Ok Birim Tailings Storage Facility Project

Environmental and Social Impact Assessment

Chapter 4

Assessment framework for the ESIA

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4. ASSESSMENT FRAMEWORK FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This chapter outlines the framework used to evaluate the impacts of the Ok Birim Tailings Storage Facility (TSF) Project (the project) on environmental and social values. The assessment approach comprises:

- Technical studies including field investigations and modelling across key environmental and social aspects to provide scientific and technical data. These studies underpin the environmental and social impact assessment (ESIA) by characterising the existing environment, developing effective management measures and informing impact assessments.
- Characterising the existing environmental and social conditions within the local and regional areas, including identifying environmental and social values and the sensitivity of these values to potential changes caused by the project.
- Identifying and assessing potential credible environmental and social impacts across all project phases, based on knowledge of the existing environment, project details, lessons learned from the four decades of the Ok Tedi Mine, experience from comparable operations in similar physical and biological environments, and stakeholder concerns.
- Defining achievable management measures aligned with the mitigation hierarchy.
- Evaluating credible residual impacts expected after implementation of the management measures.

4.1 GENERAL APPROACH

The assessment framework aligns with recent ESIAs for resource projects in Papua New Guinea (PNG) and internationally, following the International Finance Corporation (IFC) (2012) approach.

Three methods have been used to assess project impacts depending on the aspect:

- **Significance assessment.** A qualitative or semi-qualitative assessment of credible impacts, using the sensitivity of the environmental or social value and the magnitude of the impact to assess the significance of potential impacts. Residual impacts are assessed based on the application of management measures.
- **Compliance assessment.** A quantitative assessment using international, national, or best-practice limits or guidelines to measure an impact. As part of the ESIA, a compliance assessment has been adopted for air quality, noise, and water quality, where modelling and existing standard comparisons are possible.
- **Benchmarking assessment.** Adopted to evaluate greenhouse gas (GHG) emissions associated with the construction and operation of the project. The method uses internationally recognised emission factors to quantify GHG outputs and compares the project's emissions intensity against PNG's national inventory.

Impacts from low likelihood, high consequence extreme natural hazards and incidental events, such as significant earthquakes or landslides, and TSF and pipeline failure, are covered separately in Chapter 13.

4.1.1 Data sources

This ESIA draws on a range of primary and secondary data sources. Where data gaps or uncertainties exist in the data, conservative assumptions were applied.

Primary data collection provided a characterisation for many aspects of the assessment and included:

- Targeted field surveys.
- Where information gaps were identified, short-term investigations (i.e., studies that do not require long periods of data collection) and long-term investigations (i.e., studies that require long periods of time to establish a suitable data record).
- Modelling and predictive tools.
- Stakeholder engagement.

Secondary sources of data which supplemented the primary data included:

- Existing data from Ok Tedi Mining Ltd. (OTML) environmental and social monitoring programs.
- Pre-feasibility studies for the project.
- Relevant third-party reports.
- Project design and operational information.
- International and national standards and guidelines.

4.1.2 Key assumptions and limitations

The ESIA is based on two key assumptions that underpin the assessment framework:

1. Effective implementation of management measures. This assumes that all proposed avoidance and management measures stated in the ESIA and construction environmental and social management plan will be successfully implemented.
2. Project design. Assumes that the project design, footprint, and operational scope remain generally consistent with the descriptions provided. Significant changes to project parameters may require reassessment.

Limitations of the assessment include:

- Data gaps and uncertainties. In some cases, limited data availability or inherent variability in environmental and social conditions introduce uncertainties into impact predictions. These uncertainties are acknowledged and addressed through conservative assumptions and adaptive management measures.
- Temporal and spatial constraints. The assessment is based on data collected over specific timeframes and spatial extents, which may not capture all seasonal or long-term variations in environmental and social conditions.
- Stakeholder input. While stakeholder consultations inform the assessment, some perspectives or concerns may not be fully captured due to logistical or timing constraints, or changes in views of stakeholders over time.
- Unforeseen events. The assessment cannot fully predict the effects of extreme natural hazards, accidental events, or changes in regulatory or social contexts that may occur during the project's lifecycle.

OTML is committed to ongoing monitoring and management to address these assumptions and limitations, allowing environmental and social outcomes to be effectively managed throughout the project.

4.2 SCOPE OF TECHNICAL STUDIES

The ESIA draws on an integrated work program of technical investigations to inform the assessment of environmental and social impacts for the project. The scope of the studies was informed by the preparation of the Environmental Inception Report (EIR). The EIR serves as a key early step in the permitting process, enabling the Conservation and Environment Protection Authority to review the adequacy and relevance of the proposed technical studies for inclusion in the ESIA and provide feedback to OTML regarding this. The EIR for the project outlined the preliminary scope and method for each study, based on the project description, known environmental and social sensitivities, and input from OTML and regulatory stakeholders.

The ESIA team included technical specialists from OTML, Tetra Tech Coffey, and external subject matter experts, supported by the OTML site team. Where appropriate, existing environmental and social monitoring data from OTML operations and previous studies were reviewed and incorporated, and supplementary field data were collected to address identified information gaps.

The specific methods and scope for each technical study are summarised in the corresponding chapters of the ESIA, with detailed approaches and results provided in the respective appendices.

4.2.1 Data collection

The preparation of study scopes considered factors such as the required timeframes for data collection, the need for seasonal or temporal coverage, appropriate spatial boundaries for each discipline, the availability of existing information, and the potential for cumulative and transboundary effects. Consequently, technical studies were structured into three main phases:

- **Phase 1 – Long-term and OTML-led baseline investigations.** Focusing on areas requiring extended monitoring and for parameters with high variability (for example hydrometeorology, surface water, social conditions).
- **Phase 2 – Short-term investigations.** Targeting topics where existing data or desktop review was sufficient to scope or confirm conditions, or where the subject matter required limited field verification (for example aquatic and terrestrial biodiversity, cultural heritage, soils).
- **Phase 3 – Modelling and impact assessment studies.** Drawing on characterisation data to assess potential impacts, identify management measures and predict residual impacts.

Some international standards, including for human rights, ecosystem services, and climate change risk, are not typically included in PNG ESIAs but are expected under the (IFC 2012) and Equator Principles IV (Equator Principles Association 2020a). These were incorporated into the technical specialist scopes and refined in consultation with OTML and technical leads.

4.2.2 Area of influence and study areas

The project area is defined as the footprint of the project's construction, operation and decommissioning phases. Impacts may extend beyond the physical footprint of the project and hence the spatial boundaries of the characterisation and impact assessment need to reflect this. The spatial boundaries for the assessment were broadly defined as the areas which may be directly or indirectly impacted by each phase of the project and subsequently required further investigation. These areas are referred to as the project area of influence (AOI).

Determining the AOI is important for identifying receptors potentially affected by the project and for designing appropriate assessment and management measures. Broadly, the AOI encompasses (a) the project footprint, including construction and operational sites, and associated infrastructure corridors; (b) areas subject to potential impacts, including areas that may be impacted by dust dispersion, noise propagation, hydrological changes, ecological disturbances and TSF discharges.

In social terms, the AOI includes communities and settlements that may experience changes in livelihood, access to resources, health, or social conditions due to their proximity to project activities. This includes villages near the TSF development area, villages and settlements along the infrastructure corridor development area, and regional areas potentially affected by project-related impacts.

Temporally, the assessment considers temporal boundaries that are defined as the duration of the project, including construction (approximately 36 months), operation (approximately 20 years), decommissioning (approximately 24 months) and closure (approximately five years) phases.

Each technical study has a study area that reflects the AOI and nature, scale, and pathways of potential impacts relevant to the environmental or social aspect being assessed. Defining specific study areas supports targeted data collection, impact assessment, and monitoring programs, enabling OTML to implement effective mitigation and engagement strategies tailored to the spatial extent of project effects.

4.3 CHARACTERISATION OF EXISTING ENVIRONMENT

Characterising the existing environment involves describing the current conditions in the project's AOI and providing regional context for the project. This allows the identification of environmental and social values and provides a characterisation of existing conditions against which potential impacts of the project can be evaluated. This is particularly important given the legacy impacts of the Ok Tedi Mine.

Environmental and social values refer to the attributes, characteristics and conditions of the physical, biological and social environments. For the purposes of the impact assessment, environmental and social values are defined as:

- A quality or physical characteristic of the environment that is important to ecological health, public benefit (or amenity), safety or human health.
- A quality of the environment formally recognised as an environmental value under applicable environmental regulations.

Technical specialists identified environmental and social values based on regulations, policies or guidelines, and, when absent, defined them using their expertise, established practices, and feedback from stakeholders.

Chapter 8 and Chapter 9 present the characterisation of the existing biophysical and social environment, respectively, and provide the foundation for the subsequent impact assessments.

4.4 IMPACT ASSESSMENT

This section provides an overview of the methods used for the environmental and social impact assessments. The ESIA involved identifying, predicting, and evaluating potential environmental and social impacts associated with the construction, operation, and decommissioning of the project. In accordance with IFC (2012), and Vanclay et al. (2015), the ESIA considers direct, indirect, and cumulative impacts defined as:

- **Direct impacts.** Effects (whether positive or negative) that are directly caused by project activities. These are typically physical, biological, or social changes that result immediately from project actions.
- **Indirect impacts.** Effects (whether positive or negative) that are related to project activities but are not directly caused by them and often occur because of a direct impact.
- **Cumulative impacts.** Effects (whether positive or negative) resulting from the incremental impact of the project in combination with other past, present, or reasonably foreseeable future activities that affect the same environmental or social values (IFC 2013a).

Impacts were assessed using discipline-specific methods, drawing on characterisation information and predictive tools to evaluate potential changes to environmental and social values. The assessment identifies management measures to avoid or reduce adverse impacts or maximise positive impacts and evaluates the

residual significance of impacts following the application of these measures. The impact assessment approach focuses on credible impacts, i.e., those that could be reasonably expected during the life of the project within the context of the existing environment.

The general approach to environmental and social impact assessment is summarised in the following subsections, with further detail provided in chapters 10 to 12 of this ESIA and the supporting technical appendices.

4.4.1 Environmental impact assessment

The environmental impact assessment for the project follows a structured approach to identify, evaluate, and manage potential impacts on the physical and biological environment. The assessment considers both direct and indirect impacts and uses the significance, compliance and benchmarking assessment methods.

The environmental impact assessment process involved:

- Describing environmental conditions and the sensitivity of receptors.
- Identifying potential project-related changes based on the project description and stakeholder concerns.
- Proposing technically and economically feasible management measures.
- Assessing the residual significance of impacts after minimisation.

The approach is consistent with IFC Performance Standards (IFC 2012) and the DEC (2004) Environmental Impact Assessment Guidelines.

4.4.1.1 Significance assessment

The significance assessment method uses the sensitivity of the environmental or social value and the magnitude of the impact to assess the significance of residual impacts. The assessment of residual impacts assumes the effective implementation of avoidance and management measures.

Most impact assessments combine objective (technical) analysis with subjective analysis to represent value-based issues where difference of opinion about significance may arise. The approach adopted therefore relies on the technical specialists' professional judgment supported by scientific evidence from field data, technical assessment and scientific literature. The ESIA explains the rationale behind these judgments to allow transparency. The assessment does not explicitly analyse the likelihood of the impact as all impacts described in the ESIA are credible project outcomes.

4.4.1.2 Compliance assessment

The compliance assessment method uses the results of modelling and predictive tools to evaluate adherence to statutory limits or guidelines. This method was adopted for environmental aspects where objective, quantitative criteria, guidelines or standards for specific aspects of the project were available, such as toxicant impacts on water quality and associated environmental values.

These assessments typically involve modelling emissions or discharges from project infrastructure and operations to verify compliance with published limits or thresholds and identify the need for further avoidance or management measures to be implemented. Surrogate thresholds from other jurisdictions or recognised guidelines have been adopted where PNG has no such published limits or thresholds, as outlined in Chapter 3.

4.4.1.3 Benchmarking assessment

The assessment of GHG emissions generated by project activities and associated facilities involved comparing fossil fuel emissions generated by the project against PNG's national emissions inventory to determine the project's theoretical contribution.

Emission factors used to quantify the GHG emissions from the project were primarily sourced using the following documents:

- *International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines* (2007a).
- *United Nations Framework Convention on Climate Change Estimation of GHG emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity* (UNFCCC 2007).
- *Greenhouse Gas Protocol for Project Accounting* (WBCSD 2003).
- *Australian National Greenhouse Accounts (NGA) Factors* (2025).
- *Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (2006).
- *PNG Second National REDD+ Forest Reference Level* (PNG Government 2023).

This benchmarking approach is a standard method for assessing the emissions intensity of project-related GHG emissions.

4.4.2 Social impact assessment

The social impact assessment was undertaken in line with the legislative and regulatory requirements detailed in Chapter 3. In addition to these requirements, the approach to identifying, assessing and managing the project's social impacts was informed by:

- *IFC Performance Standards on Environmental and Social Sustainability* (IFC 2012).
- *International Association for Impact Assessment (IAIA) guidance on social impact assessment* (Vanclay et al. 2015).

The method used to undertake the social study comprised:

- Scoping the range of potential social impacts of the project to inform the definition of the study area and information to be collected through the social characterisation analysis.
- Characterising the existing social conditions within the social study area.
- Assessing potential social impacts, including identifying the project-related activities that may cause change to the social environment, and evaluating the significance of identified impacts.
- Developing management measures to avoid, minimise or mitigate potential negative impacts and maximise or enhance positive impacts.

Methods for assessing cultural heritage, ecosystem services and human rights impacts were also included to align with international lender expectations. Chapter 11 provides details of these assessments.

4.4.3 Cumulative impact assessment

Cumulative impacts result from the successive, incremental and/or combined effects of a project when added to the effects of other planned and/or reasonably foreseeable future projects. They can include individually minor actions by more than one project that collectively cause impacts in the same AOI or on the same environmental value during the same timeframe. These cumulative actions can increase the level of significance of a potential impact. The AOI varies depending on the environmental, or social value that is impacted.

The cumulative impact assessment considers the spatial and temporal overlap between the project and other activities and examines whether this overlap could result in greater impacts on environmental and social values.

The method applied is based on the IFC Good Practice Handbook on Cumulative Impact Assessment and Management (IFC 2013a) and comprises the following steps:

- Identifying the pathways or mechanisms that might lead to cumulative impacts.
- Identifying the key environmental and social values that might be impacted by cumulative impacts.
- Identifying other projects/activities and understanding whether they are credible or not.
- Understanding whether the project's activities overlap or connect in space with those of the other projects, such as, if there is a spatial relationship.
- Understanding whether the project's activities overlap in time with those of the other projects, such as, if there is a temporal relationship.
- Assessing the cumulative impacts and their significance.
- Proposing management measures OTML can implement to avoid or mitigate the project's contribution to cumulative impacts.

Chapter 12 provides the detailed approach and assessment of cumulative impacts.

4.5 APPLICATION OF MITIGATION HIERARCHY

The mitigation hierarchy is a structured approach used by OTML and other organisations to manage environmental and social impacts, prioritising actions to avoid, minimise, restore/rehabilitate, or offset potential impacts. Consistent with international standards, in order of preference this hierarchy includes:

- **Avoidance.** Avoidance measures will prevent the impact from occurring and is the preferred form of management for environmental and social impacts.
- **Minimisation.** Management measures that aim to mitigate impacts by reducing the magnitude of the impact (by reducing the severity, duration or spatial extent of the impact), reducing the sensitivity of the environmental or social value, or reducing the likelihood of the impact occurring will minimise impacts on environmental or social values.
- **Restoration and rehabilitation.** Manages a residual impact that remains following the adoption of the avoidance and minimisation. This is usually achieved through a means of restoration, establishment, enhancement, or preservation of a similar value identified elsewhere.
- **Offset and compensation.** Where impacts cannot be avoided or minimised and the environmental and social values impacted cannot be restored or rehabilitated, measures can be implemented to offset or compensate for the impacts.

Implementing this hierarchy aligns with international standards and regulatory requirements.