A	Ground displacement	Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan Air Emissions Management Plan Well Blowout Prevention Plan			1	1	1	
Earthquake	Access Road	N/A	Ground displacement	Debris blocking access, damage to road, restricting access for personnel evacuations	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	
Earthquake	Pipeline	N/A	Ground displacement	Physical damage to pipeline resulting in leaks	2		4		5	40	Emergency Response Plan Community Health and Safety Management Plan Training Plan Occupational Health and Safety Plan Biodiversity Management Plan Water Management Plan Noise Mitigation Plan			1	1	1	

APPENDIX D DGDC DISASTER RISK AND EMERGENCY PLAN (2021)

Dominica Geothermal Development Company Limited
Powering a New Generation...

DISASTER RISK and EMERGENCY MANAGEMENT (DREM) PLAN

Second Edition | December 2021

FOREWORD

The Dominica Geothermal Development Company (DGDC) is focused on the sustainable development of Dominica's geothermal resources, starting with the delivery of a domestic plant in the near future. The delivery of this facility is critical to both the nation's renewable energy goals and its climate resilience strategy.

We need no reminders of our vulnerability to the forces of nature. We have been well schooled on how easy it is for a single natural hazard event to reverse progress on the most promising of initiatives. This Plan is intended to help mitigate the impact of these natural events on DGDC personnel and facilities, as well as on the communities in which we operate. This detailed strategy and plan aim to heighten awareness of the relevant issues, and provide instructions on steps to be taken in preparation for and response to natural hazard events. The emphasis is on prevention, mitigation and preparedness. These begin with design and construction to reduce our exposure and vulnerability and extend to how we operate. Response, recovery and rehabilitation are addressed in greater detail in other avenues.

We wish to commend and thank the staff of DGDC for developing this document. We also wish to express DGDC's gratitude to the agencies that worked alongside our staff and provided expert guidance throughout.

This plan will also continue to evolve to reflect best practices, and to reflect changes in social, operational and environmental factors.

The DGDC Board of Directors

ACKNOWLEDGEMENT

The DGDC extends its gratitude to its international partners that have supported and guided the design of the first Disaster Risk and Emergency Management (DREM) Plan.

The Plan was developed within the contract with Seureca https://www.seureca.veolia.com/en (France) and with technical support from the Risk Society www.risk-society.com (The Netherlands). The financial support for this work was provided by the *Agence Française de Développement (AFD)* and *European Union's Caribbean Investment Facility (CIF)*.

Contributions were also provided by the Office of Disaster Management (ODM), Dominica Meteorological Service, UWI Seismic Research Centre, the Ministry of Communications & Works, University of Twente.

Interviews have been conducted with and contributions received from:

- Fitzroy Pascal, Coordinator of ODM, Dominica
- Marshall Alexander, Senior Meteorological Officer, Dominica
- Richard Robertson and staff of UWI-SRC, Trinidad and Tobago
- Magnus Williams, Chief Engineer – Dominica Water & Sewerage Company Ltd, Dominica
- Cees van Westen, Associate Professor, University of Twente, The Netherlands
- Hervé Traineau, Project Manager – Geologist, CFG Services, Orléans, France

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Acronyms and Abbreviations

AFD	Agence Française de Développement
CIF	Caribbean Investment Facility of the EU
DGDC	Dominica Geothermal Development Company Ltd
DREMP	Disaster Risk and Emergency Management Plan
EOC	The Emergency Operations Centre of NEPO
EPC	Engineer, Procure and Construct
EU	European Union
NEPO	National Emergency Planning Organization
ODM	Office of Disaster Management
UWI-SRC	Seismic Research Centre of The University of the West Indies

INTRODUCTION

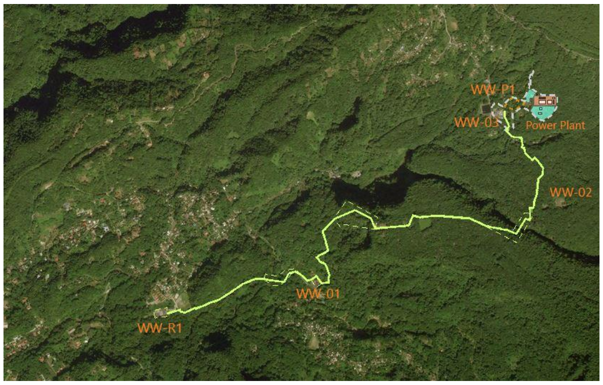
1. Purpose and Objectives

The very first geothermal power plant to be developed at Laudat in the Roseau Valley is regarded as a critical component of Dominica's future infrastructure development plans as well as country's sustainable development priorities. Dominica is a volcanic island situated in the common path of tropical cyclones and in a seismically active part of the planet. It has suffered devastating consequences of several hurricanes in the past, including the recent one, the hurricane Maria (Category 5+)[1] considered the worst in the history of Caribbean hurricanes. Dominica was the most affected country in the region hit by hurricane Maria on 28 September 2017. It, therefore, is essential that the plant be designed, built, operated and maintained in a manner consistent with the country's stated goal of becoming the world's first climate resilient nation. Appendix 6 provides a brief overview of the rationale for this Plan.

Towards this end, the Disaster Risk and Emergency Management (DREM) Plan is developed by the staff of Dominica Geothermal Development Company (DGDC) to ensure resilience of this critical infrastructure to **natural hazards.** The DREM Plan is aimed at fostering a heightened attention to safety and security issues among the employees of the Company and preparing them to ensure adequate preparedness and response to various scenarios if natural hazards such as ***floods, landslides, earthquakes, volcanic eruptions, and hurricanes*** impact the geothermal power plant. Hence, the ***purpose*** of the plan is to guide the resilience building efforts of the DGDC throughout the ***pre-construction, construction, and operation & maintenance*** phases.

This document (2nd edition – December 2021) is an update of the original edition (August 2019). It accounts for changes in the project design, specifically the adoption of a new injection strategy. A new reinjection well RV-I2 is to be drilled and WW-R1 and WW-01 will no longer be part of the project. The route of the reinjection pipeline has consequently changed, which is significantly shorter as illustrated in Figure 1. A new backup production well RV-P2 will also be drilled.

[1] To be classified as a hurricane, according to the Saffir–Simpson hurricane wind scale, a tropical cyclone must have one-minute maximum sustained winds of at least 74 mph (33 m/s; 64 kn; 119 km/h) (Category 1). The highest classification in the scale, Category 5, consists of storms with sustained winds exceeding 156 mph (70 m/s; 136 kn; 251 km/h). However, it is noticed that the sustained winds increasingly exceed the margins set in the Saffir-Simpson scale. The hurricane Maria in 2017 was classified as 5+.



Original Reinjection Pipeline Route

Revised Reinjection Pipeline Route

Figure 1: Pipeline Routes - Comparison

The ***overall objective*** of the plan is to *save lives, prevent injury to persons, minimize damage to Company's property, protect the environment and ensure rapid recovery from a disaster*. The ***specific objectives*** of the DREM Plan include:

a. To develop the awareness of the staff and other stakeholders of the various disaster risks from natural hazards that are likely to impact the geothermal powerplant.

b. To clearly define the roles and responsibilities of the DGDC's staff in the management of disaster risk. Appendix 1 provides an overview of the organogram of the DGDC.

c. To guide disaster mitigation, preparedness and emergency actions of DGDC staff and contractors at all phases of the project implementation: ***pre-construction, construction, and operation & maintenance*** phases.

The DREM Plan covers the geothermal power project sites, which include associated steam fields and reinjection line, whereby

- **WW-P1** and **WW-03** are the production wells;
- **RV-I2** will be the reinjection well, and
- the areas that will be used for routing the pipelines.

The areas where the **WW-01**, **WW-02** and **WW-R1** wells are located are also covered by the DREM Plan. These areas are not part of the revised project, i.e. they will not be further exploited, however, since they are the property of the DGDC and there are some assets available at the sites, they are therefore included in the DREM Plan. Additionally, a proposed production well **RV-P2** is covered by this Plan. See Figure 2b below.

Figure 2a: Geothermal project location

Figure 2b: Project Area Details

2. Limitations of the DREM Plan

While developing the DREM Plan Second Edition, due to time and resource constrains a number of limitations are encountered and must be taken into consideration:

a) The DREM Plan is limited to only natural hazards. Any other hazards are beyond the scope of this Plan.

b) The DREM Plan is concerned only by the risks to the geothermal power plant areas. No cascading effects were considered beyond the project area.

c) The DREM Plan is limited by the data that is currently available on hazards, exposure, and vulnerabilities. For example, although some hazard maps for Dominica have been produced, the extent to which they can be useful for hazard/risk analysis of the project site, is limited by the scale of those maps.

d) The current version of the DREM Plan is focused only on the pre-construction phase. The next iterations of the DREM Plan will cover construction and operational phases respectively.

3. Key concepts

Emergency – is an out-of-the-ordinary situation that must be managed by urgent procedures in order to stop it escalating and thus having consequences that are more serious and damaging.

Disaster - is an event that has a substantial negative impact on human lives and activities and on the built or natural environment.

Crisis – is a sudden, intrusive interruption of normal conditions with potentially adverse consequences.

APPROACH AND METHODOLOGY

1. Approach to DREM Plan

The approach used in developing the DREM Plan is based on understanding disaster risk as the interaction between **hazard** and the characteristics that make people and places **exposed** and **vulnerable**. The theory behind this approach is further explained in Appendix 4: Understanding Disaster Risk.

The approach employed for the DREM Plan is, therefore,

(a) to identify those natural hazards that are likely to impact the geothermal power plant site.

(b) to examine the extent of exposure and vulnerability of the plant site to each natural hazard at the pre-construction phase.

(c) to determine the worse-case scenarios caused by the combination of the natural hazard and exposure/vulnerability of each of the seven areas of the geothermal power project.

(d) consider each scenario as a unique risk and identify the likelihood and impact rate of each scenario, hence, the risk severity. Detailed description of impact is critical in order to guide adequate prevention, preparedness, and response and recovery measures. Applying precautionary principle, the focus of the risk assessment is based on the worst-case scenarios.

(e) design the response measures to address high risk scenarios. When disaster risks are identified, the DREM Plan provides recommendations on disaster preparedness and disaster mitigation actions.

This approach is visualized in Table 2: Disaster Risk Profile.

2. Methodology for Disaster Risk Assessment

The combination of hazard maps and the geolocation of the geothermal power plant is used to help determine the level of exposure of the geothermal power plant site to a particular hazard. With the guidance of a subject matter expert, the vulnerabilities of the installation are assessed. On this basis the extent of risk is evaluated, and recommendations are provided as appropriate.

Hazard analysis is largely outsourced as it requires scientific analysis and must be based on a highly reliable source. Various experts and scientific/research institutions are contacted. They are asked to categorize hazard for each of the seven location areas according to the following scale: ***high***, ***moderate***, ***low***.

Exposure and vulnerability analysis and impact description for the preconstruction phase is carried out using the DGDC's in-house expertise and with the help of Seureca team. The findings for the exposure and vulnerabilities too are categorized for each of the location areas according to the following scale: ***high***, ***moderate***, ***low***.

Conclusions about disaster risk level for each of the location areas are presented both as a colour code and as a rating:

High: extensive damage to property and injury to people or serious disruption of the operations (red)
Moderate: damage to properties and human injuries (yellow)
Low: minor or no impact to assets and people (green)

HAZARD PROFILE

This section provides an overview of the hazard profile of the geothermal power plant site during the pre-construction phase. See Appendix 8: Scientific References for more details.

Earthquake: the geothermal power plant site is located in the moderate/high seismic activity zone. The expected magnitude varies from average 2.5M to peaks of 5M. Experts conclude that the seismic hazard probability in all seven areas of the geothermal power plant are moderate to high. It is recognized that because geothermal operations will be conducted in areas that are also tectonically active, it will be difficult to distinguish between any geothermal-induced and naturally occurring events.

Volcanic activity: the geothermal power plant is to be built in a region that has perhaps the densest collection of volcanic centres in the Caribbean region. Nevertheless, for the pre-construction phase, there are sufficient reasons to conclude that the probability of volcanic activities is low. It is, however, important to distinguish between volcanic activities of Morne Micotrin and Phreatic explosion in Wotten Waven area. It is also important to mention the likelihood of phreatic eruption or phreatic explosion in Wotten Waven area. This type of eruption is related to the sudden, violent boiling of shallow heated aquifers related to the geothermal system. There is no direct relation with a volcano. Several phreatic explosions have been experienced in the past in the Wotten Waven area.

Landslide: the available mass movements susceptibility map classifies landslides into four categories: low, moderate, high, and historical landslides. The geothermal project is located in a zone with low landslide susceptibility.

Hurricane: the project area, like the rest of the island, is located in the common path of tropical cyclones. Historical information on impacts of this natural hazard is well-documented, so that even without reference to scientific data, the recent history of extreme wind events like Hurricane David (1979) and Hurricane Maria (2017) category 5 and 5+ respectively, as well as the frequent occurrence of less intense hurricanes and tropical storms, supports the conclusion of high wind hazard probability. It should be noted, however, that in the absence of scientific data, the level of uncertainty is significantly high.

Flood: the level of flood exposure of the project area was established by reference to historical data and the use of a flood hazard map. The extreme level of flooding experienced during Tropical Storm Erika (2015) and Hurricane Maria was indicative of the worst-case scenario. It points to relatively low flood susceptibility for most of the project area. Further detailed study is required to substantiate this conclusion.

DISASTER RISK PROFILE: SCENARIOS

During the pre-construction phase only few assets are available at the geothermal power project sites and extended areas of interest, the list and the condition of which are presented in Table 1.

Table 1: Condition of Assets per area

Area	Description of Assets	Condition of Assets
Production Well site (WW-P1 & WW-03)	Two well heads, flow line, flash tank, weir box, sump, one diesel powered sump pump.	• Wellhead valves serviced in June 2019. Rehabilitation work carried out on flow line in June 2019. • Wellhead, flash tank and weir box are all in fair to good condition. Some early signs of corrosion were observed at the wellhead. These, upon close examination, were found to be minor. • The sump pump was fitted with some replacement parts in July/August 2019 and is now in prime working condition.
Power Plant site	No assets available	
Reinjection Pipeline route	No assets available	
Reinjection Well site (RV-I2)	No assets available	
Production Well site (RV-P2)	No assets available	
Former Reinjection Well site (WW-R1)	One well head, sump	Wellhead valves serviced in June 2019. Wellhead is in fair to good condition. Some early signs of corrosion were observed at the wellhead. These, upon close examination, were found to be minor and are being addressed.
Exploratory Well site (WW-01)	One well head, sump	Wellhead valves serviced in June 2019. Wellhead is in fair to good condition. Some early signs of corrosion were observed at the wellhead. These, upon close examination, were found to be minor and are being addressed.
Exploratory Well site (WW-02)	One well head, sump	Wellhead valves serviced in June 2019. At that time there was severe corrosion of the

		flange bolts securing the wing valve. DGDC is currently working on a solution to this issue. Wellhead is in fair to good condition. Some early signs of corrosion were observed at the wellhead. These, upon close examination, were found to be minor and are being addressed.

The exposure and vulnerability analyses are further considered while developing worse-case scenarios that are realistically possible for the geothermal power plant. Appendix 5 explains the approach employed for scenario development.

Table 2 below illustrates the disaster risk profile of the geothermal power plant site in its pre-construction phase. The risk levels are assigned a numerical score and are colour coded based on a combination of impact and likelihood of the site to the related hazard: **green** depicts a **low** level of risk, **yellow** for **moderate** level, and red for **high** risk.

Emerging from the risk level analysis, those risks indicated in red, meaning high likelihood and high impact are analyzed in terms of:

a) What to do to prevent this scenario from happening, and if this is not possible
b) What to do to prepare DGDC to respond to such a scenario in the most effective way.

Table 2: Disaster Risk Profile: Phase I. PRE-CONSTRUCTION

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
1	**Hurricane** (category 5+)	Steamfield and Production Wells (WW-P1 and WW-03)	HIGH	LOW	Impact by flying debris (trees, roofs, …)	Scenario: H1 Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	Low	High	Low/3
		Power Plant*	HIGH	n/a					
		Reinjection Pipeline*	HIGH	n/a					
		Reinjection Well (RV-I2)*	HIGH	n/a					
		Production Well (RV-P2)*	HIGH	n/a					
		Former Reinjection Well (WW-R1)	HIGH	LOW	Impact by flying debris (trees, roofs, …)	Scenario: H4 Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	Low	High	Low/3
		Test Well (WW-01)	HIGH	LOW	Impact by flying debris (trees, roofs, …)	Scenario: H5 Wellhead rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	Low	High	Low/3
		Test Well WW-02	HIGH	LOW	Impact by flying debris (trees,	Scenario: H6 Wellhead rupture: Gas and steam emission in	Low	High	Low/3

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
					roofs, …)	atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise			
2	**Earthquake** (magnitude 5.0)	Steamfield and Production Wells (WW-P1 and WW-03)	MODERATE	LOW	Ground displacement	Scenario: E1 Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Power Plant*	MODERATE	n/a					
		Reinjection Pipeline*	MODERATE	n/a					
		Reinjection Well (RV-I2)*	MODERATE	n/a					
		Production Well (RV-P2)*	MODERATE	n/a					
		Former Reinjection Well (WW-R1)	MODERATE	LOW	Ground displacement	Scenario: E4 Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well (WW-01)	MODERATE	LOW	Ground displacement	Scenario: E5 Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well WW-02	MODERATE	LOW	Ground displacement	Scenario: E6 Production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
3 (a)	**Volcanic Activity of Morne Micotrin**	Steamfield and Production Wells (WW-P1 and WW-03)	LOW	LOW	Ash fall, rock fall, pyroclastic flow, lahar	Scenario: V1.1 Wellhead rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Power Plant*	LOW	n/a					
		Reinjection Pipeline*	LOW	n/a					
		Reinjection Well (RV-I2)*	LOW	n/a					
		Production Well (RV-P2)*	LOW	n/a					
		Former Reinjection Well (WW-R1)	LOW	LOW	Ash fall, rock fall, pyroclastic flow, lahar	Scenario: V1.4 Wellhead rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well (WW-01)	LOW	LOW	Ash fall, rock fall, pyroclastic flow, lahar	Scenario: V1.5 Wellhead rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well WW-02	LOW	LOW	Ash fall, rock fall, pyroclastic flow, lahar	Scenario: V1.6 Wellhead rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
3 (b)	**Phreatic Volcanic Activity**	Steamfield and Production Wells (WW-P1 and WW-03)	LOW	LOW	Steam and gas emission, ash emission	Scenario: V2.1 Ash fall: Troubles for exploitation	**Low**	**Low**	**Low/1**
		Power Plant*	LOW	n/a					
		Reinjection Pipeline*	LOW	n/a					
		Reinjection Well (RV-I2)*	LOW	n/a					
		Production Well (RV-P2)*	LOW	n/a					
		Former Reinjection Well (WW-R1)	LOW	LOW	Steam and gas emission, ash emission	Scenario: V2.4 Ash fall, wellhead burying: Troubles for exploitation or abandonment of exploitation	**Low**	**Low**	**Low/1**
		Test Well (WW-01)	LOW	LOW	Steam and gas emission, ash emission	Scenario: V2.5 Wellhead rupture, production casing rupture: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well WW-02	LOW	LOW	Steam and gas emission, ash emission	Scenario: V2.4 Ash fall	**Low**	**High**	**Low/3**
4	**Landslide**	Steamfield and Production Wells (WW-P1 and WW-03)	LOW	LOW	Rock fall, mudflow and debris flow, scarp	Scenario: L1 Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Power Plant*	LOW	n/a					
		Reinjection	LOW	n/a					

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
		Pipeline*							
		Reinjection Well (RV-I2)*	LOW	n/a					
		Production Well (RV-P2)*	LOW	n/a					
		Former Reinjection Well (WW-R1)	LOW	LOW	Rock fall, mudflow and debris flow, scarp	Scenario: L4 Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well (WW-01)	MODERATE	LOW	Rock fall, mudflow and debris flow, scarp	Scenario: L5 Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
		Test Well WW-02	LOW	LOW	Rock fall, mudflow and debris flow, scarp	Scenario: L6 Wellhead rupture, production casing rupture, wellhead burying: Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	**Low**	**High**	**Low/3**
5	**Flood**	Steamfield and Production Wells (WW-P1 and WW-03)	MODERATE	LOW	Rupture of the hydro-electric pipeline running between the Fresh Water Lake and Laudat	Scenario: F1 Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water: No significant or slight troubles for exploitation (corrosion, damaged gauges)	**Low**	**Low**	**Low /1**

Item #	Type of Hazard	Location of Asset	Hazard Probability	Exposure and Vulnerability	Expected Events	Worst-case Scenario Impact Description	Likelihood of Worse-case Scenario	Impact of Worse-case Scenario	Risk ** Level
					Hydro Power Plant				
		Power Plant*	MODERATE	n/a					
		Reinjection Pipeline*	MODERATE	n/a					
		Reinjection Well (RV-I2)*	MODERATE	n/a					
		Production Well (RV-P2)*	MODERATE	n/a					
		Former Reinjection Well (WW-R1)	LOW	LOW	Sustained heavy rainfall and compromised drainage in the area above the site	Scenario: F4 Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water: No significant or slight troubles for exploitation (corrosion, damaged gauges)	**Low**	**Low**	**Low /1**
		Test Well (WW-01)	LOW	LOW	Sustained heavy rainfall and compromised drainage in the area above the site	Scenario: F5 Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water: No significant or slight troubles for exploitation (corrosion, damaged gauges)	**Low**	**Low**	**Low /1**
		Test Well WW-02	LOW	LOW	Sustained heavy rainfall and compromised drainage in the area above the site	Scenario: F6 Well pad covered by mudflow deposits, Well pad erosion, wellhead cellar full of water: No significant or slight troubles for exploitation (corrosion, damaged gauges)	**Low**	**Low**	**Low /1**

Notes:

* Asset not yet realized.

** Color codes for Risk: ***high (red), moderate (yellow), and low (green).***

IMPORTANT: The Disaster Risk Profile will be updated during each major review of the Plan, prior to the construction and maintenance phases. Additional updates might be envisaged as necessary and feasible during each next phase.

The analysis of disaster risk profile of the geothermal power plant suggests that there are no major disaster risks (i.e. risks with severity of 9 or red) to expect during the pre-construction phase, i.e. till the end of 2019. However, introducing time dimension in risk analysis suggests considering DGDC's capacities to cope with any emergency situation should it occur. ***Time is the major multiplier for the DGDC*.** Even if the initial impact of the identified worse-case scenario is not significant, over time if there are no capacities to address the situation, the consequences might have serious further implications for the DGDC, the geothermal power plant, environment, and the communities nearby. Table 3 explains the time range to be considered for the response to an emergency situation in each of the 5+1 geothermal power plant areas.

Table 3: Time consideration in risk analysis

Worst case scenario considered	*Natural hazards involved*	*Impacts of worst case scenario*	*Indicative time to repair / to mitigate risk*
Wellhead rupture	Hurricanes Earthquakes Volcanic activity Micotrin Phreatic explosion in Wotten Waven Landslides	Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	A few weeks to a few months
Production casing rupture	Earthquakes Phreatic explosion in Wotten Waven Landslides	Gas and steam emission in atmosphere, brine discharge and river pollution, soil erosion and landslide by flood, high level of noise	A few months to one year
Wellhead burying	Volcanic eruption Micotrin Phreatic explosion in Wotten Waven Landslides	Troubles for exploitation or abandonment of exploitation	A few weeks to a few years depending on the duration of the eruption
Ash fall	Volcanic eruption Micotrin Phreatic explosion in Wotten Waven area	Troubles for exploitation	A few weeks to a few years depending on the duration of the eruption

Worst case scenario considered	*Natural hazards involved*	*Impacts of worst case scenario*	*Indicative time to repair / to mitigate risk*
Well pad covered by mudflow deposits	Landslides Flood	Troubles for exploitation	A few days or a few weeks depending on the extent of damage
Well pad erosion	Landslides Flood	Troubles for exploitation	A few days or a few weeks depending on the extent of damage
Wellhead cellar full of water	Flood	No significant or slight troubles for exploitation (corrosion, damaged gauges)	A few days or a few weeks depending on the extent of damage

DISASTER PREVENTION and MITIGATION MEASURES

Conclusion

During the pre-construction phase, it is obvious that the main risks are related to the wells. While the priority attention is on worst case scenarios, during the pre-construction phase ***all the risks from natural hazards to the geothermal power plant are low***. Nevertheless, it is important to acknowledging that time is the major multiplier and that if the DGDC's capacities are not in place, any damage caused by natural hazards may have large implications on DGDC assets and on the natural and human environments. ***Therefore,*** *the focus of the prevention and mitigation measures for the pre-construction phase is to build* ***prevention and mitigation capacities*** *of the DGDC to ensure resilience of the geothermal power plant over time.* The critical capacities of the DGDC includes those geared towards (a) prevention of the worst-case scenarios, (b) management of emergency and crisis situation, (c) capacity building of the DGDC personnel, (d) revision of the DREM Plan, and (e) capacities to monitor the realization of the DREM Plan.

Several measures are proposed and can be further detailed by the DGDC team as deemed necessary. While the measures below are designed for the pre-construction phase, the realization of some of them might take longer time and cross over the construction phase. In that case, those activities must be further informed by the risk assessment(s) organized during the construction phase.

Recommendations

A. Measures to prevent the occurrence of worst-case scenarios

- Ensure regular visual survey to detect any problem or any weakness on wellhead.
- Regular maintenance of wellheads. A well-maintained wellhead will be more resistant to damages caused by natural hazard and also by corrosion.
- Monitoring of surface manifestations in Wotten Waven area to detect precursory signs of phreatic explosion (specific to well WW-01).
- Have a stock of spare parts of main components of wellhead (for instance, main valves, side valves) to be able to replace defective (or broken) components. This is particularly critical given that Dominica is an island and transportation of necessary spare parts might take weeks if not months. The need for such a stock might be obviated if the WW-P1 and WW-03 master valves are replaced.

- Mainstream disaster risk thinking into the design and the location of future equipment to reduce the likelihood and/or the impact of natural hazards.
- Ensure seasonal hazard forecasts and scenario planning to anticipate the occurrence of hurricanes and heavy rains which are the main trigger for landslides, rock falls and floods.

B. Measures to manage emergency and crisis situations

- Prepare procedures of technical intervention in case of emergency (emergency response plan)
- Have in Dominica equipment and products for controlling fluid discharge at wellhead (for example: pump, barite, water reserve nearby);
- Prepare a list of local contractors likely to be mobilized in case of emergency (for instance: welding, piping, pumping, crane, diesel supply, civil work);
- Prepare a list of foreign experts on geothermal wells who can be requested in case of emergency to provide help.

C. Measures to build capacities of the DGDC personnel

- Training with international consultants to learn, to develop, and to practise emergency response plan (in Dominica or in foreign country);
- Regular checking and update of the emergency response plan, of the stock of spare parts, of the list of contractors and experts, of the equipment for controlling discharge at wellhead.

D. Measures regarding revision of the DREM Plan

- Expand the focus of the DREM Plan during its next iteration to go beyond natural hazards and to consider cascading effects including those on the environment and the nearby communities.
- If considered feasible, organize monitoring of seismic activities at locations in and around the project area and discuss findings with the UWI-SRC on need basis. In addition it will also provide useful data on baseline micro-seismicity in the project area.
- Recalibrate the impact criteria and indicators for the construction and operational phases.

E. Monitoring of the DREM Plan Realization

The DGDC emergency response team will set up a system to monitor and verify that the actions of the EPC and O&M contractors are in conformity with the requirements of the

DREM Plan during the construction and operational phases of the project. The monitoring plan is to be developed prior to the construction phase.

DISASTER PREPAREDNESS and EMERGENCY MEASURES

This section provides an overview of the existing and planned measures to increase ***preparedness capacities*** of the DGDC to face various disaster risks. The current version of the Plan is focused on pre-construction phase and therefore, the measures that are feasible and necessary for this phase of the project. In the meantime, the proposed measures have more universal nature and will add value for the construction and operation phases. This section will be further updated as deemed necessary for the construction and operation phases respectively.

The focus of disaster preparedness at all phases is on ***(1)*** emergency equipment and facilities, ***(2)*** emergency notification procedures and communication system, ***(3)*** community awareness raising and communication, ***(4)*** responsibilities of the team members, and ***(5)*** evacuation and assembly points.

1. Emergency Equipment and Facilities

As of December 2021, the emergency equipment available under the ownership of DGDC and those required for the effective disaster risk management include the following:

Table 4: Emergency Equipment available and required during pre-construction phase

Currently available	Required
five (5) self-contained breathing apparatus kits	five (5)
Three (3) emergency escape breathing apparatus kits	three (3)
one (1) Automated External Defibrillator (AED) unit	One (1)

2. Emergency Notification Procedures and Communication Systems

DGDC has set up a roster for 'Duty Officer on-call' such that at each point of time one person is available to respond to emergency calls round the clock. There is a dedicated emergency mobile telephone retained by the Duty Officer: **767 235 2222 is displayed on <u>all</u> DGDC signage in and around the work sites.**

When an emergency call is received, it is the responsibility of the Duty Officer to decide who to contact next:

(a) In case of significant emergency situation (i.e. *direct threat to the functioning of the geothermal power plant, direct threat to the life and well-being of the staff, threat to the neighbouring communities and environment*), Duty Officer contacts immediately the national fire-fighting services at **911 or 448 2888**, after which contacts next-in-line within the DGDC.

(b) In all other cases, the Duty Officer records the calls in the Record Log (see Appendix 7) and acts upon as necessary: provides response to enquiries, follows-up on calls to clarify the situation and provides feedback to the caller, provide daily update to the next-in-line authority (see Appendix 8). When deemed necessary, the Duty Officer might contact the next-in-line authority for additional guidance.

Note: the organogram displayed in Appendix 1 shows the reporting relationships for the normal functioning of the company, not involving disaster/emergency management.

3. Community awareness raising and communication

Awareness raising of the local communities and continuous communication with them related to seismic activity merit particular mention. At the time of preparing the 1st Edition of this Plan, a series of earth tremors were being experienced around the south of Dominica where the project is located. Although these earthquakes are not in any way related to the project, there is the perception among part of the population that they are. Therefore, as a response measure, there is need to educate and inform the public so as to raise their awareness and dispel this myth.

In April 2021, with the assistance of experts from UWI-SRC, DGDC installed a network comprising four seismic stations to gather baseline data on micro-seismicity around the project area. The stations are located at Laudat village, Fresh Water Lake, WW-02 compound (near the old aerial tram) and WW-R1 compound in Trafalgar.

4. Responsibilities of DGDC's Team Members

Each permanent and temporary (e.g. consultant) staff member within the DGDC has delegated authority with regards to disaster preparedness, mitigation and risk management.

Management has overall responsibility to produce, make available and update this DREM Plan and to ensure that staff at all levels are familiar with its contents and have clear understanding of their own responsibilities under the Plan. They must provide staff with the necessary training in disaster risk management, as appropriate.

The line of authority within the DGDC in the context of disaster risk management during the preconstruction phase is as follows:

> The Managing Director has overall responsibility. He maintains contact with the general public and news media on matters pertaining to emergencies, working in collaboration with the Project Support Engineer-Electrical, who serves as Health & Safety and Emergency Response Coordinator, on matters of disaster risk management. The two are assisted by the Project Support Engineer-Mechanical, the Community Liaison Officer and the Site and Office Attendant. This arrangement will likely be modified at the start of the construction phase of the project, and then again for the operation phase.

Staff members must familiarize themselves with the instructions and procedures outlined in the Plan. They must also perform the specific roles and responsibilities assigned to each of them under the Plan, including the participation in training exercises required under the Plan. The following roles apply to the pre-construction, construction and O&M phases of the project. They will be revised in due course and amended, as necessary.

- Duty Officer – receives calls from the public on the emergency phone number and provides adequate response. He/she keeps a note of the nature of each call and submits these notes to his/her supervisor at the end of his/her rostered cycle. Appendix 2 provides an overview of the Duty Officer on-call roster for the current period of the pre-construction phase. The roster will be extended to the end of the said phase, at which time it will be reviewed and amended as necessary.
- Media contact person – is the only one authorized to give information on the business of DGDC and the emergency situation or disaster risk to the media and the public. The media contact person must liaise with project team leaders to verify facts and should first seek clearance for his/her supervisor before releasing any item of information for public consumption. For the time being Ms Lyn John-Fontenelle, Safeguards and Administrative Manager is performing this role.
- Site Attendant – has a critical role to play in the early detection of any potential direct threats to the site. He/she must inform the Duty Officer immediately of any such threat. Mr Garry Shillingford is currently employed in this position.
- Contractors have an obligation to conform to the general requirements of the Plan and be conversant of its contents, specifically as relates to the responsibilities set out in their contracts. More specific roles and responsibilities of each contractor will be discussed and contractually agreed in due time, i.e. during the construction and operation phases.

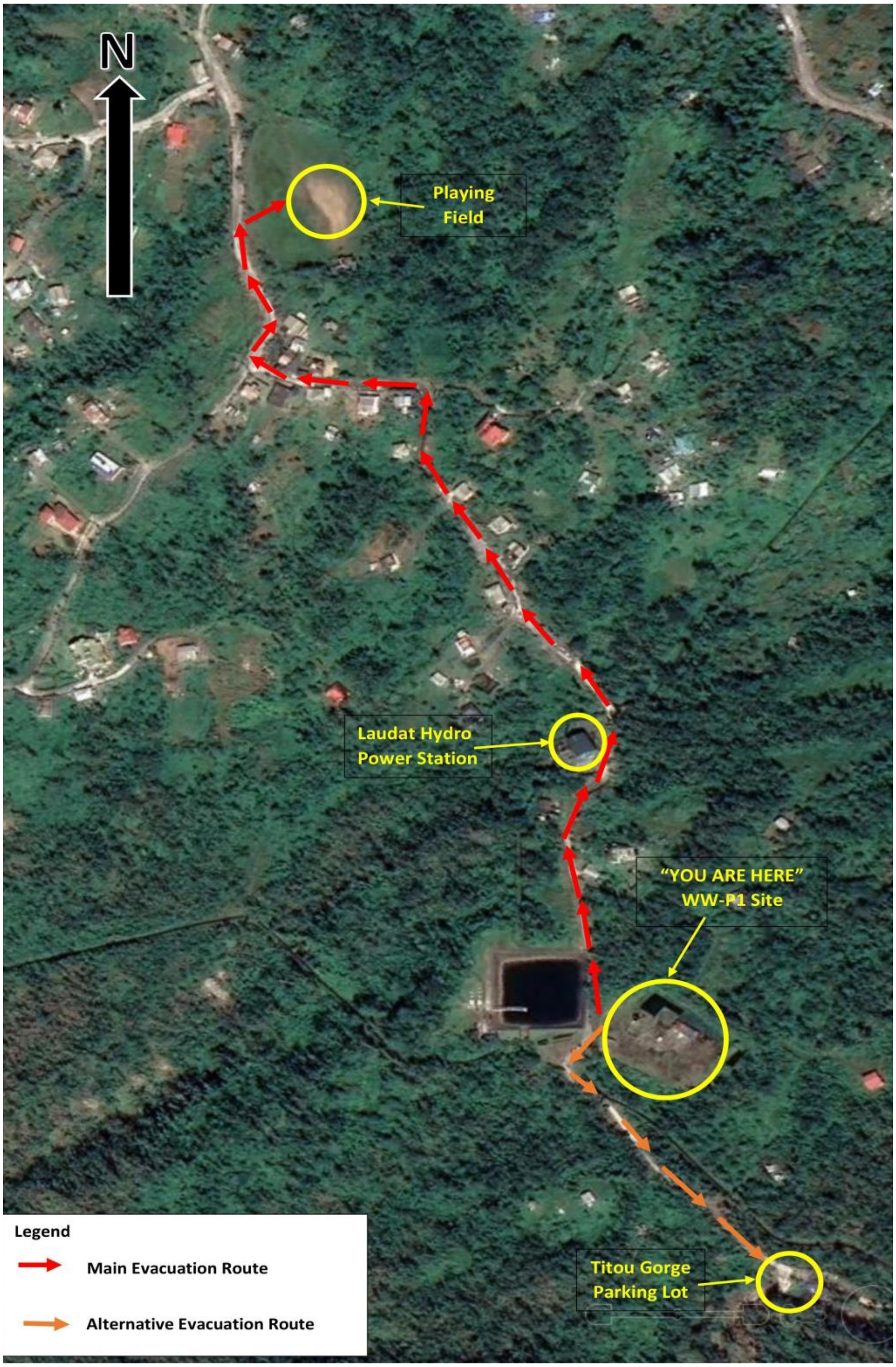
5. Evacuation and Assembly Points

The Plan indicates the designated ***main and alternative areas*** as assembly points. These assembly points might change from phase to phase and therefore, the current version of the Plan indicates the main and alternative assembly points for the DGDC's staff and contractors during the pre-construction phase only.

During the pre-construction phase of the project, the designated **main** assembly point (safe briefing area) for the DGDC team including staff, consultants, contractors, suppliers and other visitors to the Roseau Valley generation facilities, in case of an emergency is the **Village Playing Field at Laudat**. If in the event of a major gas release, the main assembly point happens to be downwind of the facilities, an **alternate** assembly point – the parking lot at the Titou Gorge/ Aerial Tram junction, which is in the opposite direction from the worksite, should be used instead. The alternate assembly point should only be used when specifically instructed to do so by the DGDC management.

Both main and alternative areas are public spaces and therefore, there are no ownership issues to address. Figure 3 provides geolocation of the main and alternative evacuation points.

Figure 3: Main and Alternative Evacuation Points



At the transition of each phase of the project the assembly points will be re-evaluated and, if necessary, revised as appropriate. The designation of assembly points for the construction and operational phases will be stated in subsequent revisions of this Plan.

A wind sock is to be installed in a prominent position at each of the principal sites of the generation facility to enable those present to have visible indication of the wind direction during an evacuation. During the pre-construction phase only one wind sock is required (at WW-P1). However, for the other two phases wind socks must be prominently installed at the power plant site and at each well location.

A flow diagram showing the evacuation procedure as well as the main and alternate assembly points shall be prominently displayed at all sites along with the emergency number.

When directed to leave the premises, personnel must move quickly but do not run; exit the compound in an orderly manner taking only personal belongings which are handy in work areas but must not go to other parts of the premises to collect them; proceed to the main assembly point (or alternate) as instructed.

6. Training and Regular Drills

All DGDC staff at the facility and staff of contractors carrying out work on behalf of DGDC shall be trained on the emergency response measures set out in this Plan. The training requirements are as follows:

- Basic first aid and CPR certification
- Training in emergency management
- The use of personal protective equipment, including self-contained breathing apparatus (SCBA)
- The proper use of fire extinguishers
- Emergency Response simulation exercises
- Technical diagnosis in emergency situation to assess accurately the failure and to prepare the right response

In order to ensure that staff are familiar with the evacuation procedures outlined in the Plan, regular training and drills will be conducted, at least every six months in accordance with the approved schedule shown in Table 5.

Table 5: Programme of Training for DGDC Staff

Training	Date Last Performed	Next Scheduled Date	Person Responsible	Repeat Frequency
Basic First Aid	1-Feb-2021	February 2023	Rawlins Bruney	Every two years
CPR	2-Feb-2021	February 2022	Rawlins Bruney	Annually
Crisis Management	N/A	N/A	Rawlins Bruney	(needs driven)
Use of Self-contained Breathing Apparatus (SCBA)	27-May-2019	March 2022	Rawlins Bruney	Every six months
Operation of fire extinguishers	N/A	26-Jan-2022	Rawlins Bruney	Annually
Emergency Response drill	11-Jul-2019	TBD	Rawlins Bruney	Every six months
Disaster Risk Management	9-Jul-2019	N/A	Rawlins Bruney	(needs driven)
Operational Health & Safety	16-Jul-2019	Q1 2022	Rawlins Bruney	Every two years or immediately after an accident involving the breaking of a rule from the content of the training.

Both the procedure and schedule will be reviewed and modified as necessary.
In addition, the emergency procedures must be included in the induction training for all new staff of DGDC and contractors to the sites.

For the avoidance of doubt, it should be pointed out that the training and drills set out in Table 5 pertain to DGDC staff only. Contractors will be required to conduct their own training programme in accordance with their obligations under the contract, and as approved by DGDC. Generally, every contractor is expected to assist DGDC proactively to instill a strong safety culture for all site activities.

REVIEW AND UPDATES OF THE DREM PLAN

While the DREM Plan is deemed as a living document that will be edited on a regular basis, the current prefatory version of the document is focused predominantly on setting the ***framework*** for the analysis and testing it for the pre-construction phase.

The document will be reviewed and updated on *a quarterly basis during the pre-construction and construction phases.*

During the construction phase it is intended to complement and be used in conjunction with the relevant section[2] of the *DGDC Occupational Health and Safety Manual*.

During the operational phase it is recommended to maintain annual review cycle.

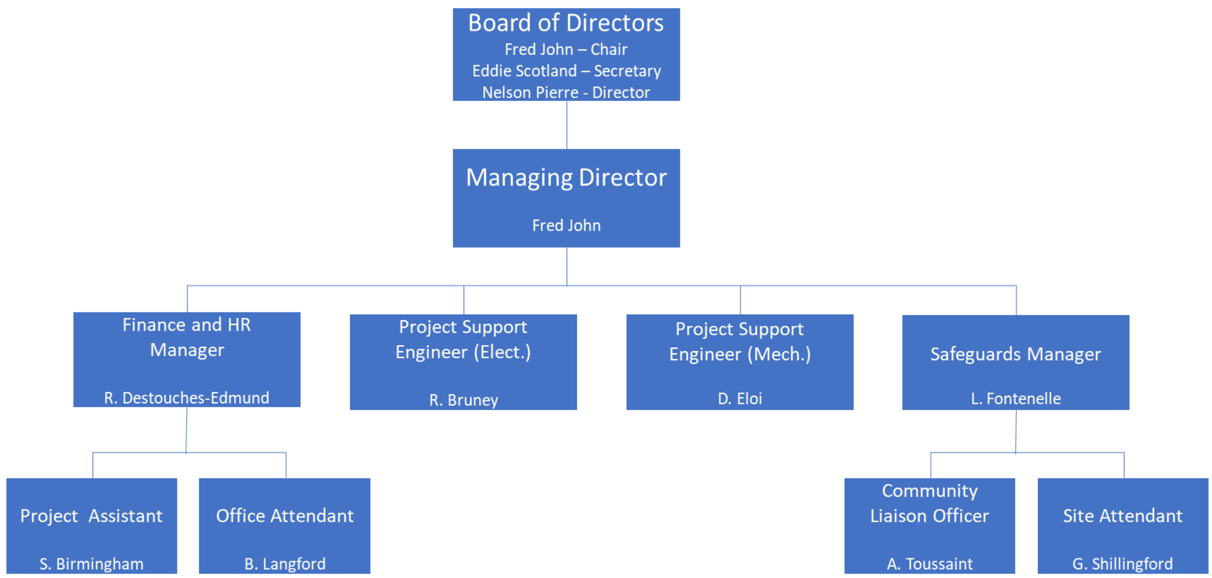
The next review of the Plan is envisioned at the beginning of the construction Phase, in Q3 2022.

***

[2] DGDC-OHS-038 Emergency Procedures.

APPENDICES

Appendix 1: DGDC's Organogram



Appendix 2: Duty Officer on-call Roster

December 2021	wk48	wk49	wk50	wk51	wk52
	30-Nov	07-Dec	14-Dec	21-Dec	28-Dec
Allan					
Dalton					
Garry					
Lyn					
Rawlins					
Rita					
Shisha					

January 2022	wk1	wk2	wk3	wk4
	04-Jan	11-Jan	18-Jan	25-Jan
Allan				
Dalton				
Garry				
Lyn				
Rawlins				
Rita				
Shisha				

February 2022	wk5	wk6	wk7	wk8
	01-Feb	08-Feb	15-Feb	22-Feb
Allan				
Dalton				
Garry				
Lyn				
Rawlins				
Rita				
Shisha				

Appendix 3: Contact Information for Subject Matter Experts

Hurricane: Dominica Meteorological Services
Senior Meteorological Officer
tel. 275 5461; email metoffice@cwdom.dm

Landslide: Cees van Westen
Associate Professor
Natural Hazards and Risk Assessment
Department of Earth Systems Analysis
Faculty of Geo-Information Science and Earth Observation (ITC)
University of Twente
Email: c.j.vanwesten@utwente.nl
Tel: +31 534874263
Skype: cees.van.westen
Web: https://research.utwente.nl/en/persons/cj-van-westen

Earthquake: Seismic Research Centre, UWI, Trinidad
tel. 868 662 4659; email uwiseismic@uwiseismic.com

Volcano: Seismic Research Centre, UWI, Trinidad
tel. 868 662 4659; email uwiseismic@uwiseismic.com

Flood: Office of Disaster Management
tel. 448 7777; email odm@dominica.gov.dm

Appendix 4: Understanding Disaster Risk

Disaster risk is a function of three interlinked components: hazard, exposure, and vulnerability as demonstrated in the exhibit below:

RISK = HAZARD X EXPOSURE X VULNERABILITY

Definitions used from UNDRR Terminology guide:
https://www.unisdr.org/we/inform/terminology#letter-r

Hazard is a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

Exposure is the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

Vulnerability is the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

The Plan is focused only on the risks posed by natural hazards to the geothermal power plant site. The secondary data analysis and consultations with subject matter experts suggest that the historical hazard profile of Dominica includes ***landslide***, ***hurricane***, ***flood***, ***volcanic eruption*** and ***earthquake***. Therefore, the hazard analysis for the geothermal power plant site is concerned with these five natural hazards. For the hazard analysis, the scale of ***highly likely, moderate, low, unlikely*** probability is used.

The exposure and vulnerability analyses are combined in this Plan.

(a) The *exposure analysis* is referred to the assets of the geothermal power plant and the people exposed to the hazard. The exposure analysis is divided into three parts: during the ***pre-construction phase***, during the ***construction phase***, and during the ***operation phase o***f the geothermal power plant.

(b) The *vulnerability analysis* instead is focused on the principal components of the geothermal power generation premises, namely the ***production wellpad (WW-P1)***,

the power plant site, and ***three reinjection wells (WW-01, WW-R1, and WW-03)*** as well as the pipelines and other equipment that connect each of them. Wellpad WW-02, though not part of the generation facilities, is included in this Plan because it belongs to DGDC and as such it is the company's responsibility to maintain it in a safe condition.

The analysis of exposure, vulnerabilities, and eventually, the risk assessment is proposed to carry out for each phase: ***pre-construction phase, construction phase, and operation phase.*** This is explained by the fact that during each of these phases the exposure and vulnerability to the identified natural hazards is different. Hence, during the pre-construction phase, both the exposure and the vulnerabilities to all five hazards are minimal because only few assets are available on the geothermal power plant location. Understandably, during the construction phase the work will be initiated to build the power plant and more people and increasingly more valuable assets will be expected on the site. This will be addressed during the review of the Plan to reflect on the changes in the exposure and vulnerabilities during the construction phase. Similarly, during the operation phase another review of the Plan will be required and new update on the exposure and vulnerability analyses must take place.

The *disaster risk assessment* for the geothermal power plant is concerned with the ***likelihood*** of an event, i.e. a serious disruption of the functioning of the geothermal power plant caused by natural hazards, and the human, material, economic and environmental ***impact*** this event might have. The plausible set of events combined with their consequences is called ***scenario***. In developing scenarios, it is important to consider scenarios that are plausible or possible.

In developing a scenario, it is important to understand (a) the context, (b) the causes or triggers, (c) the event itself, (d) primary consequences, (e) secondary consequences. The proposed approach is concerned with the ***incident scenarios***: a scenario that evolves in a relative short period of time and with a clear major event which has direct negative consequences. An incident scenario can be described by a series of causes and hazards that precede a major event which has direct negative consequences.

For the phase of the geothermal power plant, the decision is made to measure impact across the following three criteria:

- Human life and health
- Economic value and the environment
- Society's functioning

Table 6.1: Classification of likelihood

High	Medium	Low
Frequency		
1 per less than 10 years	1 per 10 to 100 years	1 per 100 to 1000 years

***** This guideline uses Annual Exceedance Probability (AEP), or the chance of the event occurring once in a year.

Table 6.2: Impact criteria and indicators

Impact Criteria	Indicators
Human life and health	1.1 Number of fatalities (0 – 1 - or more than 1)
	1.2 Number of severely injured/ill (0 – 1 - or more than 1)
	1.3 Number of people who need to be evacuated (0 – 5 - or more than 5)
Economy and the environment	2.1 Total economic impacts (0 – 1% - more than 1% of the annual budget of DGDC)
	a. impacts for nature and environment (no additional resources required for recovery from damage – major resources are required for recovery – pre-emergency condition has been lost but some degree of restoration is possible)
Society's functionality	a. Disruptions to everyday life (0 –up to 24 hours disruption – above 48 hours disruption)
	3.2 Loss to cultural heritage (no damage to MTPNP* - minor damage to MTPNP – partial loss beyond recovery)

*Morne Trois Pitons National Park

Important to note that the disaster risk evolves spatially and temporally in response to changes in one or more of its three components (hazard, exposure, and vulnerabilities), and to the inherent interactions between them— i.e., changes in one factor can influence the other factors.

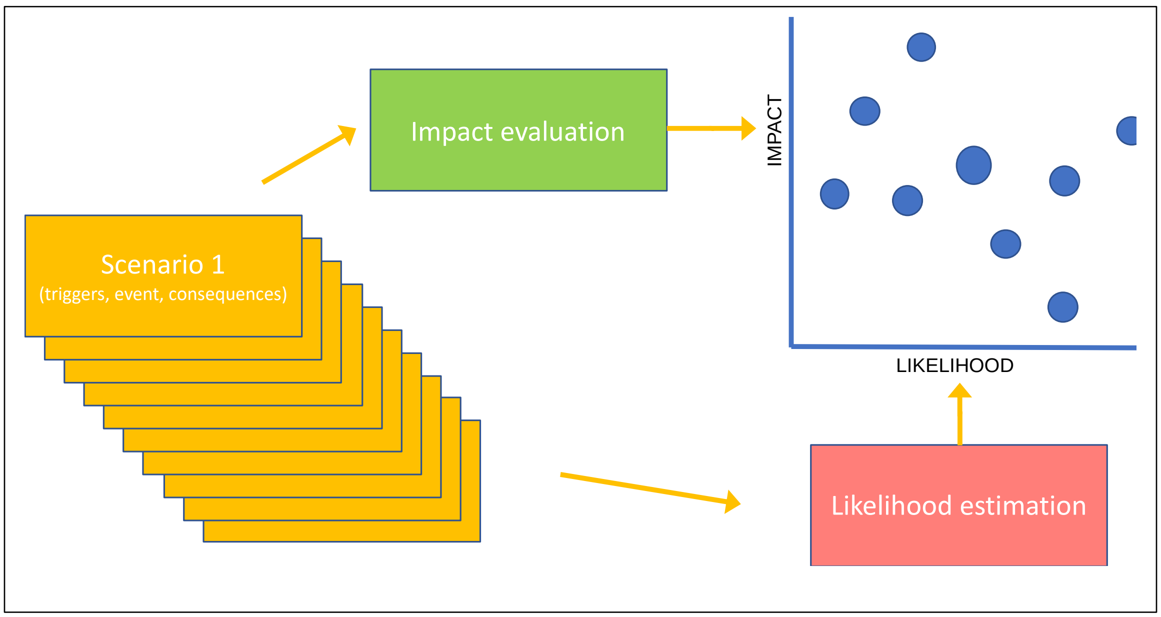
Possible scenarios for the geothermal power plans are identified using the following methods: historical data, literature review and modeling, expert knowledge.

The scenarios of various disruptive events could be addressed, however, the team working on this Plan has chosen to address the ***worst-case scenario***, i.e. *the most severe possible outcome that can reasonably be projected to occur in a given situation – all parameters are in worst position.*

To guide the disaster risk reduction, preparedness and disaster mitigation activities for the geothermal power plant, the expected impact in the worst-case scenario is described in detail. The risk then rated as ***HIGH/ damage to property and people (deep red), MODERATE/ damage to properties and human injuries (yellow), and LOW/ minor or no impact to assets and people (green).***

Disaster risks can be presented in the risk diagram as presented in the Figure 4.

Figure 4: Process of developing disaster risk diagram



Mitigation: The lessening or minimizing of the adverse impacts of a hazardous event.

Preparedness: he knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters.

Based on the results of the assessment, recommendations will be made regarding measures that must be taken in order to prevent or to mitigate the expected impacts. The focus of the prevention work will be on addressing exposure and vulnerabilities. The focus of mitigation work will be on addressing preparedness to respond and recover from a disastrous event.

Critical infrastructure: The physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society.

Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.

Appendix 5: Approach to Scenario Development

Scenario Analysis

The worst-case scenario situations that are possible for each natural hazard, as indicated by subject matter experts, are examined for each of the five areas of the geothermal power generation facility. The highest hazard probability – as indicated by the experts – is used. This exercise is conducted with initial focus on the pre-construction phase. The construction and operation phases will be considered in subsequent updates of this Plan.

Likelihood and Impact

For the agreed worst-case scenario the likelihood is rated as ***low (1), moderate (2), and high (3)***. Also, the level of impact expected from such an event (or a combination of events), is rated similarly as ***low (1), moderate (2), and high (3)***, based on three dimensions of impact:

- Human life and health: (a) number of fatalities, (b) number of severely injured, (c) number of people who need to be evacuated.
- Economy and the environment: (a) *Total economic impacts* and (b) *impacts for nature and environment.*
- (disruption of) Society's functionality / *this one is not yet relevant during the pre-construction phase.*

Risk Level Scores and Color Coding

The total risk level, which is the function of likelihood and impact [Risk level = Likelihood x Impact], is determined and recorded in accordance with the following scale and as illustrated by the matrix in Figure 5 below:

Low (green): scores 1-3
Moderate (yellow): scores 4-6
High (red): score 9

Impact			
High	3	6	9
Medium	2	4	6
Low	1	2	3
	Low	Medium	High
			Likelihood

Figure 5. Risk Colour Matrix

The results of the scenario analysis for the pre-construction phase are presented as the Framework for the DREM Plan on Table 2, in which there is a brief description of each scenario.

Appendix 6: Rationale for DREM Plan

The resilience pathway of the Caribbean region outlined in the CARICOM's *Strategic Plan for the Caribbean Community 2015-2019: Positioning CARICOM* [3] implies building region's resilience to natural and technological hazards and thereby "*to reduce vulnerability to disaster risk and the effects of climate change and ensure effective management of the natural resources across Member States*".[4] However, for Dominica building disaster resilience is of utmost priority. Building disaster resilience and more specifically, climate resilience in Dominica is an existential question conditioning the future well-being and prosperity of the Nature Island.

Located within hurricane belt, this mountainous Caribbean island has suffered devastating consequences of several hurricanes in the past. The recent one, the hurricane Maria (Category 5+)[5] was the worse in the history of Caribbean hurricanes, while Dominica was the most affected country in the region. It hit the country on 28 September 2017.

The findings of the Post-Disaster Needs Assessment (PDNA) of hurricane Maria issued by the Government of Dominica and implemented by the WB in conjunction with the UN, ECCB, and CDB, and the EU revealed the scale of its devastating impact. Hence, the estimated damages reached $931million and losses $382million, with total recovery needs of almost $1.3billion, which amounts to 226% of its 2016 gross domestic product (GDP).[6]

As a volcano island, Dominica remains prone to volcanic eruptions – while all other Lesser Antilles islands have only one active volcano, Dominica has nine[7] and is considered '*…the most worrying of all the Caribbean volcanic areas….*' [8] – and continuous frequent seismic swarms and vigorous widespread geothermal activities. As a volcano island covered by rainforest, Dominica is also prone to large number of landslides and floods. A large-scale landslide inventory/study carried out by the University of Twente after hurricane Maria (also available at UNITAR UNOSAT), shows that the hurricane Maria has triggered in total of 9,960 landslides, which include 8,576 debris slides, 1,010 debris flows and 374 rock falls.[9] The hurricane was paired by heavy rain as a result of which almost all rivers flooded due to intensive precipitation.

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[3] Strategic Plan for the Caribbean Community 2015-2019: Positioning CARICOM: https://caricom.org/STRATEGIC%20PLAN%202016_opt.pdf

[4] Ibid.

[5] To be classified as a hurricane, according to the Saffir–Simpson hurricane wind scale, a tropical cyclone must have one-minute maximum sustained winds of at least 74 mph (33 m/s; 64 kn; 119 km/h) (Category 1). The highest classification in the scale, Category 5, consists of storms with sustained winds exceeding 156 mph (70 m/s; 136 kn; 251 km/h). However, it is noticed that the sustained winds increasingly exceed the margins set in the Saffir-Simpson scale. The hurricane Maria in 2017 was classified as 5+.

[6] Post Disaster Needs Assessment Hurricane Maria, A Report of the Government of the Commonwealth of Dominica, September 2017

[7] http://caribbeanvolcanoes.com/dominica-geology/

[8] Ibid.

[9] https://www.unitar.org/unosat/maps/114

Dominica remains highly exposed to various disaster risks that are further exacerbated by changing climate. In the meantime, after the hurricane Maria, Dominica is left with sky-high recovery needs, heightened recognition of the importance of disaster management and resilience building, and a major commitment to build the first climate resilient nation in the world. For the purpose of the latter, the Government of the Commonwealth of Dominica together with its development partners created and launched the Climate Resilience Agency of Dominica (CREAD)[10] in 2018.

Contributing towards increased disaster resilience of the country and building upon its safety and security priorities, the management of the DGDC aims to ensure disaster resilience of the key critical infrastructure in the country, i.e. the first geothermal power plant of Dominica.

The ***Disaster Risk and Emergency Management Plan*** for DGDC has been developed with due consideration of natural hazards. The Plan will be supplemented with the Emergency Management procedure to be activated and comply in case of *force majeure* situation.

[10] http://news.gov.dm/index.php/news/4546-climate-resilience-execution-agency-of-dominica-launched

Appendix 7: Emergency Call Register

To be documented and reported by the Duty Officer for emergency calls received during his/her rostered time on shift

REPORTED BY:________

DATE OF REPORT: __________

POSITION: _______

TIME OF REPORT: __________

DATE OF CALL: __________

INCIDENT TYPE: ___________

TIME OF CALL: __________

LOCATION: ____________

INCIDENT DESCRIPTION: ____

____

____

CONTACTS OF THE CALLER: _____________

NUMBER OF PEOPLE INJURED (M/F): _____________

DAMAGE TO INFRASTRUCTURE:____________

DAMAGE TO ENVIRONMENT: ______________

DAMAGE TO COMMUNITIES: ______________

ACTIONS TAKEN BY DUTY OFFICER: ____

OTHER RELEVANT INFORMATION: _____________________________________

Appendix 8: Scientific References

Evaluation of landslide susceptibility for geothermal project area

Cees van Westen

Faculty ITC, University of Twente, Enschede, the Netherlands

c.j.vanwesten@utwente.nl

Introduction

The Dominica Geothermal Development Company (DGDC) (www.geodominica.dm) is a wholly-owned company of the government of Dominica with the mandate to construct the first geothermal power generating station on the island of Dominica in the eastern Caribbean. The project, funded by the World Bank and EU/AFD among others, is currently at the stage in which financing agreements have been signed and the tender documents are about to be advertised for the invitation of bids for the award of an Engineer, Procure and Construct (EPC) contract to build a 7 megawatt plant, along with its associated steam field and reinjection pipeline.

At this moment the DGDC is working on the development of a Disaster Preparedness, Mitigation and Risk Management Plan, focusing on natural hazards that are likely to impact the proposed power plant during three phases of development, viz: pre-construction, construction and operation & maintenance. As part of this exercise DGDC is looking to hold discussions with subject matter experts related to each of the hazards identified. ITC has been involved in the World Bank CHARIM project (www.charim.net) and has carried out investigation on landslides in Dominica.

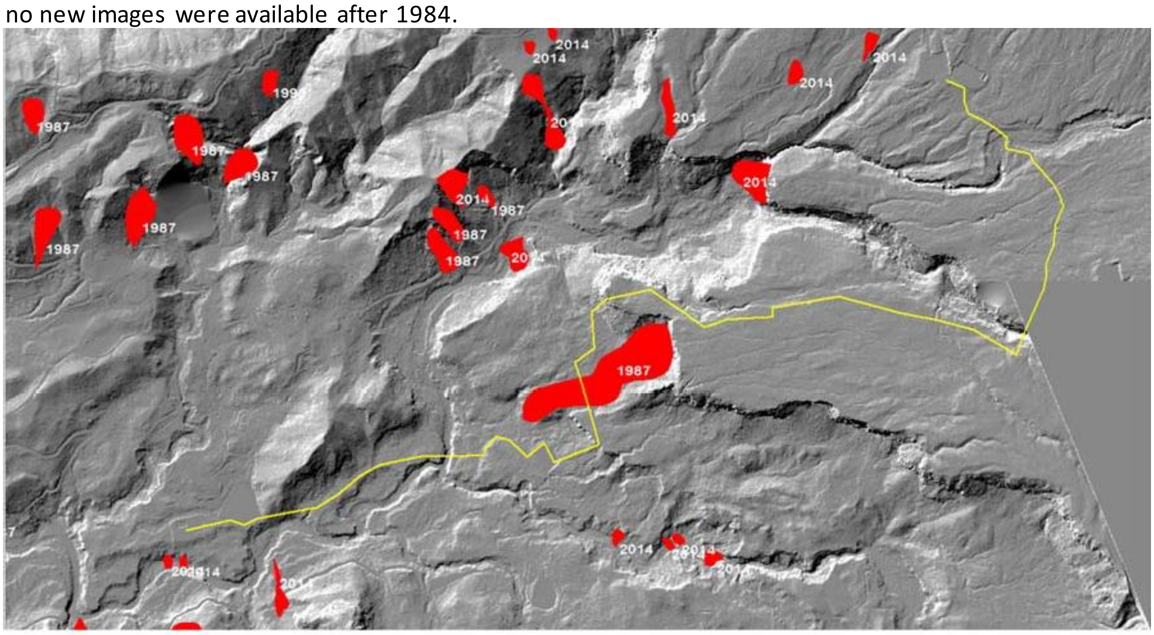
This document is aimed to support the discussion on the exposure of the plant to landslides, so as to help DGDC to determine the level of risk that exists. Figure 1 indicates the location of the project.

Figure 1: Location of the proposed geothermal project

Historical landslides

We have evaluated the occurrence of historical landslides in the area that might be of influence to the project. This is based on our previous work. The landslide report for Dominica can be downloaded here:
http://www.charim.net/sites/default/files/handbook/maps/DOMINICA/Landslide_susceptbility_report_Dominica.pdf

The first map on which landslides related to a triggering event are indicated is from a study related to the impact of Hurricane David in 1979. This very devastating hurricane could be seen as the worst case scenario for Dominica, given the reported casualties and damage. However, the map doesn't indicate actual landslide location, but merely the stretches of road that have to be repaired because of landslides. A full overview of the landslides caused by this category 4 event (which is considered to have a return period around 125 years) is not known. Walsh (1982) reported that small rotational failures triggered by Hurricanes David and Frederic were only noted on cultivated slopes. The baseline study for landslides in Dominica is the work carried out by Jerome DeGraff from the US Forest Service for the OAS in 1987. He carried out detailed image interpretation of landslides using detailed stereoscopic image interpretation of 1:20,000 scale black and white aerial photographs, which were taken in 1984, so five years after the occurrence of Hurricane David, which was very destructive in Dominica. DeGraff revisited the area several years later in 1990 to check the quality of the earlier landslide zonation, and he mapped the landslide that occurred in the years 1987-1990 (DeGraff, 1990). In this period two hurricanes produced significant rainfall amount (1987 Emily, 1988 Gilbert, and 1989 Hugo) and also a number of tropical storms and other rainfall events occurred. He only used field verification to map the new landslides, as no new images were available after 1984.



1987 Historical landslide with year in which it occurred
1987 and 1990 are based on two inventories made by J. deGraff based on airphoto interpretation.
2014 is an inventory made by C.J. van Westen based on high resolution satellite images.

Figure 2: Historical landslide inventory before hurricane Maria in 2017

As part of the CHARIM project we carried out a detailed landslide inventory that complements the earlier ones, and that portrays the current situation, incorporating also the older landslide inventories into a single new and comprehensive analysis. We obtained through the EU FP7 Copernicus project INCREO (http://www.increo-fp7.eu/) the possibility to order very high resolution satellite images (Pleiades images, with 0.5 m spatial resolution for panchromatic and 2 m multi-spectral) for Dominica. The high resolution images from 2014 covered different parts of the island, and also had sometimes serious cloud coverage which didn't allow us to map the entire island. Therefore we decided to carry out an extensive interpretation of landslides using different sets of satellite images, and also using historical imagery from Google Earth Pro.

We also carried out an evaluation of the landslides caused by Tropical Storm Erika in 2015. However, in this part of the island this event did not cause major landslides.

Landslides during hurricane Maria

The largest triggering event that caused many landslides, debris flows and flashflood was hurricane Maria. Hurricane Maria which hit Dominica on September 18 2017, is regarded as the most destructive natural disaster that has affected Dominica in the last decades.

A large scale landslide inventory was carried out by a team from the University of Twente, use of 5 scenes of Pléiades satellite imageries with resolution of 0.5m, which were obtained in September 23 and October 5 after the hurricane, made available through UNITAR-UNOSAT. Apart from these also a series of Digital Globe Images were used that were collected for the Google Crisis Response through a KML layer. The images were visually interpreted by image interpretation experts, and landslides were mapped as polygons, separating scarp, transport and accumulation areas, and classifying the landslides in types. Unfortunately, due to cloud coverage in all available images.

Figure 3 shows the inventory of landslide and debrisflows/flashfloods for the study area. We also mapped the areas affected by flashflood and or debrisflows along the river channels by mapping unvegetated areas and accumulations of debris. From the image interpretation it was not possible to differentiate whether these were caused by flashflood, hyperconcentrated floods or debrisflows.

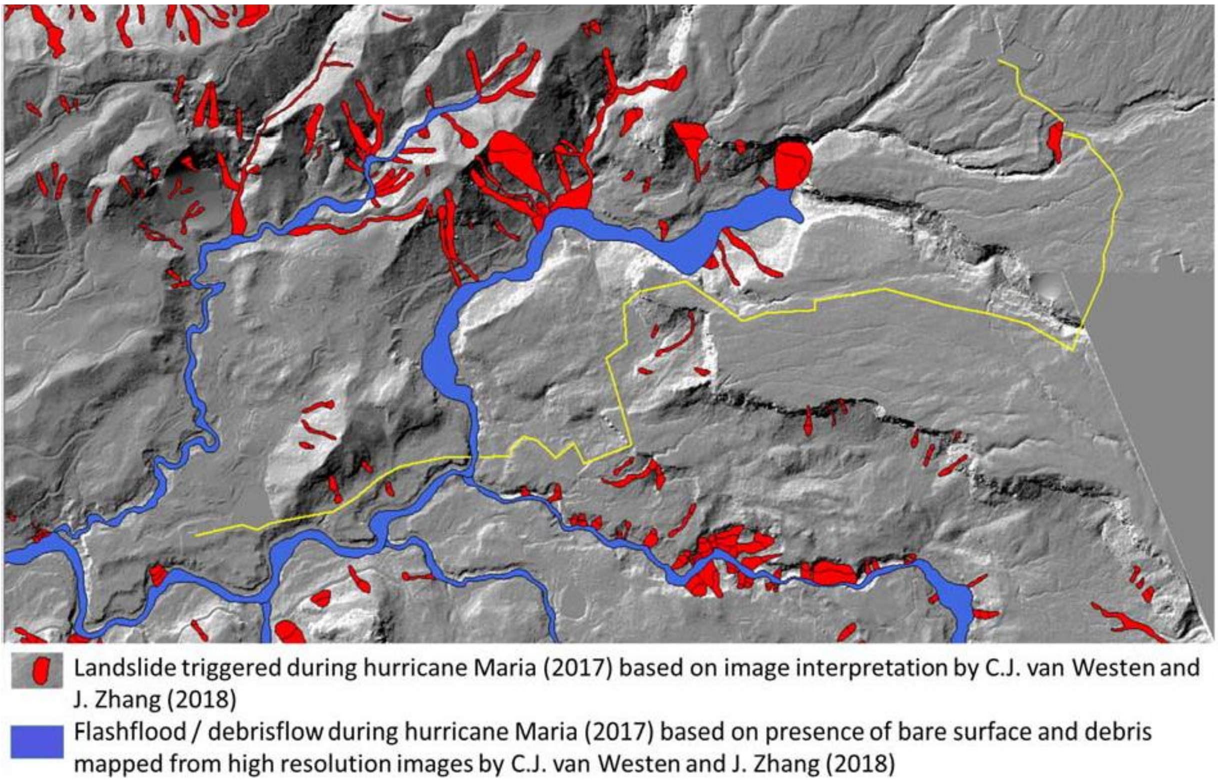


Figure 3: Landslides and flashflood/debris flows triggered by hurricane Maria

Landslide susceptibility map

Based on the historical landslides and on causal factor maps , including the new LIDAR-based digital elevation model that was made available through the World Bank recently, we carried out an update of the landslide susceptibility evaluation for the project area. The evaluation was done based on the landslide susceptibility map which was produced within the CHARIM project and which can be downloaded here:
http://www.charim.net/sites/default/files/handbook/maps/DOMINICA/Dominica%20Landslide%20susceptibility%20Map.pdf
The map was updated after Tropical storm Erika. However, due to the occurrence of Hurricane Maria , the number of landslides in Dominica increased enormously. Although the landslide locations generally fitted well with the landslide susceptibility zones, it is important to generate an updated landslide susceptibility map. We are currently in a process with the World Bank to come to a new contract to update the landslide susceptibility map for Dominica. But the map is currently still not available. The availability of the high resolution Digital Elevation Model from the LIDAR data will certainly improve the quality of the landslide susceptibility map. Other factor maps, such as soil types and soil depth, and geology are currently also considered for updating.
We used the hillshading maps of the Digital Surface Model (containing also building and vegetation) and the Digital Terrain Model (bare surface model) to make an updated landslide susceptibility map for the project area. In the east part we were constrained by the absence of DTM data, as the LIDAR data is not available for the central mountainous part of Dominica, due to persistent cloud cover. We interpreted the terrain and subdivided it into four classes: historical landslides, high, moderate and low susceptibility (Table 1).

Table 1: Mass movement susceptibility classes

Class	Explanation
Low	This class generally is landslide free, although under special circumstances it may be possible that a landslide might occur in this zone, but the density and frequency will be very low.
Moderate	This class has some probability that landslides might occur, although not very frequent and not with a high density.
High	This class has conditions related to slope conditions and soil materials that mass movements might be expected during future triggering events. Many of these areas experienced landslides in the past decades.
Historical landslide	Historical landslide / debris flow / flashflood activity. This area has experienced the impact of a mass movement before, and is therefore considered to be dangerous, unless mitigation measures are carried out.

We have made a mass movement susceptibility map, and not a mass movement hazard map. This means that we didn't indicate the expected frequency of mass movements, nor the expected size or magnitude. This requires more detailed studies, and more detailed historical data on landslide occurrences and rainfall records, than that are now available for Dominica. However, we are also working on physically based multi-hazard modelling approach for Dominica where we can model the expected areas of instability and flooding based on given rainfall scenarios. This would be part of the upcoming World Bank funded project for updating the landslide susceptibility map for Dominica.

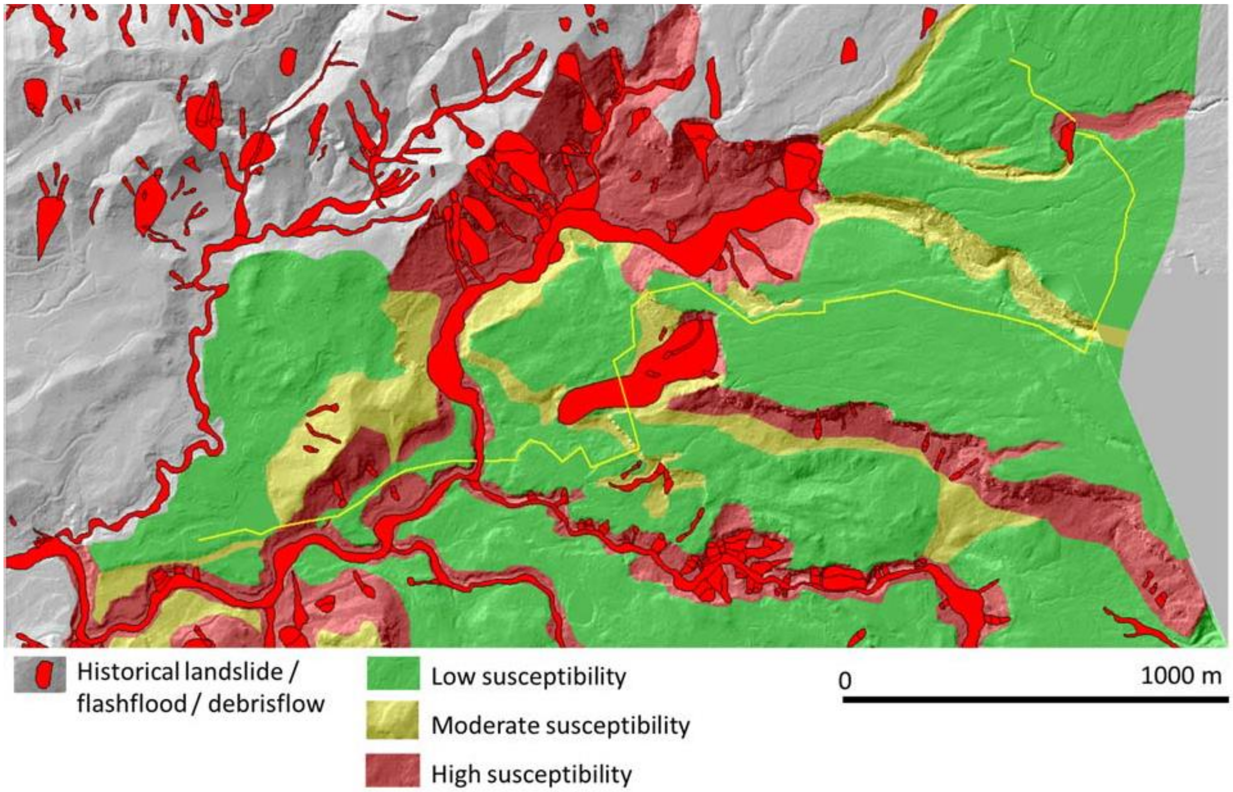


Figure 4: Landslide and flashflood susceptibility map for the project area.

Areas of specific interest

Based on the landslide susceptibility assessment we have outlined a number of points where the geothermal project might be exposed to landslides. These are summarized in the table 2.

Table 2: Area of specific threat to mass movements and floods

Location	Specific interest
A	Crossing of a Titou Gorge, where there was a landslide triggering by hurricane Maria. This site might experience a landslide of small size in future, and slope should be properly stabilized.
B	Here the pipeline crosses a major landslide that occurred most probably during hurricane David in 1979 and was mapped by DeGraff in 1987. Since then there were no major reactivations (although some minor events occurred during hurricane Maria). The location has the potential that it may be affected by another landslide in a future event. The recommendation is to deviate the pipeline a bit to avoid this area,
C	Crossing of a stream that had active flashflood/debris flow in hurricane Maria, and where there are many landslides in the upper section, thus carrying substantial volumes of sediments and tree debris during a flash flood event. Care should be taken to cross the channel high enough to avoid impact by future events.

D	The pipelines passes above an old landslide that was probably caused by river undercutting. The landslide could be old, and wasn't active in the period 1987 to 2018. But based on the topography it is a clear old landslides, and if reactivated might retrogressively affect the pipeline. Also minor landslide activity from the upslope part can be expected.
E	Pipeline crosses a section with a steep slope that is undercut by a stream, which had flashflood / debris flow activity during hurricane Maria. Further undercutting might destabilize this slope.

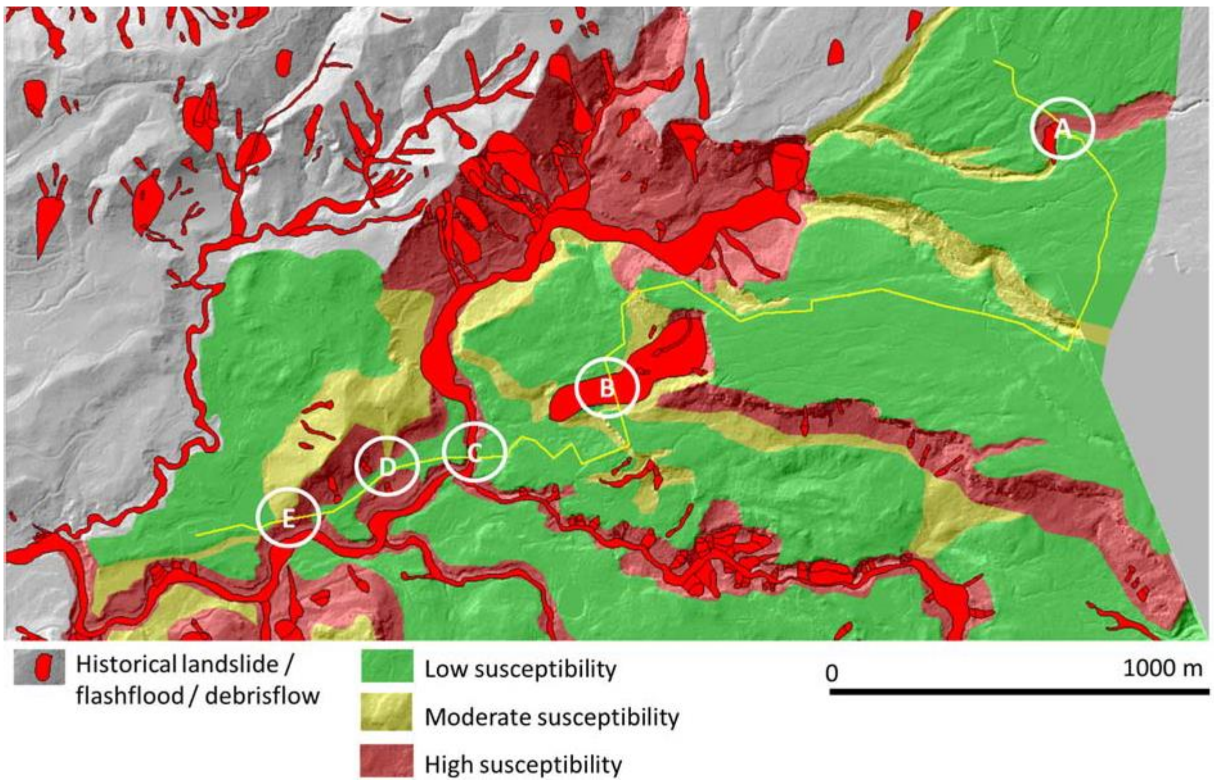


Figure 5: Location of areas with specific attention to threats of mass movements.

Conclusions

Although the geothermal plant is located in a zone with low landslide susceptibility, the route of the reinjection pipeline runs through some dangerous locations with respect to landslides and flashfloods. Five locations have been identified, which may have to be further studied. Large volumes of sediments and tree trunks can be expected when a major triggering event occurs.

I agree with the statement given in the DGDC Post Hurricane Maria Report: Steeper hillside vegetation has been badly damaged which could lead to further erosion and slips (see DGDC Post Hurricane Maria Report, Figure 16). Major landslides evident which could destabilise further in time should another storm event occur. We are planning to study the recovering of vegetation in relation with instability with one of our MSc students this year.

Considerations for volcanic and seismic hazard to geothermal plan in Dominica

RESPONSE TO DOMINICA GEOTHERMAL DEVELOPMENT COMPANY LTD RE: EARTHQUAKE AND VOLCANIC ACTIVITY AND HAZARDS IN DOMINICA.

Background

The Commonwealth of Dominica is in the process of Disaster Preparedness, Mitigation and Management Plan for a proposed geothermal power generating facility in the Roseau Valley in Dominica. Given our mandate[1], the UWI-SRC was contacted by Mr Rawlins Bruney, of the Dominica Geothermal Development Company Ltd, in May 2019, requesting our assistance in this process with regard to seismic and volcanic hazards. Following several telephone conversations, email exchanges and a teleconference, it was agreed that we would provide a brief outline on existing hazard maps by Tuesday 28 May 2019. Furthermore, we indicated our intention to provide additional advice with respect to the ongoing monitoring and assessment of hazards and risks associated with the geothermal operation. This document is our assessment. Copies of some relevant papers and hazard may be found here: https://drive.google.com/open?id=1dYp1yEO2D1a5RYVYaA8Z1nWQ3U8kqgRH

Seismic & Volcanic Activity & Hazard

The latest and most comprehensive study of volcanic activity in Dominica may be found in the Dominica chapter of the Volcanic Hazard Atlas (Lindsay 2005). Additional research has been done since then by other workers, the most significant with respect to having hazard implications are the publications of Smith et al (2013) and Howe (2014a, 2014b, 2015).

The latest assessment of earthquake hazard for Dominica is the update of the probabilistic seismic hazard maps of the Eastern Caribbean (including Dominica), which was undertaken by the UWI-SRC in collaboration with the EUCENTRE, Pavia, Italy. The results of that work were published (Bozonni et al. 2011) and copies of the maps, along with associated documents, are available on the SRC website (see http://uwiseismic.com/seishaz.aspx).

Recommendations

1. Site-specific study

The 2011 Eastern Caribbean seismic hazard maps (Bozonni et al. 2011) use two methodologies for the calculation of the Probabilistic Seismic Hazard: the standard

Cornell- McGuire approach based on the definition of appropriate seismogenic zones, and the zone- free approach developed by Woo (1996), which overcomes the ambiguities related with the definition of seismic sources. The seismic hazard study includes an analysis of regional historical seismicity, along with an assessment of the seismic potential of known seismogenic sources. The seismic hazard maps show contours of various intensity measures of ground shaking (peak ground acceleration and spectral acceleration at 0.2 and 1.0 second) that are associated with specified probability of exceedance for periods of engineering interest. The intensity measures are calculated for rock sites using grid nodes spaced 0.025 degrees (2.8 km) apart and computations were performed for four return periods (95, 475, 975 and 2475 years). There is ongoing debate as to whether the parameters used to define maximum magnitude in the hazard analysis (tectonic constraints and maximum historical observed magnitude) are sufficiently robust, particularly for critical infrastructure. Moreover, the International Building Code (code recommended/mandated by the civil authorities in Dominica) has revised the seismic coefficient for the design of critical infrastructure to cater for ground motions of return period of 5000 years

Based on these considerations and in light of the potential critical nature of the geothermal plant, in the context of Dominica, we recommend that a site specific study of the area be done. Such a study will produce important subsurface geological detail that play a key role in seismic motion at the surface. This insight, within the constraints of current understanding, should lead to a more appropriate earthquake resistant engineering design.

2. Ongoing monitoring

Earthquake activity, or seismicity, is generally caused by displacement along active faults in tectonically active zones (Kagel et al, 2007). An earthquake occurs when a rock mass ruptures and radiates seismic waves that produce ground vibration (i.e. shaking of the ground). Although it is generally a natural process, seismicity may be induced by human activity, including the development of geothermal fields. Small earthquakes often occur during the development of hydrocarbon and geothermal reservoirs, particularly when fluid, under pressure, is injected into a borehole, in what are variously called stimulations, hydraulic injections, hydro fracturing and, colloquially, “fracking” (Stewart, 2013). In these cases, the resulting seismicity is usually low-magnitude events, known as “micro- earthquakes”. Humans do not generally feel such earthquakes, which are of magnitudes less than 2 or 3. They are centred on the injection site and are not considered to be a hazard to the geothermal power plants, or the surrounding communities. Most would go unnoticed unless sensitive seismometers are located nearby. However, there was one well-known example of earthquakes of magnitude >3.0 induced during such geothermal exploitation in Basel, Switzerland (Bachmann et al. 2011).

A significant level of seismicity may be induced by geothermal plant operation due to perturbations in the effective stress caused by fluid injection and contraction of the geothermal reservoir (Fialko and Simons, 2000). Because geothermal operations are usually conducted in areas that are also tectonically active, it is often difficult to distinguish between geothermal-induced and naturally occurring events (Kagel et al., 2007). Given the potential for altering the seismic signature during geothermal development, it is important to carefully monitor seismic activity throughout the exercise. Induced microseismicity is often monitored using a microseismic network that is used as a tool to track the movement of the injection fluid and to determine the extent of the reservoir. The microseismicity data can, in conjunction with other data, be useful for identifying additional drilling targets within the reservoir (e.g. Richards et al, 1994; Rothert and Shapiro, 2003; Maxwell et al, 2010; Simiyu, 2011; Fang et al. 2018).

Based on the issues outlined above we propose that serious consideration be given to the establishment of a mechanism to effectively monitor the seismic activity in and around the planned geothermal facility. The SRC has presented a proposal in the past, to the Geothermal Project Management Unit, to undertake this work and can easily update and resubmit, if there is an expressed interest in pursuing this matter by the Company.

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APPENDIX E UPDATE OF THE DISASTER RISK MANAGEMENT PLAN

The disaster risk management plan must develop the following table of contents and template:

- Introduction. Present the context, background of events and their DALAs, applicable regulations, purpose of the plan, etc.

- Responsible for overviewing the Plan. Depending on the regulations of the previous section, the type of infrastructure and hazard exposure.

- Risk study. Summarize or refer to the analysis already carried out for the case backing the plan, as well as related studies e.g. geology, hydrological-hydraulic.

- List of measures for risk mitigation (both structural and non-structural):

• the detailed description of the measure;

• its type (structural/non-structural);

• responsible(s) for its application and follow-up;

• stage of application of the measure within the life cycle of the project (design, construction, operation, maintenance);

• priority of implementation;

• application term (short, medium, long term);

• monitoring indicators (baseline indicator, target indicator);

• estimated implementation budget – orientative to include in the corresponding component of the loan.

- Emergency Response Plan. In the event of the materialzation of an extreme event, establish the actions, persons in charge, resources to be made available, simulacrum exercises, definition of the decision system, communications and monitoring in emergencies, among others.

- Socialization Plan. Ways to carry out a successful socialization of the PGRD.

- Monitoring Plan. Including monitoring indicators and those responsible to follow their progress, outlining how it is going to be monitored, how often, those responsible, etc;

- Period of validity and update of the Plan.

Measure #1: Name the risk reduction measure	
Type of measure: [Structural or non-structural]	
Natural Hazard: [Indicate the hazard to be mitigated. It can be a measure for hazards in general, or specific to floods, landslides, hurricanes, droughts, etc.]	
Measure Description: [Describe the specific measure or action to be implemented to manage and control the risk to the defined threat.]	
Implementation Timeline or Project Phase: [Design, Construction, Maintenance and Operation]	Frequency of implementation: [indicate whether it is done every three months, six months, every year, etc.]
Specifications: Material or equipment: Personnel involved: Responsible:	
Budget: [Indicate estimated implementation cost for the proposed measure]	
Follow-up and monitoring: [Follow-up, supervision and monitoring activities]	Monitoring Frequency: Compliance Indicator:
Stakeholder Responsibility and Participation: [Indicate agencies and institutions responsible for this action]	

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ERM's DC Office

1776 I St. NW
Suite 725
Washington, D.C. 20006

T +1 202 466 9090
F +1 202 466 9191

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