8.0 Identification of Mitigation Measures and Development of Management Plans

8.1 MITIGATING IMPACTS THROUGH THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The management and mitigation commitments contained in the EIS were taken forward during the development of the ESMP for the Project (see Section 3.1.2).

All environmental and social management and mitigation commitments made by Esso Highlands Limited are identified in the PNG LNG Project Environmental and Social Mitigations Register, which is used to track and document the implementation and status of each commitment. The register is updated as necessary to incorporate new commitments that arise as construction progresses. It includes site-specific mitigation and management measures resulting from preconstruction environmental and social surveys and other alternative and/or additional measures identified as Project execution progresses and lessons learned from field programs are documented.

Some key environmental impacts relating to biodiversity in the Upstream Project Area, as listed in Table A5.4 of Appendix 5, are addressed in the following Esso Highlands Limited environmental management plans:

- ESMP Appendix 1: Ecological Management Plan.
- ESMP Appendix 8: Weed, Plant Pathogen and Pest Management Plan.
- ESMP Appendix 9: Erosion and Sediment Control Management Plan.
- ESMP Appendix 11: Reinstatement Management Plan.
- ESMP Appendix 12: Induced Access Management Plan.
- ESMP Appendix 31: Quarantine Management Plan.

The scope of these plans and key management measures contained therein are discussed below.

Environmental preconstruction surveys will be undertaken both by Esso Highlands Limited and its contractors in order to further define environmental characteristics on a site specific basis, assess the associated potential environmental impacts to enable measures to prevent, reduce, mitigate, and otherwise manage and control such impacts.

8.1.1 Ecological Management Plan

The objectives of the Ecological Management Plan are to reduce the impacts on habitat and specific ecological aspects arising from construction activities. It addresses the impacts of habitat loss, edge effects in high-altitude karst, barrier and erosion impacts in high-altitude karst, and barrier and erosion impacts in high cuttings.

The focus of the Ecological Management Plan is twofold: to protect particularly susceptible features from direct impacts; and to pay due attention to preventing indirect impact processes that could survive the period of direct impacts. It applies at all three scales of biodiversity values.

Environmental preconstruction surveys are undertaken prior to construction and the Ecological Management Plan requires these surveys of all Project worksites to identify not only focal habitats but also karst pinnacles that may contain bat colonies, bird-of-paradise and bowerbird display grounds or trees, large individual trees, *Pandanus* swamp forest, *Nothofagus* forest that will require special hygiene measures and IUCN-listed species.

The outcome of the surveys are defined GPS-registered constraints/sensitivities for avoidance, definition of further measures/methods to reduce and mitigate impacts on sensitive ecological features, such as seasonal constraints (breeding and lekking periods, migratory stop-over or pass-through periods, etc.) and identification of sections of access ways/infrastructure that require area or site-specific rehabilitation and revegetation intervention.

Please refer to the Ecological Management Plan for further details.

8.1.2 Weed, Plant Pathogen and Pest Management Plan

The objectives of the Weed, Plant Pathogen and Pest Management Plan are to prevent the introduction and spread of alien species and diseases in the Project Areas during construction works, identify and contain, suppress or manage significant weeds, plant pathogens and pests already in the Project Area to prevent spread by Project activities and implement measures to reduce the risk of spread of dieback in *Nothofagus* forests.

The scope of this plan includes measures to address (i) new weeds, plant pathogens or pests[20] imported into the Project Area from contaminated vehicles, machinery, equipment and/or freight and (ii) weeds, plant pathogens and pests spread by Project activities from existing infestation/dieback areas.

The plan requires preconstruction surveys to identify activities that present a high risk of spreading weeds and pests[21], construction areas that are high risk for new weed and pest invasion[22], particular weeds and pests for surveillance, control and management, including compilation of a list detailing priority weeds and pests[23] and common weeds, *Nothofagus* forest susceptible to fungal disease and associated dieback that will require special hygiene measures, areas of *Nothofagus* dieback and areas of infestations of priority weeds or pests that require management.

Control of priority weed species is required to prevent them becoming further established at Project worksites and to prevent the spread of priority weeds beyond their current distribution. Monitoring for the presence of weed species identified during preconstruction surveys shall be undertaken during construction and, when encountered, priority weeds species shall be appropriately controlled. Topsoil from Project worksites shall not be transported offsite nor stockpiled directly adjacent to natural drainage lines.

To facilitate the control of weeds, plant pathogens and pests, vehicle washdown facilities will be installed at strategic locations to prevent contamination of priority ecosystems.

8.1.3 Erosion and Sediment Control Management Plan

The objectives of the Erosion and Sediment Control Management Plan are to maintain stable landforms to reduce erosion and enhance reinstatement, maintain integrity of assets (through stable landforms) and reduce adverse impacts on stream water quality, and associated beneficial values, and in-stream sedimentation. It addresses the impacts of habitat loss, edge effects in high-altitude karst, barrier and erosion impacts in high-altitude karst, and barrier and erosion impacts in high cuttings.

The scope of the plan includes measures to address destabilized landforms and soil erosion potentially resulting in reduced water quality and/or reinstatement success, loss or degradation of topsoil from cleared areas, potentially resulting in reduced reinstatement success and runoff from cleared and disturbed areas causing increased suspended solids/turbidity and in-channel sedimentation, potentially resulting in reduced water quality with consequent reduction in availability of aquatic resources and suitability of water for drinking.

Project contractors are required to assess and establish erosion and sediment control requirements for each worksite (particularly in relation to site-preparation earthworks, road construction across watercourses, watercourse diversions, site drainage), detailing specific erosion and sediment controls to be implemented (e.g., diversion drains, sediment ponds and fabric silt curtains).

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[20] An exotic weed or pest is defined as an invasive (native or introduced) or introduced species that causes an adverse impact on the ecology and/or communities.

[21] High risk is defined as anything that a weed or pest can attach itself to, or be transported by.

[22] High risk is defined as an area that intersects a priority ecological area, i.e., Hides Ridge, or anywhere that has potentially uncontrolled access.

[23] Weeds and pests that have a high potential for significant adverse impacts if an incursion occurs or spread from an existing incursion occurs.

8.1.4 *Reinstatement Management Plan*

The objectives of the Reinstatement Management Plan are to establish stable landform conditions in areas disturbed as a result of construction activities and create ground conditions conducive to natural plant regeneration. It is another plan addressing the impacts of habitat loss, edge effects in high-altitude karst, barrier and erosion impacts in high-altitude karst, and barrier and erosion impacts in high cuttings.

No specific surveys are required for the plan as part of the environmental program; however, preconstruction pipeline engineering surveys will be undertaken, which will include the collection of data required to facilitate reinstatement planning.

Project contractors are required to develop site-specific reinstatement plans based on land systems or equivalent and address ground-preparation activities, interim and permanent soil erosion and sediment management issues, and approaches to revegetation (natural regeneration versus intervention). Project contractors are required to undertake site reinstatement promptly and progressively as works are staged, and as soon as possible after disturbance, taking into account the nature of subsequent Project activities that will be undertaken at the same sites and agreed end uses.

8.1.5 *Induced Access Management Plan*

This plan is entirely focused on managing the potential impact of induced access. Its objectives are to control access to new Project roads and reduce the occurrence of potentially damaging non-Project activities.

The planned approach for controlling access is an integrated management process that involves:

i) Use of natural terrain features and conditions to control access e.g., steep slopes, watercourses.

ii) When no longer required, removal of strategic Project infrastructure to control access.

iii) Installation of operational controls, e.g., security guards, physical barriers.

Additionally there are three specific measures for particular sections.

1. **Controlling Access for the Southern Access Route**[24]**:** the road from Gobe to Kantobo will be closed at the end of the construction phase to prevent induced access. A combination of natural terrain features and the removal of two culverts will prevent through access in the Southern Access Route.

2. **Kantobo Section:** the removal of culverts will occur at the end of the construction phase. Natural terrain and removal of culverts will prevent future passage of traffic.

3. **Gobe Section:** the removal of culverts will occur at the end of the construction phase.

8.1.6 *Quarantine Management Plan*

The Quarantine Management Plan has been developed to prevent the importation and spread of pest, plant pathogen or disease (invasive species) via Project personnel or cargo and ensure full compliance with all PNG laws and regulations.

[24] The Southern Access Route is a Project-developed logistics route between Kopi in the south and Hides in the north. It involves construction of new and repairs to existing sections of roads and bridges to allow transport of essential equipment and machinery to develop the facilities and infrastructure in the Upstream Project Area.

The objectives of this plan are to:

i) Prevent the importation and spread of pest, plant pathogen or disease (invasive species) via Project personnel or cargo.

ii) Ensure full compliance with all PNG laws and regulations.

iii) Facilitate expedient quarantine clearance of all freight imported into PNG for the Project.

iv) Implement effective quarantine control measures for the export of Project freight.

This plan is focused on prevention before either freight or personnel arrive in PNG. This is directly compatible with PNG Government policy, which, in view of the high quarantine risk associated with the import of goods such as new and used vehicles, plant and machinery, requires offshore cleaning and inspection before cargo is exported to PNG.

8.1.7 Fire Management

Prevention and response to fires (including wildfires) is addressed as part of the Project Safety Plan.

8.2 EXAMPLES OF MITIGATING IMPACTS ON VALUES

The majority of the mitigation and management commitments from the ESMP are applicable to the Upstream Project Area, priority ecosystems and the focal habitats. More specifically, 199 have been identified that apply to all three aspects. Appendix 3 includes the number of mitigation and management measures included in each ESMP appendix.

8.2.1 Upstream Project Area

There are 33 mitigation and management measures from the ESMP that are specific to the Upstream Project Area. Examples of these include:

- The standard pipelines' right-of-way (ROW) width for the Project is 30 meters. The pipeline ROW disturbance area should be limited to a 5-meter-wide buffer either side of the standard pipeline ROW, where practicable. Following construction, the ROW will be allowed to naturally regenerate except for a 15-meter-wide swathe to provide a gap in the canopy for aerial surveillance of the pipeline. If there is a requirement to exceed the ROW design width, the contractor shall seek approval through a formal procedure from Esso Highlands Limited.
- Design the modified and new wharfs at the Kopi Shore Base to take account of channel characteristics of the lower Kikori River that may affect the long-term stability of the river frontage.
- The construction and reinstatement of the pipeline ROW in the Omati River swamp area will be managed to maintain natural hydrologic flows and connectivity in the surrounding area. Monitoring of vegetation condition in the vicinity of the pipeline ROW will be conducted to assess the need for post-construction remedial works in this area.

8.2.2 Priority Ecosystems

There are 29 management and mitigation measures from the ESMP that directly relate to priority ecosystems. Those specifically related to Hides Ridge, for example, include:

- Prohibit transportation of live animals, plants or seeds to the Hides Ridge area.
- At Hides Ridge, hydrotest water sourced off the ridge will be discharged into the same watershed as its source to prevent cross-contamination with live organisms from another catchment.

- No quarries beyond cut to be established on the Hides Ridge where practicable.
- No construction camps are to be constructed on Hides Ridge beyond Hides Wellpad A[25] (with the exception of drilling camps).
- If a temporary drilling camp is necessary on Hides Ridge, there should be only one and it is to be located near Hides Wellpad D and to be used by successive drilling campaigns.
- The design criteria for the pipeline ROW width on Hides Ridge is 18 meters. During operations, the pipeline ROW will be allowed to regenerate except for a 10-meter-wide access road required for ongoing drilling and maintenance access to the wellpads on the ridge.
- Control access to Hides Ridge west of Hides Wellpad A and implement a permit system for vehicle access for the duration of construction.
- Dispose of drilling fluids, drilling cuttings and other drilling materials in an appropriate manner away from Hides Ridge.
- Dispose of wastes from pipeline ROWs and access ways construction activities (not spoil or timber) and camps (including the drilling camp) away from Hides Ridge.
- Identify areas requiring active revegetation on Hides Ridge and in areas between Idauwi and Homa, in particular unstable volcanic terrains.

8.2.3 Focal Habitats

There are 14 mitigation measures specific to focal habitats from the ESMP. The main focus of these management and mitigation measures is to avoid these particular habitat types, where possible. Examples of these measures include:

- Locate off-river waterbodies that might provide juvenile nursery habitat for New Guinea crocodiles and swamps in sinkholes less than 50 meters deep, and avoid destroying or avoid sidecasting into them.
- Implement appropriate avoidance measures for caves with bat colonies by prohibiting or controlling blasting within 100 meters of known colonies of cave bats.
- Reduce impacts on *Pandanus* swamp forest by designing access ways, pipeline ROWs, facility sites and supporting infrastructure to allow adequate surface flows.
- Conduct surveys along access ways, pipeline ROWs, facility sites and supporting infrastructure sites to identify sensitive features.

The main focus of the preconstruction surveys is to locate focal habitats (see Section 7.2.3). In instances where these habitats are found, the management and mitigation measures in the ESMP are refined and made specific to the survey site. Examples of site-specific mitigation measures include:

- The Ramsar-listed Lake Kutubu is located downstream of the Moro Parker Camp worksite. Control is required to prevent the release of pollutants to the Hamua Creek. Pursuant to Mitigation Measure M134 of Esso Highlands Limited's Water Management Plan, wastewater discharges shall be treated as necessary to comply with the wastewater discharge conditions prescribed in the Environment Permit. A contingency plan shall be developed to enable prompt preventive/remedial action in case discharge criteria may not be or are not met.
- Pursuant to Mitigation Measure A61 of Esso Highlands Limited's Weed, Plant Pathogen and Pest Management Plan, control is required to prevent *Lantana camara* and frangipani ginger becoming established at the Kobalu Camp worksite. Monitoring for the presence of these weed species shall be undertaken and, when encountered, be appropriately treated (i.e., via chemical application) or otherwise controlled.

[25] Wellpad A is the southernmost wellpad and located off the ridge in previously disturbed terrain.