Ok Birim Tailings Storage Facility Project

Environmental and Social Impact Assessment

Chapter 11

Socio-economic impact assessment

TETRA TECH COFFEY

OK TEDI MINING

11. SOCIAL, CULTURAL, ECOSYSTEM SERVICES AND HUMAN RIGHTS IMPACT ASSESSMENT

This chapter presents the social, archaeological and cultural heritage, ecosystems services and human rights impact assessments for the Ok Birim Tailing Storage Facility Project (the project).

11.1 SOCIAL IMPACT ASSESSMENT

Social impact assessment (SIA) involves the process of assessing and managing the social consequences of a project. This section describes potential positive and negative impacts on the social characteristics, values and features of the study area from the construction, operation and rehabilitation phases of the project.

11.1.1 Assessment method

The approach used to assess social impacts for the project involved:

- Identifying potential social impacts for assessment due to direct or indirect changes to the social, economic, physical or natural environment from project activities.
- Evaluating identified social impacts, using a significance-based assessment approach.
- Identifying management measures to avoid, minimise or mitigate the potential negative impacts, and maximise or enhance the potential positive impacts of the project.

Cumulative impacts are assessed in Chapter 12. Social impacts associated with natural hazards and unplanned events relevant to the project are addressed in Chapter 13.

11.1.1.1 Identifying potential social impacts

A social impact is something that is experienced or felt, either physically or perceived, and is generally considered anything linked to a project that affects or concerns impacted stakeholders (e.g., individuals, groups, or communities) (Vanclay et al. 2015). The potential social impacts identified in the scoping phase were reviewed (see Chapter 9), and new and changed impacts were identified based on:

- Results of the social characterisation study.
- Feedback from consultation with communities and other stakeholders.
- Outcomes of technical studies undertaken for the environmental and social impact assessment (ESIA).
- Review and understanding of potential impacts from the existing Ok Tedi Mine operations, and similar resource-related projects in Papua New Guinea (PNG) and elsewhere.

Social impacts of a project activity may be experienced differently by individuals and communities depending on their circumstances, vulnerabilities and attitudes to the project or a particular change.

11.1.1.2 Potential impact pathways

Construction and operational activities for the project may result in direct or indirect changes to the social, economic, physical or natural environment. Social impacts result where these changes are experienced or felt by people. Key project drivers that have potential to result in social changes include employment and accommodation, procurement, project construction and operation activities, project benefit streams, and project-induced in-migration (PIIM). Section 11.1.2 provides further details on each of these.

11.1.1.3 Approach to impact assessment

A significance-based approach was used to assess the identified social impacts of the project's construction, operation and decommissioning, which considers:

- The sensitivity of the social value based on its social, cultural or economic importance, and its ability to cope or adapt to changes from the project. Factors that contribute to the sensitivity of a social value to change may include its uniqueness or rarity, importance, resilience to change, or replacement value.
- The magnitude of the impact based on its scale, extent and duration. The criteria used to determine the magnitude of identified impacts considered factors such as the:
  - Scale of the change to the social value, which may be positive or negative.
  - Extent of the potential impact and population affected, including potential for vulnerable groups to be affected.
  - Duration or time over which effects on people are expected to occur[1].

Table 11.1 describes the criteria used to determine the sensitivity of social values and the magnitude of potential impacts.

Professional judgement was used to determine these with reference to results of environmental and social studies undertaken for the ESIA, project information, outcomes of engagement with potentially affected communities and stakeholders, literature and previous experiences of social impacts of other resource projects in PNG and elsewhere.

Table 11.1 Sensitivity and magnitude criteria

Level	Description
Sensitivity of social value	
Very high sensitivity	An aspect of the environment# that is essential to livelihoods, health, safety, or culture. The community has identified the value as critically important, and/or the value affects intersecting aspects of social wellbeing. There are no alternative resources or services available nationally.
High sensitivity	An aspect of the environment that materially contributes to livelihoods, health, safety, or culture. The community has identified the value as a matter of high importance, and/or the value affects intersecting aspects of social wellbeing. No alternative resource or service is available for people to access or use at a provincial level.
Moderate sensitivity	An aspect of the environment that contributes to livelihoods, health, safety, or culture. The community has identified the value as a matter of moderate importance. The value does not affect intersecting aspects of social wellbeing. There are no locally available alternative resources or services; however, these are available and have capacity at a district or provincial level.
Low sensitivity	An aspect of the environment that contributes to livelihoods, health, safety, or culture at a local level, but has limited use or importance to the broader community. The community has identified the value as having limited importance. There are alternative resources or services available at a local level.
Not sensitive	An aspect of the environment that is not valued within the community and does not contribute to local livelihoods, health, safety or culture. There are many alternative resources or services available at a local level.

[1] The magnitude of an impact is not always directly related to the duration of impact (i.e., minor impacts are not always short-term, and major impacts are not always long-term). Consequently, while duration or time over which effects on people are expected to occur was a consideration for determining the magnitude of an identified impact, this was generally not the key determining factor.

Level	Description
Magnitude of potential impact	
Severe	A fundamental change to the social value. The change affects a major number of people within the area of impact, or people across a large number of communities, or most people within a vulnerable group. The effect of the change is permanent.
Major	A considerable change to the social value. The change affects large groups of people within the area of potential impact, or people across many communities, or a majority of a vulnerable group. The effect of the change may persist over the longer term (i.e., 5 to 25 years or up one generation), although for some impacts, effects may occur over the short to medium term or the life of the project.
Moderate	A noticeable change to the social value. The change affects notable numbers of people within the area of potential impact or people across several communities, or significant proportions of a vulnerable group. The effect of the change may persist over the short to medium term (i.e., up to about 5 years), although for some impacts, effects may occur over the longer term.
Minor	A small but measurable change to the social value. The change affects small groups of people within the area of potential impact or a small number of villages or a small but notable proportion of a vulnerable group. The effect of the change may be intermittent or persist over the short term (i.e., up to about one year), although for some impacts, effects may occur over the medium to long term.
Negligible	A marginal change to the social value. The change affects a small number of individuals across one or two villages. The effect of the change is likely to occur for a limited time (i.e., up to about three months).

The term 'environment' is defined under section 2 of *Ok Tedi Environment Management Act 2019* (OTEMA) to include ecosystems and their constituent parts, including people and communities and including human-made or modified structures and areas; amenity values; and the qualities and characteristics of locations, places and areas, that contribute to among other things amenity, harmony and sense of community.

The significance evaluation matrix in Table 11.2 was used to determine the significance of positive and negative impacts based on the identified levels of sensitivity and magnitude.

Table 11.2 Significance evaluation matrix

Level of magnitude	Level of sensitivity				
	Not sensitive	Low sensitivity	Moderate sensitivity	High sensitivity	Very high sensitivity
Severe	Moderate	High	High	Major	Major
Major	Moderate	Moderate	High	High	Major
Moderate	Low	Low	Moderate	High	High
Minor	Very low	Low	Low	Moderate	Moderate
Negligible	Very low	Very low	Low	Low	Moderate

11.1.1.4 Impact management

Management measures were identified to avoid, minimise or mitigate the potential negative impacts, and maximise or enhance the potential positive impacts associated with the construction, operation and decommissioning of the project. Measures identified to manage potential social impacts considered those:

- Used to manage social impacts of existing OTML activities or of similar projects in PNG and elsewhere.
- Identified through consultation with potentially affected communities and other stakeholders for the project, and other technical studies undertaken for the ESIA.

The residual impact assessment assumes the effective implementation of the identified management measures.

11.1.1.5 Community and stakeholder engagement

This social impact assessment has been informed by engagement with potentially affected communities and other stakeholders undertaken for the social studies and the ESIA more generally. Specifically, outcomes of engagement have informed:

- The identification and assessment of potential social impacts, both positive and negative, from design, construction, operation and rehabilitation activities.
- The level of sensitivity of social values.
- Measures identified to manage potential social impacts of the project.

Further details on engagement are provided in Appendix M and in Chapter 5.

11.1.1.6 Assumptions and limitations

The following assumptions and limitations apply to this social impact assessment:

- This social impact assessment is based on the scope of the project in Chapter 6. Material changes to the project may result in additional social impacts or changes to the significance of the identified impacts.
- This assessment has been conducted at a point in time and has sought to use the most recently available information at this time. Currently, the project has been designed to avoid dwellings and community infrastructure, and physical resettlement is not anticipated. Changes from external factors to communities and socio-economic conditions may result in changes to social impacts identified in this assessment.

11.1.2 Drivers of potential social change

Drivers of potential social change include aspects of the project that will directly cause change and those that may result in association with the project and therefore have an indirect impact. PIIM is an example of the latter particularly relevant in PNG and particularly applicable to the project. As a result, PIIM has been considered in detail in this section.

Key aspects of the project with the potential to cause social impacts, either positive or negative, include:

- Physical disturbance of land and waterways within the tailings storage facility (TSF) footprint, infrastructure corridor, and gravel extraction sites that support social, economic, and cultural activities of individuals, households, and communities.
- Physical and economic displacement, including potential livelihood disruption.
- Changes to access and connectivity from the construction of the infrastructure corridor and crossings of the Ok Tedi and Ok Birim.
- Use of the Kiunga-Tabubil Highway, ITCS Road, and infrastructure corridor by project vehicles during construction and operation, including for the transport of workers, and supplies, materials, plant and equipment.
- Project employment for construction and operation, including opportunities for local workers, influx of project workers from other PNG provinces and overseas, and establishment of temporary and/or permanent worker accommodation facilities at Ningerum, Alice Pit, and along the infrastructure corridor.
- Project procurement opportunities for local, regional and national suppliers of goods, services, materials and equipment.
- Changes to existing local environmental conditions due to construction and operation of the project, such as air quality, noise levels, water quality, and aquatic and terrestrial ecology.
- Payment of compensation related to land access and distribution of project benefits such as employment and business opportunities.

Potential social impacts may also result from population changes due to in-migration of people into project communities. PIIM is defined as the movement of people into an area drawn by a project's actual or perceived economic opportunities, such as employment, business development or compensation (IFC 2009). PIIM is commonly associated with mining projects in PNG (Bainton et al. 2017; Bainton and Banks 2018), and in some cases, has led to significant population growth.

Enhanced access and connectivity provided by the project for communities west of the Ok Tedi, and direct and indirect economic opportunities such as land compensation, employment and business opportunities related to the project's construction and operation are expected to encourage population movement into project communities. An analysis was conducted to identify the potential for PIIM into project communities. This considered:

- Proximity of the community to the project, with areas closer to the project likely to be a focus of potential direct and indirect project-related economic opportunities.
- Opportunities for project-related compensation such as land access payments. This may influence movement of people through marriage or people returning to their village seeking access to project compensation and other benefits.
- Proximity to major population centres (e.g., Tabubil, Ningerum, Kiunga). These centres are the main focus of social services and economic development within the North Fly District.
- Availability of existing community services and amenities, such as schools, health care, markets, and stores. Communities that provide access to these are more likely to attract in-migrants.
- Existing levels of in-migration and landowner and community attitudes to migration, with in-migration often following existing migration pathways. Tabubil and the nearby settlement of Seven Kona have already experienced significant in-migration due to the presence of Ok Tedi Mine and OTML.
- Changes in connectivity between communities, and to services and trade. This is anticipated to attract people seeking areas with better access to services, or people who may choose to return to their home village

Consideration was also given to the likely profile of in-migrants moving into various communities, including:

- Returning family and clan members, and extended family members.
- Project employees from outside the project area and their immediate and extended families.
- People who may look to conduct artisanal and small-scale mining (ASM), attracted by better access provided by the project.
- Potential providers of goods and services to the project and local communities.
- Opportunistic migrants seeking direct and indirect project-related opportunities.

Table 11.3 provides an overview of potential for PIIM into project communities, including possible drivers. Communities that are anticipated to experience a high potential for PIIM include:

- Birimkamba, with in-migrants likely to include returning family members, providers of goods and services to local populations and the project, and opportunistic in-migrants.
- Seven Kona, particularly by people participating in ASM attracted by improved access to Tabubil provided by the pipeline access road, and opportunistic in-migrants.
- Ok Ma, with in-migrants expected to include returning residents, providers of goods and services to local populations, and opportunistic in-migrants.
- Alice Pit, particularly by people participating in ASM attracted by improved access provided by the project, and providers of goods and services to local populations and the project.
- Ningerum, with in-migrants likely to include project employees from outside the project area, people participating in ASM, providers of goods and services to local populations and the project, and opportunistic in-migrants.

Table 11.3 Potential for project-induced in-migration

Location	Overall potential for in-migration	Potential drivers of project-induced in-migration					
		Proximity to project activities	Opportunities for project related compensation	Proximity to large population centres	Availability of community services	Existing migration/ landowner/ community attitude to migration	Connectivity to services and trade)
Birimkamba	**Very high**	High	High	Medium	Very low	High	High
Ambaga	**Moderate**	Medium	Medium	Low	Low	Low	Medium
Putmambin	**Low-moderate**	Low	Low	Low	Very low	Low	Low
Kungembit	**Moderate**	Medium	High	Low	Very low	Low	Very low
Kungim	**Low**	Low	Low	Low	Medium	Low	Very low
Karandimok	**Low-moderate**	Medium	Medium	Low	Very low	Low	Very low
Komokpin	**Low**	Low	Low	Very low	Very low	Very low	Very low
Seven Kona	**Very high**	High	Low	High	Very low	High	High
Ok Ma settlement	**High**	High	Low	Low	Medium	High	Medium
Southern infrastructure corridor communities	**Moderate-high**	High	Low	High	Medium	Low	Medium
Alice Pit	**Very high**	High	Low	High	Very low	High	High
Ningerum	**Very high**	High	Low	High	High	High	High
Tabubil	**Low-moderate**	Low	Low	High	High	High	Low
Kiunga	**Very low**	Very low	Very low	High	High	High	Low

11.1.3 Impact assessment

This section presents the assessment of potential social impacts on communities in the study area due to the construction, operation and decommissioning of the project.

11.1.3.1 People, community identity and place

This section assesses potential impacts of the project on cultural identity and traditions, social cohesion, community safety, levels of community violence, and landscape and amenity.

Cultural identity and traditions

Construction and operation of the project have the potential to impact on the cultural identity of local communities from the loss or disturbance of cultural heritage values within the project's footprint and changes to cultural traditions and practices due to factors such as project-related employment, changes to household incomes, and in-migration of people into the local communities. Section 11.2.2 provides the assessment of potential impacts to cultural heritage sites.

Intangible and tangible cultural heritage values

TSF communities

Construction activities for the TSF and associated infrastructure will result in the permanent loss, damage or disturbance to tangible and intangible cultural heritage values within the TSF development area. These values are important to Yongom peoples of the TSF communities for their historical, social and spiritual meanings or relevance to traditional customary practices. The cultural heritage values in the TSF development area and surrounds are diverse and include sacred and mythical areas associated with ancestral beings, traditional settlement sites, ancient clan boundaries, burial grounds, waterway route or tracks, and resource-use zones such as gardens, sago groves, and fishing, and hunting sites (Appendix L). The sensitivity of these sites varies from moderate to high, with the cultural significance of potential impacts ranging from low to high. Loss, damage, or disturbance of these values has the potential to diminish the connection of clans to their land, and impact on the cultural identity of affected clans and their ability to sustain cultural traditions. Based on available information and verification undertaken during the assessment, no identified heritage values within the project area were determined to meet International Finance Corporation Performance Standards 8 (IFC PS8) Critical Cultural Heritage thresholds. Similarly, no identified heritage values were determined to meet IFC PS7 Critical Cultural Heritage thresholds at a national or international scale.

Fieldwork for the ESIA verified the location of four sites of clans from Birimkamba within the TSF footprint, including one spirit site important to local belief systems and oral traditions assessed as high significance to the community. Verified sites of Ambaga, Karandimok, and Komokpin are located outside of the TSF footprint, although have potential to be impacted by construction of ancillary infrastructure, including laydown areas, access roads and surface water diversions. Consultation with community leaders and cultural knowledge holders of other TSF villages identified additional cultural heritage sites, including sites important to the Kungembit community, which has clan areas within the TSF footprint. The location of these sites was unable to be verified through fieldwork at the time of the survey due to time and weather constraints, although it is likely that some are located within the footprint of the TSF and associated infrastructure. Consequently, there is potential for direct impact on cultural heritage sites of varying significance to the local community that includes both sites that have been field verified and sites that have not yet been field verified. Further, due to the longstanding occupation of the area there is potential for unidentified surface and sub-surface archaeological materials and additional culturally known places not previously disclosed and/or located, or indirect impacts on access and landscape relationships to occur (Appendix L). Loss, damage or disturbance of these values have potential to diminish the connection of clans to their land, and impact on the cultural identity of affected clans and their ability to sustain their cultural traditions.

Infrastructure corridor communities

Construction of the infrastructure corridor has potential to result in the loss, damage or disturbance to cultural heritage values of customary landowners. Potential impacts on cultural heritage sites would mainly be associated with construction activities involving ground disturbance through previously undisturbed areas, for example trenching through isolated heritage locations, disturbance near settlements or burial places or inadvertent finds during bridge and crossing works; temporary disruption to tracks or access routes; or vegetation clearing near sacred locations (Appendix L).

Consultation with infrastructure corridor landowners, cultural knowledge holders, and communities undertaken for the Archaeology and Cultural Heritage Assessment identified a large number of cultural heritage sites within or surrounding the proposed infrastructure corridor, including sacred and spirit sites, mythical sites, ritual sites, ancestral burial sites and community cemeteries, cave sites, and hunting and gardening sites. The cultural significance of the sites varied from moderate to high (Section 11.2.2.2). The location of these sites could not be verified through fieldwork due to time and access constraints at the time of the survey. Loss, damage or disturbance of these values have potential to diminish the connection of clans to their land, and impact on the cultural identity of affected clans and their ability to sustain their cultural traditions.

Cultural practices and traditions

The project has potential to lead to the loss or decline in cultural traditions and practices within TSF and infrastructure corridor communities due to social changes that result from in-migration of people from other parts of PNG attracted by project opportunities, increased incomes leading to a shift from a subsistence to cash economy, and reduced time available for people to spend on traditional practices due to project-related employment and business activities.

Community identity across the TSF and infrastructure corridor communities relating to cultural traditions and practices remains strong, with feedback from consultation noting examples such as the use of traditional language (tok ples), dancing and costumes, medicines for treating illness, and subsistence practices and methods for cooking, hunting and fishing. However, community members also reported a loss or decline in some local traditions and cultural practices already due to factors such as the influence of the church, education providing new perspectives and ways of doing things, population growth and marriage, the introduction of the cash economy and modern lifestyles, and younger generations not upholding practices.

Social and economic changes within the TSF and infrastructure corridor communities including increased incomes, employment and PIIM, may accelerate the loss, or decline of cultural practices and traditions currently occurring and further affect the communities' ability to sustain their cultural identity and traditions. Increased incomes will provide opportunities for households to participate in the cash economy, reducing reliance on subsistence livelihood activities. At the same time, peoples' involvement in project employment and business activities may reduce their reliance on subsistence practices, or interest and time available to participate in some traditional activities, while the movement of people into the communities near the project in response to opportunities may also influence community members' lifestyle and attitudes towards their traditional cultural practices. This was reflected in community feedback about potential changes to local customs and traditions related to the project, which included concerns that traditions might disappear, particularly as younger people may not see these as important, and that people will be attracted by the cash economy and lose sight of holding onto cultural practices. Some women also commented during consultation for this assessment that their subsistence lifestyle was difficult and physically demanding, and that income from the project will allow them to buy garden produce and sago rather than having to conduct these activities themselves.

Management measures

Management of potential impacts on cultural identity and traditions will mainly be achieved through:

- Implementation of the Cultural Heritage Management Plan (CHMP) (see Attachment 2) that outlines measures for the management of archaeology and cultural heritage sites in line with PNG legislation and the IFC PS (e.g., avoidance where possible, use of buffers, pre-construction surveys, construction clearance procedures, chance finds procedure).
- Engagement with the customary landowners in relation to cultural heritage management and preservation of cultural identity and traditions, including getting free, prior and informed consent (FPIC) for any cultural heritage considered to be critical to communities under IFC PS7.
- Implementing strategies to minimise and managing potential impacts of in-migration into the study area.

In addition, pre-construction surveys will be conducted prior to ground-disturbing activities to verify the presence of potential cultural heritage sites and identify strategies in consultation with affected clans for managing potential impacts (see Section 11.2.3).

Table 11.4 outlines the proposed measures to mitigate and manage potential impacts of the project on cultural identity and traditions.

Table 11.4 Proposed management measures – cultural identity and traditions

ID#	Potential impact	Key measures
SIA-01	Loss or decline in cultural connection to land due to loss of tangible and intangible cultural heritage values within the TSF development area.	• Implement management measures outlined in the CHMP (MM163). • Site project infrastructure, including the hydro-cyclone house, tailings pipeline, laydown areas, access roads and surface water diversions, to avoid cultural sites of high significance, where possible (MM164). • Conduct consultation with affected landowners and communities around methods for managing impacts on cultural heritage values, including getting FPIC where triggered (MM165).
SIA-02	Loss or decline in cultural connection to land due to loss of tangible and intangible cultural heritage values within the footprint of the infrastructure corridor.	
SIA-03	Loss or decline in cultural traditions and practices due to in-migration into the TSF and infrastructure corridor communities, further shift from a subsistence to cash economy, and decreased time available to spend on these activities due to project related employment.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in migration and develop solutions and community assistance for limiting PIIM (MM167). • Work with communities and relevant NGOs or CSOs to implement programs to preserve cultural traditions and practices of high value, including documentation of cultural traditions and practices (MM168).

Residual impact assessment

Intangible and tangible cultural sites

The project will result in the permanent loss of cultural heritage values within the TSF footprint, while construction and operation of the hydro-cyclone house, ancillary infrastructure such as laydown areas, access roads and surface water diversions also has potential to result in the loss, damage or disruption to cultural heritage sites. Potential impacts on cultural heritage values are most likely to impact clans within villages closest to the project such as Birimkamba, Kungembit, Ambaga, and Karandimok. The importance of connection to customary land is highly valued in Papua New Guinean culture, and peoples' cultural connection to land is **highly sensitive**. Following the implementation of management measures outlined in Table 11.4 the magnitude of impact of the project on peoples' cultural connection to land due to the loss, damage or disruption to cultural heritage sites and values within the footprint of the TSF and associated facilities is **major**, and the significance of impact is **high** (SIA-01).

Within the infrastructure corridor, potential impacts on cultural heritage values will be dependent on the final alignment of the tailings pipeline and pipeline access road. Where possible, project infrastructure will be sited within existing disturbed areas to minimise potential impact on environmental values, including cultural heritage. It is also likely that impacts on significant cultural heritage values present in the infrastructure corridor development area could be avoided through micro-siting of the tailings pipeline and access road (Appendix L), although there is potential for small, permanent changes to cultural heritage values impacting on some peoples' cultural connection to land due to construction of the project. The magnitude of this impact is **moderate**, with the residual significance **high** (SIA-02).

Cultural practices and traditions

Cultural traditions and practices continue to be maintained and valued by TSF and infrastructure corridor communities, although the loss or decline in cultural traditions and practices already were reported during consultation for this assessment. Consequently, the sensitivity to change of the communities' ability to sustain their cultural identity and traditions is **moderate**. The project will contribute to the permanent loss or decline in cultural traditions and practices with potential to impact on large numbers of people across the TSF and infrastructure corridor communities. The implementation of management measures outlined in Table 11.4 will help to preserve knowledge of cultural traditions and practices, and possibly slow the loss of some traditions already happening. The magnitude of impact of the project on peoples' ability to sustain cultural identity and traditions due to the loss or decline in cultural traditions is **moderate**, and the residual significance of impact **moderate** (SIA-03).

Social cohesion

The project has potential to impact on social cohesion within project communities due to an influx of workers into areas surrounding the TSF, infrastructure corridor, and communities such as Alice Pit and Ningerum, and distribution of project benefits and compensation.

The project will require a construction workforce of about 300 people and an operations workforce of about 150 people. It is anticipated that the construction and operational workforces will predominantly comprise men, which is consistent with OTML's existing workforce and typical of similar projects in PNG and elsewhere. The project will seek to maximise employment of workers from project communities, the North Fly District and Western Province, although workers are also likely to include Papua New Guineans from other areas of the country, and international contractors who may bring different customs and attitudes to people in local communities. Non-local workers will mainly be accommodated in facilities in Ningerum, Tabubil and Alice Pit, although during construction some workers will be accommodated in work camps along the infrastructure corridor, and during operation a small number of staff will be accommodated at permanent onsite facilities at the TSF site. The presence of the project workforce and interactions between workers and communities have potential to affect social cohesion, particularly if tensions arise regarding:

- Worker behaviour towards community members or the local environment.
- Damage caused by project activities.
- Workers' use of surrounding areas for personal activities such as fishing or hunting.

Customary landowners whose land is within the lease area for the project will receive lease compensation from OTML. Compensation payments will be consistent with similar OTML agreements such as for Bige operations, and requirements of PNG Government legislation and the IFC PS. The project will also generate local employment and business opportunities, which will aim to prioritise people and businesses from project communities, the wider North Fly District, and Western Province. In the PNG context, access to employment and business contracts can be influenced by the *wantok* system, which results in the distribution of benefits to family and clan members. The distribution of project compensation and benefits has potential to cause community tension and disputes impacting on social cohesion if these are distributed unequally amongst project communities and groups. Tension and disputes between community members can also arise if people perceive the distribution of project benefits and compensation is not evenly shared amongst project communities and landowners. Feedback from consultation for the project has included concerns that the location of project infrastructure, including construction facilities, will likely exclude some communities and clans from project-related compensation.

Management measures

Table 11.5 outlines the proposed measures to manage potential impacts on social cohesion from the project's construction and operation.

Table 11.5 Proposed management measures – social cohesion

ID#	Potential impact	Key measures
SIA-04	Reduced social cohesion related to potential conflict associated with the presence of the project workforce and interactions between workers and communities.	• Prioritise employment of local people (e.g., from project communities and the North Fly District) (MM169). • Implement a workforce Code of Conduct, which includes provisions that prohibit workers' use of local areas for activities such as fishing and hunting (MM170). • Implement worker Code of Conduct and conduct workforce education and awareness about expected standards in relation to community interactions (MM171). • Implement community complaints and grievance mechanism for the project (MM172).
SIA-05	Increase in community tension and conflict relating to distribution of land compensation payments for the TSF and infrastructure corridor.	• Provide community-wide opportunities for project communities to participate in project benefits outside of compensation for land access (e.g., employment, business opportunities) (MM173). • Monitor grievances and complaints regarding distribution of project benefits to identify escalating tensions (MM174).

Residual impact assessment

The project will result in an increase in people from other parts of PNG and internationally into areas surrounding the project. During construction, project workers will be present in areas closest to the TSF development area, and along the infrastructure corridor, and communities such as Alice Pit, Ningerum and Tabubil. Once operational, project workers will mainly be present at the TSF site or in Ningerum, which will be the location of the worker accommodation facility.

For the TSF, it is anticipated that people in Birimkamba and Kungembit are most likely to interact with the project workforce due to the proximity of the project to these villages, although people from other TSF villages may interact with the project workforce as they travel through the area. For the infrastructure corridor, interactions between members of specific communities and the project workforce will generally occur as construction progresses along the infrastructure corridor or as people travel along the corridor. Community feedback for this assessment reported that communities generally perceive their villages to be safe and peaceful. Social cohesion is of **moderate sensitivity**. With the implementation of management measures, potential conflict between community members and project workforce is anticipated to result in a marginal decline in social cohesion with potential to affect notable numbers of people across project communities. Potential impacts are most likely to occur during the construction phase, due to the larger size of the construction workforce and multiple areas of construction activities across a broad geographic area making it more challenging to manage. Consequently, the magnitude of potential impact on social cohesion due to the presence of the project workforce is anticipated to be **minor**, and the residual significance of impact is **low** (SIA-04).

Consultation for this assessment identified that disputes do occur over the use of land, although these were generally limited. Concerns about potential land impacts of the project were also raised during engagement for the ESIA, including that the TSF and infrastructure corridor would only impact on the land belonging to clans within some villages, meaning that people of other villages will miss out on project related

compensation. Social cohesion is of **moderate sensitivity**. The distribution of land compensation and project benefits have potential to result in a small, permanent change in social cohesion with potential to affect a notable number of people across project communities. Consequently, the magnitude of potential impact on social cohesion and harmony related to the distribution of project benefits and compensation is **moderate**, and the residual significance of impact is **moderate** (SIA-05).

Community safety

Construction and operation of the project have potential to adversely impact on community safety for people within project communities due to an increase in project-related traffic on local and regional roads, and the presence of construction works, including within the Ok Tedi and Ok Birim. During operation, risks to community safety may also result from accidents or unplanned events such as the failure or breach of the TSF or failure of the tailings pipeline. Potential risks for community members of potential accidents or unplanned events are assessed in Chapter 13 and so they are not considered further in this assessment.

Traffic safety

Traffic associated with the construction and operation of the TSF and infrastructure corridor has potential to increase road safety risks for local communities and users of the ITCS Road, the pipeline access road, and Kiunga-Tabubil Highway. Transport activities for construction and operation of the project will involve a mix of light vehicles, buses for transport of workers, and trucks for the haulage of materials, supplies, plant and equipment.

TSF communities

When complete, the ITCS Road will provide access for pedestrians and motorists between the PNG border with Indonesia at Pos Lintas Batas Negara Yetetkun (Yetetkun PLBN) and the Kiunga-Tabubil Highway at Alice Pit. The road will also provide access for people within TSF villages, particularly Birimkamba, Kungembit, Ambaga and Putmambin, supporting improved access to markets, services, education, and health facilities at Yetetkun PLBN, Alice Pit, Ningerum, Kiunga and Tabubil.

The ITCS Road will be used during construction and operation to provide access to the TSF site. The main transport activities for construction and operation of the TSF include:

- Truck haulage of gravel for the TSF starter embankments from gravel extraction sites in the Ok Tedi to the TSF site, which may require up to 207 vehicles per day over four years during construction of Cell 1, 62 vehicles per day over two years during construction of Cell 2, and five vehicles per day over about 20 years for ongoing maintenance.
- Truck haulage of plant, equipment and materials for construction of the TSF and associated infrastructure such as the hydro-cyclone house.
- Truck haulage of supplies to support construction and operation of the project (e.g., fuel).
- Bus transport for workers during construction and operation, including three return trips daily between Ningerum and the TSF site.

The ITCS Road will also support transport and haulage activities for the southern part of the infrastructure corridor via a new bridge crossing of the Ok Birim.

Use of the ITCS Road by the project is expected to reduce community safety for pedestrians, motorists and public motor vehicle (PMV) users due to increased risk of road accidents due to the increased volume and type of traffic. Potential impacts are most likely to affect users of the road between the Ok Tedi and TSF access road near Birimkamba. OTML information on road accidents from existing use of the Kiunga-Tabubil Highway by mine-related vehicles noted that between 2024 and 2026, 23 accidents had occurred between OTML and contractor vehicles, including three involving light vehicles and 20 involving convoy trucks.

Infrastructure corridor communities

Once constructed, the pipeline access road will be used to support construction of the tailings pipeline. The main transport activities for construction are anticipated to include:

- Truck haulage of plant, equipment and materials for construction of the tailings pipeline.
- Truck haulage of supplies to support construction.
- Bus transport for workers, including six return trips per day between Tabubil and construction worksites for the northern section of the pipeline, and six return trips per day between Alice Pit and construction worksites for the southern section of the pipeline.

During operation, the pipeline access road will support ongoing maintenance activities for the pipeline, which would generally require about two vehicle movements per week. Public use of the pipeline access road will also be available following construction of the pipeline access road. OTML may also use the road to transport goods to Tabubil from Indonesia rather than using the Kiunga-Tabubil Highway.

The use of the pipeline access road by project and non-project traffic will introduce road safety risks relating to potential accidents between project and non-project vehicles, and pedestrians, including children and other vulnerable groups such as disabled and elderly people.

Construction haulage communities

The Kiunga–Tabubil Highway will be used to transport materials, supplies, plant and equipment during construction and operation of the project from the Kiunga Port to Tabubil and Ningerum. The Kiunga-Tabubil Highway is an important access route for haulage access for Ok Tedi Mine and access for pedestrians, private vehicles, and PMVs to villages, regional centres such as Kiunga, Ningerum and Tabubil, and community services. The highway passes through numerous villages located along the highway and also passes by other community areas such as houses, formal and informal trade stalls, markets and schools.

The project is expected to require an average of two convoys per day between Kiunga and Tabubil across construction and operation. The highway will also be used to transport project workers from Ningerum to the TSF site, with this involving about three return trips per day for the duration of the project. This will result in an average of about 34 additional vehicle trips per day in addition to the vehicles that are estimated to currently use the highway, which is estimated to be about 180 vehicles daily based on data from OTML. Feedback from community consultation for this assessment included concerns about existing road safety and reports of accidents resulting in injuries and occasional fatalities. Fieldwork observations noted several existing safety issues along the highway, including blind spots over crests and around bends, areas with narrow sections of road, and a lack of pedestrian access. The use of the Kiunga-Tabubil Highway for construction and operation will increase road safety risks, impacting on community safety for road users and communities along the highway, including school students who use the highway to walk to school.

Interaction with construction activities

The presence of construction works for the project has the potential to impact on community safety for TSF and infrastructure corridor communities. Public access to project worksites will be prohibited, although construction works within the road reserve, across the Ok Birim and Ok Tedi, and near areas used by the public present risks to personal safety. In particular, there is potential for accidents to occur involving community members due to the movement of project vehicles and machinery, changes to local access, and changes in local conditions (e.g., trenching for the tailings pipeline within the road).

Within the TSF communities, reductions in community safety may occur in areas used by people of Birimkamba and Kungembit due to the proximity of these villages to the project, although the project also presents safety risks for people from other villages as they move about the area. Potential safety risks will be present across the life of the project, but will be highest during construction and into the early phases of operation, given the higher level of construction haulage and construction activities occurring across multiple

areas. Construction works for the tailings pipeline and pipeline access road will progress along the infrastructure corridor. Temporary reductions in community safety may occur where works occur near villages.

The Ok Birim is used for transport and livelihood activities such as fishing by people from Kungim and Karandimok. Areas of the Ok Tedi near the bridge crossing at Tabubil and gravel extraction areas near Birimkamba are also used by people within villages and settlements along the river for ASM activities. Changes in river conditions near to construction works for the crossings of the Ok Tedi and Ok Birim, and near gravel extraction activities within the Ok Tedi may also present risks to personal safety for users of these rivers.

Management measures

Management of potential impacts on community safety due to transport activities, and construction and operational works will mainly be achieved through:

- Implementation of OTML's existing procedures relating to transport activities (e.g., use of convoy arrangements along the Kiunga-Tabubil Highway).
- Development and implementation of a Traffic and Transport Management Plan for the project.
- Implementation of a Construction Environmental and Social Management Plan (CESMP) and site management and safety measures for project worksites.

Table 11.6 outlines proposed measures to manage potential impacts of the project on community safety.

Table 11.6 Proposed management measures – community safety

ID#	Potential impact	Key measures

SIA-06	Reduced safety for communities and users of the ITCS Road due to the use of the road by construction vehicles.	• Implement traffic management measures, including (MM175):
		  ○ Use of traffic controllers (e.g., near work areas, at entries/ exits to construction sites).
		  ○ Driver training, education and awareness about potential road safety risks.
		  ○ Notification of communities about periods of high traffic movements.
		• Implement road safety education and awareness with local communities, particularly with children (MM178).

SIA-07	Reduced safety for communities and users of the Tabubil-Kiunga Highway due to use of the road by construction vehicles.	
SIA-08	Reduced safety for people of communities along the pipeline access road, including children, due to use of the road by public and project vehicles during operation.	• Implement traffic management measures, including road signage and speed limits near to villages and settlements (MM179). • Implement road safety education and awareness with local communities, particularly with children (MM178).
SIA-09	Reduced safety for community members near to construction and operational activities and facilities for the TSF due to potential interaction with construction activities and equipment.	• Implement site management and safety measures (e.g., exclusion zones near construction works) (MM180). • Implement education and awareness with local communities, including children, about potential safety risks of construction activities (MM181). • Locate laydown areas and construction facilities away from villages and major settlements where possible (MM182). • Implement security measures at project sites to manage public access (MM190).
SIA-10	Reduced safety for community members near to construction activities and facilities within the infrastructure corridor due to potential interaction with construction activities and equipment.	
SIA-11	Reduced safety for users of the Ok Tedi and Ok Birim due to construction of the river crossings near Tabubil and Karandimok, and gravel extraction activities in the Ok Tedi near Birimkamba.	• Implement safety and exclusion zones near works within the Ok Tedi and Ok Birim (MM183).

Residual impact assessment

People in the project communities generally perceive their communities to be safe. Communities are removed from existing roads that may present safety risks for community members, particularly children and vulnerable groups such as disabled and elderly. As such, community safety is **highly sensitive**.

Traffic safety

The project will result in an increase in traffic along the Kiunga-Tabubil Highway, and will use the ITCS Road, and the pipeline access road to transport the workforce, materials, equipment and supplies.

The use of the ITCS Road by light and heavy haulage vehicles will increase the risk of project-related road accidents, particularly for that section of the road between Alice Pit and the TSF site past Birimkamba. The project will also increase the risk of road accidents from the project use of the pipeline access road during construction. Following the implementation of management measures, use of these roads has potential to result in noticeable changes to community safety, for a notable number of people, for pedestrians, motorists and PMV users. In particular, use of these roads by project vehicles have potential to impact on safety for children and other vulnerable groups such as elderly and people with disability. The magnitude of change will be **moderate**, with the residual impact of **high** significance (SIA-06).

The project will result in an increase traffic on the Kiunga-Tabubil Highway across the life of the project associated with the transport of plant, equipment, materials and supplies from the Kiunga Port to project sites. This has potential to impact on safety for a notable number of people in communities and settlements along the highway. Following the implementation of management measures, potential reductions in safety are likely to be marginal, with the magnitude of impact on community safety being **minor**. The residual significance of this impact is **moderate** (SIA-07).

A pipeline access road will be constructed along the pipeline corridor, which will be accessible for public use. Prior to 2013, a road connected Ok Ma settlement to Tabubil via a bridge over the Ok Tedi that provided vehicle access for communities between Seven Kona and Ok Ma. The collapse of the bridge in 2013 stopped vehicle use of the road, although it continues to provide pedestrian access between villages and Tabubil. Use of the road by project and public vehicles has potential to result in permanent reduction in community safety for communities along the infrastructure corridor due to the introduction of road safety risks, particularly if OTML uses the road as an alternative access route to Tabubil. Following the implementation of management measures, this is expected to result in a marginal reduction in safety, with the scale of impact being **minor**. The residual significance of impact will be **moderate** (SIA-08).

Interaction with construction activities

The presence of construction activities in areas surrounding the TSF and infrastructure corridor, including the Ok Birim and Ok Tedi, will increase safety risks for people as they move around areas near the project.

For the TSF, potential risk of interaction with construction equipment and facilities, is most likely to impact on safety for people from communities closest to the project such as Birimkamba and Kungembit, although the project will also present risks to others as they travel on roads used by the project. With the implementation of management measures, including implementation of safety zones near project works and education and awareness, it is anticipated that community safety impacts associated with interactions with construction equipment and facilities will result in a small change to community safety for TSF communities, with the magnitude of impact being **minor**. Given the **high sensitivity** of community safety, the residual significance of impact is **moderate** (SIA-09).

Potential impacts on community safety for communities along the infrastructure corridor, are likely to occur for short periods as construction works move along the corridor, impacting on communities closest to construction activities as people move about the surrounding area. With the implementation of management measures, the scale of change in community safety is will be marginal, with the magnitude of impacts o anticipated to be **negligible**. The residual significance of impact expected to be **low** (SIA-10).

Temporary reductions in safety for river users may occur due to works for the bridges across the Ok Birim, Ok Ma and smaller waterways and from gravel extraction works in the Ok Tedi. Construction works for the bridges may result in short-term risks to safety for people traveling by boat and canoe near to construction works. Gravel extraction activities in the Ok Tedi near Birimkamba are expected to occur for up to four years during construction of Cell 1 and two years for construction of Cell 2, with gravel extraction also required for ongoing maintenance. With the implementation of management measures, these activities are expected to result in a marginal change in river safety, with the scale of impact **minor**. The residual significance of impact is expected to be **moderate** (SIA-11).

Community conflict

Social and economic changes resulting from the construction and operation of the project may increase levels of crime, conflict and community conflict within project communities, leading to potential impacts on the safety and security of community members. Key drivers of social change that have potential to lead to increases in community conflict include:

- Increase in disposable incomes due to project compensation payments, and wages from direct and indirect employment from the project.
- Population growth related to PIIM into project communities of people attracted by project-related employment and business opportunities and improved access supported by the development of the pipeline access road and bridge crossings of the Ok Birim and Ok Tedi.
- Population and demographic changes related to an influx of a predominantly male project workforce into project communities, including workers from other PNG provinces and from overseas.

Project compensation payments to directly affected landowners and wages from direct and indirect project related employment are expected to result in increased disposable incomes for some individuals and households in project communities. Increased household incomes associated with resource projects in PNG and internationally have been linked to increased consumption of drugs and alcohol and associated increases in anti-social behaviour and crime (MacIntyre 2007, 2008; Blazey and Perkiss 2016; Beer 2018). Issues relating to drug and alcohol use varied across project communities. TSF communities generally reported that disturbances relating to drug and alcohol use were uncommon and mainly occurred around community events or celebrations. However, drug and alcohol related violence, including family and sexual violence, are existing issues in larger communities such as Alice Pit, Ningerum, and Seven Kona, with increased access to money from ASM seen as the primary contributor.

Changes in population due to the influx of workers and in-migration of ‘outsiders’ into project communities due to economic opportunities supported by the project may also contribute to an increase in crime and violence, including against women and girls. Family and sexual violence against women are ‘pervasive’ issues in PNG, with gender-based violence ’a part of everyday life, [that is] widely tolerated and accepted’ (Garbe and Struck-Garbe 2018). It is estimated that more than 1.5 million women in PNG experience gender based violence each year, although incidents of rape or domestic violence often go unreported due to stigma, fear of retribution, or limited trust in authorities (USDOS 2023).

Based on similar construction and resource projects in PNG and elsewhere, direct and indirect employment for the project is likely to see an increase in males across the study area, particularly in areas near to the TSF site, construction worksites for the infrastructure corridor, and at worker accommodation facilities at Alice Pit, Ningerum and Tabubil. More males, coupled with higher disposable incomes, has potential to lead to an increase in the exploitation and abuse of women and girls, leading to gender-based violence, demand for commercial sex, and enticement to transactional sex for women and girls.

Concerns about potential changes in safety and security, particularly for women and girls, due to the project were reflected in community feedback during consultation for this assessment, with comments including:

> *A lot of people will be coming because of this project, including more men from other places, which will change the safety levels.*
>
> *We are worried about girls if other people are coming into the community.*
>
> *Social issues will increase in the community once the TSF is established in the area. The road access will also provide easy access for outsiders to come into the community.*
>
> *Law and order issues might increase due to alcohol consumptions.*

Stakeholder consultation for this assessment noted that the traditional belief of sorcery (sanguma) remains strong within the area, with fear of sorcery accusation related violence (SARV) noted as a concern for community members from TSF communities and in Alice Pit. Women in particular raised fear of sorcery as their main safety concern. It is estimated that between 30 and 500 fatalities related to SARV occur in PNG each year (USDOS 2023). SARV in PNG is often related to disputes over land, marriage, resources, and political or business rivalries, with feelings of jealousy and perceived inequality, including around money and goods, often fuelling SARV. Both men and women can face SARV, although gendered dynamics are central to SARV in PNG, with older women, widows, childless women, and women without strong kinship protection often targeted (UNFPA 2025).

Social and economic changes related to in-migration, and distribution of compensation and other project benefits have potential to increase the incidence of SARV, due to community conflicts over land and other resources, uneven distribution of project benefits and opportunities and perceived disparities between those that benefit from the project and those that do not, and social tensions and jealousies.

Management measures

Table 11.7 summarises measures to mitigate and manage the project's impact on community safety and security due to increased levels of community conflict within project communities.

Table 11.7 Proposed management measures – community conflict

ID#	Potential impact	Key measures
SIA-12	Reduced safety and security in project communities related to increased drug and alcohol-related crime and violence due to increased disposable incomes, and population changes from PIIM and presence of a predominantly male project workforce.	• Prioritise employment of local people (e.g., from project communities and the North Fly District) (MM169). • Implement community development initiatives to support community safety (MM184). • Work with provincial, district and local government to strengthen response to law and order within project communities (MM185). • Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in migration and develop solutions and community assistance for limiting PIIM (MM167). • Implement worker Code of Conduct and conduct workforce education and awareness about expected standards in relation to community interactions (MM171). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor community complaints and grievances related to PIIM and develop strategies to respond to emerging issues (MM186).
SIA-13	Reduced safety and security for women and girls, due to increased incidence of gender-based violence related to increased disposable incomes of young males, and population changes related to PIIM.	

ID#	Potential impact	Key measures
SIA-14	Reduced safety and security due to increase in SARV, associated with community conflicts over land and other resources, uneven distribution of project benefits and opportunities, social tensions and jealousies.	• Work with provincial, district and local government to strengthen response to law and order within project communities (MM185). • Implement education programs regarding SARV in collaboration with national and provincial governments, and other stakeholders (e.g., non government organisations, civil society organisations) (MM188).

Residual impact assessment

Population changes in project communities due to PIIM and influx of project workers, and increased disposable incomes, particularly for young men, from employment and project benefits, may contribute to a rise in drug and alcohol related crime, violence, and anti-social behaviour, including family and sexual violence. People in the TSF and infrastructure corridor communities generally perceive their villages to be safe, with community members reporting that disturbances relating to drug and alcohol use were uncommon and mainly occurred during community events. However, drug and alcohol related crime and violence was reported to occur in larger communities such as Alice Pit, Ningerum, and Seven Kona. Safety and security of project communities is **highly sensitive** to change, with safety and security of women and girls **very highly sensitive**.

Potential impacts on safety and security in project communities related to increased incomes and population and demographic changes are likely to persist over the life of the project, although are likely to be greatest during the construction phase. The construction phase of the project is likely to have higher direct and indirect employment and economic opportunities, resulting in larger numbers of people having access to cash incomes, and possibly higher levels of in-migration. Following the implementation of management measures, reductions in safety and security due to increases in drug and alcohol- related crime and violence are expected to affect a noticeable number of people across the project communities. Consequently, the magnitude of change is anticipated to be **moderate**, with the residual significance of impact being **high** (SIA-12).

A greater number of males across the study area due to PIIM and the presence of the project workforce, and increased access to disposable incomes has potential to lead to an increase in violence against women and girls, including exploitation and abuse due to demand for commercial sex, and enticement to transactional sex, impacting on safety and security of women and girls. These impacts are most likely to occur during the construction phase due to the larger workforce and likely higher levels of PIIM, although may also occur during the operations phase of the project. The magnitude of potential impacts on the safety and security of women and girls is **moderate**, with the residual significance of impact being **high** (SIA-13).

The project has potential to lead to an increase in SARV associated with uneven distribution of project compensation and benefits, either actual or perceived, resulting in tension and conflict between project communities, groups or individuals. Jealousies over money and goods is also likely to occur between those that receive land compensation payments or wages from project employment, and those that do not, further contributing to SARV within project communities. Given compensation payments and project benefits will also occur for the life of the project, there is potential for SARV to also occur over this timeframe. This may lead to noticeable changes in safety and security, particularly for women and girls. The magnitude of potential impact on safety and security of project communities related to SARV is anticipated be **moderate**, with a residual significance of impact of **high** (SIA-14).

Landscape and amenity

The following sections assesses potential impacts on landscape and scenic amenity, and community amenity, from the construction and operation of the project.

Landscape and scenic amenity

Construction of the TSF will result in permanent changes to landscape and scenic amenity from the progressive clearance of vegetation within the TSF footprint, and development of the TSF storage cells, and vegetation clearing and development of ancillary infrastructure such as laydown areas, access roads and surface water diversions.

The TSF is located within a predominantly natural landscape characterised by dense tropical forest, river valleys, and undulating ridges, with the visual landscape of TSF villages dominated by continuous forest canopies, shaded clearings, garden plots, and small, dispersed settlements. Elevations across the area typically range from 40 to 110 m AMSL and long-distance views are generally limited by vegetation and terrain, with broader outlooks only available from local high points. The clearing of approximately 1,500 ha of land for the TSF and ancillary facilities will represent a change in the landscape character of the area from a largely undisturbed, natural environment to a more industrial environment. Figure 11.1 and Figure 11.2 show computer-generated aerial views towards Cell 1 and Cell 2 of the TSF from Kungembit and Ambaga once the TSF is developed. These figures are the view that could be expected to be seen from a helicopter flying past; they are not what people will see from their villages.

Houses and community areas of villages closest to the TSF site such as Kungembit, Birimkamba, Ambaga and Karandimok are generally enclosed by dense forested vegetation, which generally limits views beyond the immediate area of the community. Further, the distance from Karandimok and Ambaga from the project means that it will not be visible from areas within or near to the village. Figure 11.3 to Figure 11.6 show representative views of the surrounding area from within Kungembit, Birimkamba, Ambaga and Karandimok.

Within Kungembit, the highest points within the village are along a north-south ridgeline that ranges from 85 to 90 m AMSL. This is higher than the final crest height of the TSF. Views of the TSF may occur from some locations along this ridgeline, although these will likely be partly screened by existing vegetation. For Birimkamba, while views of the project are not expected within the village, the project is likely to be visible at the entrance to the village from the ITCS Road. At this location, views of the TSF will be screened by vegetation and the alignment of the ITCS Road, although views of the laydown area and possibly site offices located north of the road are likely. The laydown area will be set back from the road by approximately 30 to 40 m, and views will depend on the extent of vegetation clearing between the road and the laydown area (see Figure 11.6).

In surrounding areas, views of the TSF will occur as people travel through the area. Views of the TSF are likely to be a prominent feature for people travelling along the ITCS Road and perimeter road. These views will generally occur for short periods as people travel along these roads and are likely to be partly screened by existing vegetation and the undulating terrain from many locations.

Potential impacts on landscape and scenic amenity within the infrastructure corridor will mainly be associated with the construction of the bridge over the Ok Birim, vegetation clearing and earthworks within the road corridor.

The infrastructure corridor passes through a generally undisturbed natural environment comprising forested terrain, river corridors and alluvial floodplains, and dispersed villages and settlements with traditional dwellings interspersed among gardens and secondary forest regrowth. Vegetation clearing and construction of the tailings pipeline, pipeline access road and bridge over the Ok Birim, will represent a change in the predominantly natural landscape along the infrastructure corridor. The corridor has been located around villages and settlements, to avoid impacts on dwellings. Existing vegetation and terrain will help to screen the infrastructure corridor in areas near to villages and settlements.

Aerial view at Kungembit looking south
Existing Conditions

Aerial view at Kungembit looking south
with the proposed **TSF Cells 1 & 2**

Aerial view at Kungembit looking south with the proposed **TSF Cells 1 & 2**

OK TEDI MINING

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.1

Conceptual view of the TSF (Cells 1 & 2) – looking south from Kungembit

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.01_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.
DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA002.AI_4 | SAVED BY: RH 19.06.26

Aerial view at Ambaga looking east
Existing Conditions

Aerial view at Ambaga looking east
with the proposed **TSF Cells 1 & 2**

Aerial view at Ambaga looking east with the proposed **TSF Cells 1 & 2**

OK TEDI MINING

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

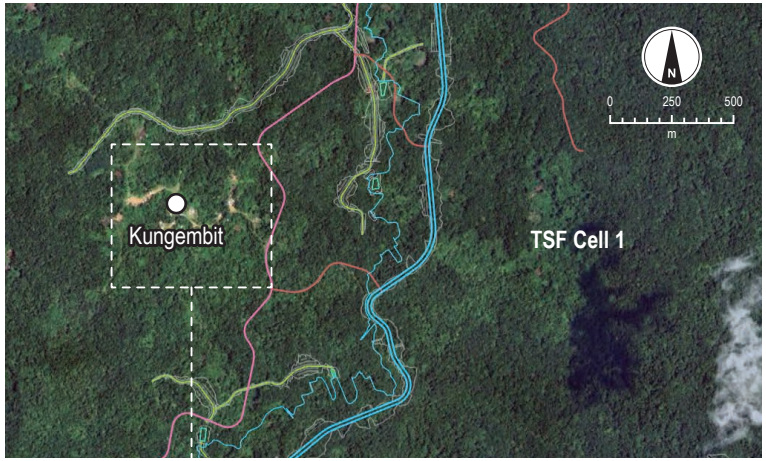
FIGURE 11.2

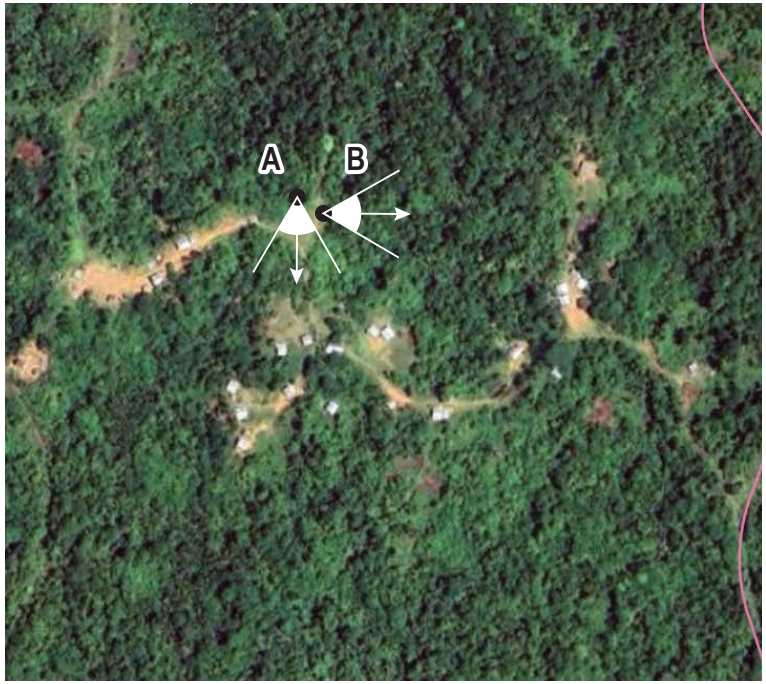
Conceptual view of the TSF (Cells 1 & 2) – looking east from Ambaga

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.02_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.
DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA001.AI_4 | SAVED BY: RH 19.06.26





OK TEDI MINING

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.3

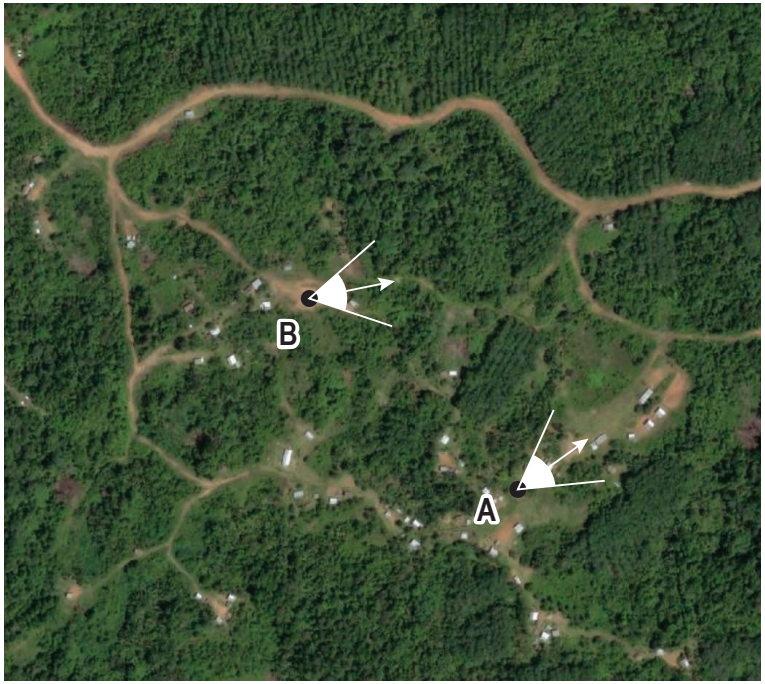
Views from within Kungembit village

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-POMEN374244C FILE: 374244C_R08_F11.03_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA006.AI_3 | SAVED BY: RH 19.06.26



OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.4

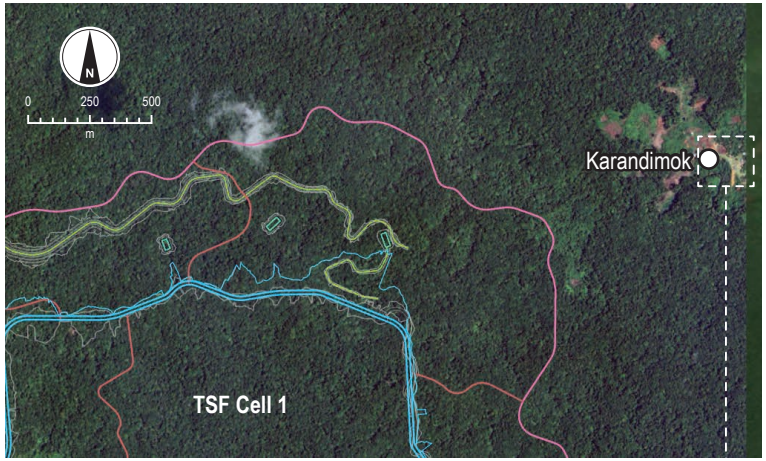
Views from within Ambaga village

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-POMEN374244C FILE: 374244C_R08_F11.04_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA006.AI_3 | SAVED BY: RH 19.06.26



OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.5

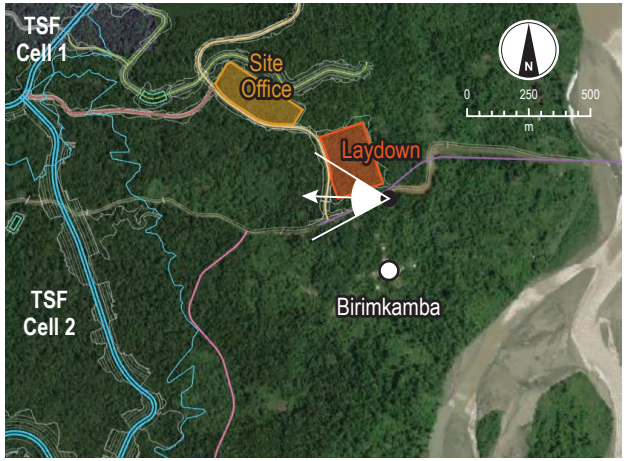
Views from within Karandimok village

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-POMEN374244C FILE: 374244C_R08_F11.05_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA006.AI_3 | SAVED BY: RH 19.06.26



Viewpoint and direction

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.6

Views towards the TSF from the entrance to Birimkamba village (TSF Cells 1 & 2)

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.06_GRA

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\374244_MELEN_OTML_OKBIRIMTSF\2_GRAPHICS\VIA\374244C_VIA_GRA004.AI_4 | SAVED BY: RH 19.06.26

Construction of the bridge over the Ok Birim will introduce changes to the natural river environment. The bridge over the Ok Birim is located approximately 800 m downstream of Karandimok and is away from any dwellings. For most people, views of the bridge would be temporary as they travel along the Ok Birim within about 800 m either side or use this section of the river for activities such as fishing, and typical of most bridges across similar sized rivers in PNG. The bridge across the Ok Tedi at Tabubil will be construction adjacent to the existing bridge. As such, it will not represent a significant change in this section of the river.

Community amenity

During construction, impacts on community amenity will mainly be associated with noise, dust and lighting from construction works for the TSF and infrastructure corridor, and traffic noise from construction vehicles using the ITCS Road, Kiunga-Tabubil Highway, and pipeline access road. Once operational, impacts on community amenity will be localised to communities closest to the TSF site and will mainly result from noise, dust, and lighting from TSF operations.

The section assesses impacts on community amenity due to changes in noise and vibration, air quality and lighting. Detailed assessments of noise and vibration impacts and air quality impacts are presented in Chapter 10.

Noise and vibration

The main noise generating activities associated with construction of the TSF include (Appendix I):

- Initial construction of the starter bund for Cell 1, including vegetation clearing, gravel extraction from the Ok Tedi and transport of gravel to the TSF site.
- Construction of TSF access roads and infrastructure such as the hydro-cyclone house, power generation and other facilities.

The main noise sources during project operation will be the operation of the hydro-cyclone house, mobile equipment used for tailings placement and compaction, and power generation at the TSF site (Appendix I).

Noise modelling conducted for the ESIA found that noise levels generated by construction activities, including for the initial starter bunds for Cell 1 and Cell 2 and construction haulage to the TSF site, will be within the noise assessment goals adopted for the project. Construction of the TSF perimeter road and ancillary infrastructure such as the hydro-cyclone house will be within World Bank Environment, Health, and Safety Guidelines for noise, apart from at Birimkamba and Kungembit, which may experience short-term noise impacts when construction works for the perimeter road are within about 500 m of dwellings (Appendix I). Noise from construction activities and construction haulage will be noticeable at villages closest to the TSF site, and will represent a change to the typical background noises heard in these villages (e.g., from natural sources, local village activities such as livestock and woodchopping). This may cause temporary nuisance impacts for some community members, leading to a decline in the perceived amenity of these villages, possibly affecting some peoples' use and enjoyment of areas within the village closest to construction activities.

Operation of the TSF is expected to meet the noise assessment goals within all villages surrounding the TSF site, except for Kungembit where noise from the operation of mobile plant and equipment for the tailings placement and embankment raises may exceed the night-time noise assessment criteria adopted for the project during worst-case meteorological conditions. Noise impacts will mainly occur when activities occur for the tailings placement and embankment raises within about 1,500 m from the village but management and mitigation measures are anticipated to reduce these as much as practicable. This has potential to impact on the night-time amenity for people within areas of the village closest to the TSF and possibly result in short-term disruptions in sleep for some people during this period. Where operational activities are further away, noise levels are predicted to be within the adopted noise goals.

Noise from construction of the tailings pipeline and pipeline access road is expected to be within the noise assessment goals adopted for the project at the nearest dwellings or other sensitive receivers. Construction of the tailings pipeline through Tabubil will generate the highest noise levels, particularly if rock breaking is required (Appendix I). Similar to construction activities for the TSF, noise from construction will be noticeable for people in villages and settlements as construction progresses along the infrastructure corridor. This may result in short-term changes to the amenity of villages when construction works occur nearby, with noise levels reducing as construction works move away from the village.

Following construction of the pipeline access road, traffic noise generated from the use of the pipeline access road by project and public traffic is expected to be below the adopted noise goals for the project at dwellings and other sensitive receptors (Appendix I). However, noise from passing vehicles may cause a temporary nuisance impact for people when they are in garden or community areas located close to the road.

The Kiunga-Tabubil Highway will be used for haulage of plant, materials, equipment and supplies during construction and operation. There are currently seven convoys daily that transport equipment and supplies for the mine from the Kiunga Port to Tabubil, with two additional daily convoys required to support construction and operation of the project. Noise modelling predicts that traffic noise levels from haulage activities on the Kiunga-Tabubil Highway are expected to be negligible in context of the existing noise environment and existing traffic levels (Appendix I).

Air quality

Construction and operation of the project will generate dust from activities such as land clearing, earthworks, vehicle movements on unsealed roads, excavation and trenching for the tailings pipeline, and handling, haulage and placement of soil, sand, gravel, tailings and fill materials. Wind erosion from exposed areas of the TSF will also contribute to dust emissions during extended dry periods. Emissions will also be generated by plant and equipment used for the project such as diesel generators, project vehicles, excavators, bulldozers, and graders (Appendix H).

During construction, activities such as earthworks, excavation and construction vehicle movements will cause dust deposition at dwellings and other sensitive receptors close to the activities with potential impacts on community amenity. Potential amenity impacts are most likely to occur for communities closest to construction activities such as Birimkamba and Kungembit. Given the naturally high annual rainfall levels (i.e., in excess of 6,000 mm) within the study area, potential dust impacts for communities are expected to be manageable with the implementation of standard dust mitigation measures. However, temporary, localised impacts may occur from periods of high construction intensity such as peak earthworks, during dry and windy conditions. Emissions from diesel powered construction equipment have potential to result in small, localised increases in ambient concentrations. This is not expected to cause short- or longer-term changes in air quality.

Once operational, air quality impacts will mainly be due to dust from exposed TSF surfaces during extended dry conditions, traffic movements on unsealed roads and nitrogen oxide emissions from power generation. Dust levels are anticipated to be lower than those generated by construction activities (Appendix H). Consequently, potential changes in the amenity of nearby communities due to dust from the TSF operations are not expected above the adopted air quality goals for the project.

Construction activities for the infrastructure corridor are anticipated to generate short-term dust impacts as construction activities move along the infrastructure corridor. However, given the naturally high annual rainfall levels within the study area, these impacts will be effectively managed with the implementation of dust mitigation measures. Any potential impacts on community amenity will be temporary, and localised in areas closest to construction works (Appendix H). Impacts on community amenity are expected to reduce as construction works move away from villages. Emissions from plant and equipment will be below the ambient air quality goals adopted for the project and will not result in impacts on air quality for infrastructure corridor communities (Appendix H).

Communities along the Kiunga-Tabubil Highway currently experience temporary dust impacts as traffic passes, particularly convoys for Ok Tedi Mine that involve heavy vehicles. Construction haulage activities for the project will contribute to existing dust impacts, with intermittent impacts on community amenity for dwellings and other sensitive uses adjacent to the road. Community concerns about dust from vehicles currently using the Kiunga-Tabubil Highway were identified during engagement with highway villages. These included concerns about potential contamination of food crops grown in gardens along the highway and impacts on rainwater collected in tanks. Sealing the Kiunga-Tabubil Highway is currently being carried out, which will reduce dust impacts on community amenity. Sealing the highway between Kiunga and Ningerum is expected to be completed by 2028, with the timing of sealing the highway north of Ningerum yet to be determined.

Light spill

Potential impacts on night-time amenity may result from lighting of construction facilities for the TSF and infrastructure corridor such as worksites, site offices, and laydown areas, and of operational facilities for the TSF site. Construction of the TSF, tailings pipeline and access road will generally be conducted during the daytime with night-time works expected to be limited. However, construction facilities will have lighting for safety and security. Lighting of TSF work areas will be required during operation to provide safety for workers and security of the site given the 24-hours-per-day operation. The TSF site is currently located in a predominantly natural landscape characterised by dense tropical forest away from light sources. Lighting within villages is limited and is generally provided within dwellings through the use of solar lighting, battery operated lanterns, or open fire. The introduction of lighting for the project will represent a change in the night time environment in areas surrounding the TSF and infrastructure corridor communities. However, potential impacts on community amenity will mainly be localised to areas immediately surrounding project facilities, which are generally away from dwellings and other sensitive receptors.

Management measures

Table 11.8 describes proposed measures to mitigate and manage the project's potential impacts on landscape and amenity within project communities from construction and operation of the project.

Table 11.8 Proposed management measures – landscape and amenity

ID#	Potential impact	Key measures
SIA-15	Reduced visual amenity due to changes to the landscape and visual environment from establishment of the TSF (e.g., vegetation clearing, construction of embankments).	• Minimise extent of clearing where possible and maintain vegetation buffers around the perimeter of the TSF and ancillary infrastructure (e.g., laydown areas), and the infrastructure corridor and nearby villages and settlements (MM189). • Restore and rehabilitate disturbed areas no longer required for use as early as possible and progressively throughout project construction (MM054).
SIA-16	Reduced visual amenity due to changes to the landscape and visual environment from construction of the tailings pipeline, pipeline access road and bridges across the Ok Tedi and Ok Birim.	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM055). • Minimise extent of clearing where possible and maintain vegetation buffers around the perimeter of the TSF and ancillary infrastructure (e.g., laydown areas), and the infrastructure corridor and nearby villages and settlements (MM189). • Avoid villages and settlements through the design and siting of the infrastructure corridor, including the bridge across the Ok Birim (MM191). • Restore and rehabilitate disturbed areas no longer required for use as early as possible and progressively throughout project construction (MM054).

ID#	Potential impact	Key measures
SIA-17	Reduced amenity for people in communities surrounding the TSF due to noise, dust and lighting from construction and operational activities, including haulage activities.	• Implement traffic management measures, including road signage and speed limits near to villages and settlements (MM179). • Implement noise and dust management measures outlined in the CESMP sub-plans (MM192). • Implement site-specific noise mitigation and management measures to minimise disruption to people at night, when night-time operational activities are conducted within 1,500 m of Kungembit (MM193). • Site and design lighting to minimise light spill into surrounding areas (MM194).
SIA-18	Reduced amenity for people in communities near to the infrastructure corridor (including bridge crossings of the Ok Tedi and Ok Birim) due to noise, dust and lighting from construction activities.	• Avoid villages and settlements through the design and siting of the infrastructure corridor, including the bridge across the Ok Birim (MM191). • Implement traffic management measures, including road signage and speed limits near to villages and settlements (MM179). • Implement noise and dust management measures outlined in the CESMP sub-plans (MM192). • Site and design lighting to minimise light spill into surrounding areas (MM194).
SIA-19	Reduced amenity for people in communities along the pipeline access road due to noise and dust from operational road traffic.	• Avoid villages and settlements through the design and siting of the infrastructure corridor, including the bridge across the Ok Birim (MM191). • Implement traffic management measures, including road signage and speed limits near to villages and settlements (MM179). • Implement noise and dust management measures outlined in the CESMP sub-plans (MM192).
SIA-20	Reduced amenity for people in communities along the Kiunga-Tabubil Highway due to noise and dust from construction traffic.	• Implement traffic management measures, including road signage and speed limits near to villages and settlements (MM179). • Implement noise and dust management measures outlined in the CESMP sub-plans (MM192).

Residual impact assessment

Existing landscape character and visual amenity within the TSF villages is characterised by dense tropical forest, river valleys, and gently undulating ridges. The visual character and natural serenity of the landscape contribute to quality of life and reinforce peoples' connection to the land. Community feedback noted that the forest and rivers define sense of place for community members supporting livelihoods and cultural grounding. Seasonal and daily movements through the landscape to access gardens, fishing grounds, and hunting areas, reflect a relationship between residents and their surrounding environment. Therefore, landscape character and visual amenity is **moderately sensitive**.

It is recognised that social impacts from changes in landscape character and amenity may be experienced by individuals and communities as positive, neutral or negative, depending on their attitudes to the project or a particular change. For example, some people may perceive the presence of the bridge as a positive as it provides access across the river, while others may consider the presence of the bridge as a negative due to the changes that it introduces to the landscape and visual environment. The follow assessment of residual impacts considers potential changes based on the identified community sensitivity.

The impact assessment involved the identification, analysis, and evaluation of potential changes to existing social conditions from the construction, operation and decommissioning of the project. This includes consideration of both positive and negative impacts, direct and indirect impacts, and cumulative impacts with other projects. It is acknowledged that social impacts resulting from an action (e.g., siting of the transmission line over property) may be experienced by individuals and communities as positive, neutral, or negative depending on circumstances, vulnerabilities and attitudes to the project or a particular change.

The project will result in a permanent and noticeable change to the landscape and visual character due to vegetation clearing and the introduction of project infrastructure and activities. Villages most impacted will be those in proximity to the TSF development area with open landscapes or high vantage points, including Kungembit, Birimkamba and Ambaga. Following the implementation of management measures the magnitude of potential impact is **moderate**, and the significance of the residual impact is **moderate** (SIA-15).

Construction within the infrastructure corridor, including the bridge over the Ok Birim, will also result in a permanent change to the landscape and visual environment for villages and settlements along the corridor and for users of the Ok Birim. With the implementation of management measures, particularly as vegetation in rehabilitated areas becomes established, the project will result in a small change in landscape and visual values. Consequently, the magnitude of potential impact is **moderate**, and the significance of residual impact is **moderate** (SIA-16).

Existing amenity within the TSF and infrastructure corridor communities is characterised by noise and air quality typical of villages in PNG. The community amenity of TSF and infrastructure communities is therefore **moderately sensitive**. Following the implementation of management measures, the construction and operation of the TSF are expected to result in noticeable and/or perceived impacts on the amenity of local communities due to changes in noise, dust and lighting from the project. Impacts will occur across the life of the project and are most likely to be experienced by people of villages closest to the project, such as Kungembit and Birimkamba. Consequently, the magnitude of the potential impact is **moderate** and the significance of the residual impact is **moderate** (SIA-17).

Within the infrastructure corridor communities, short-term, localised amenity impacts will occur over the construction period. These will mainly occur during peak construction activity periods and affect communities closest to construction works as these progress along the tailings pipeline and pipeline access road. Following the implementation of management measures, the magnitude of potential impacts on amenity is **minor**, with the residual significance **low** (SIA-18).

Following construction, public, project and broader OTML use of the pipeline access road may result in permanent changes to amenity of communities along the road affecting notable numbers of people. The road has been designed to avoid villages and settlements and maintain a separation distance to minimise potential noise and dust impacts. With the implementation of management measures use of the road during operation will result in a marginal change to existing amenity. The magnitude of potential impacts on community amenity is **moderate**, with the residual significance of impact **moderate** (SIA-19).

The Kiunga-Tabubil Highway passes through numerous villages and settlements. The amenity of these communities is currently affected by noise and dust from existing vehicle use of the highway, including OTML convoys. The amenity of these communities is of **low sensitivity**. Use of the highway by project vehicles during construction and operation are expected to result in a marginal change to the amenity of villages along the highway. The magnitude of the impact is **minor**, and the residual significance is **low** (SIA-20).

11.1.3.2 Economy and livelihoods

This section assesses potential impacts on the economy and livelihoods within project communities, including peoples' natural resource use, employment and income. The biophysical impacts of the construction of the TSF, tailings pipeline and access road on aquatic ecology, soils, landform and stability and groundwater are discussed in Chapter 10.

Natural resource use

Construction and operation of the project will impact on land and water resources used by communities to support their livelihoods. Potential impacts will mainly be associated with the loss of, or disturbance to land and water within the TSF and infrastructure corridor development areas, although impacts may also result from increased demand for land from in-migration of people into project communities due to potential

economic opportunities of the project, and beneficial changes to the riverine environment due to the reduction in tailings disposal into the Ok Tedi.

TSF communities

Construction of the TSF development area will result in the clearing of approximately 1,500 ha of forested areas used by TSF communities including Kungembit, Karandimok, Birimkamba and Ambaga for livelihood activities such as gardening, sago production, hunting, cash cropping, and collection of bush resources. The TSF development area and areas surrounding it also include rivers, creeks and springs that are used by communities as sources of drinking water, for fishing and to support gardening activities. This includes the Ok Yep, which is used for gardening, fishing and as a water source by some communities during drought periods. Potential impact on food and water security from the loss of or impact on land and water used for household consumption are assessed in Section 11.1.3.4.

Livelihoods in the TSF communities are primarily derived from natural resources. Subsistence gardening is the primary livelihood activity for households in the TSF communities, with marketing and sale of garden produce, and sale of gold from ASM also important livelihood activities for households in communities surrounding the TSF. Construction of the TSF development area, including hydro-cyclone house, ancillary infrastructure such as laydown areas, access roads and surface water diversions, has potential to reduce livelihoods for households within the TSF communities, due to the loss of land used for:

- Growing cash crops and garden food for consumption and to sell at markets.
- Collection of resources to support activities such as house construction, canoe making, firewood, and medicinal plants.

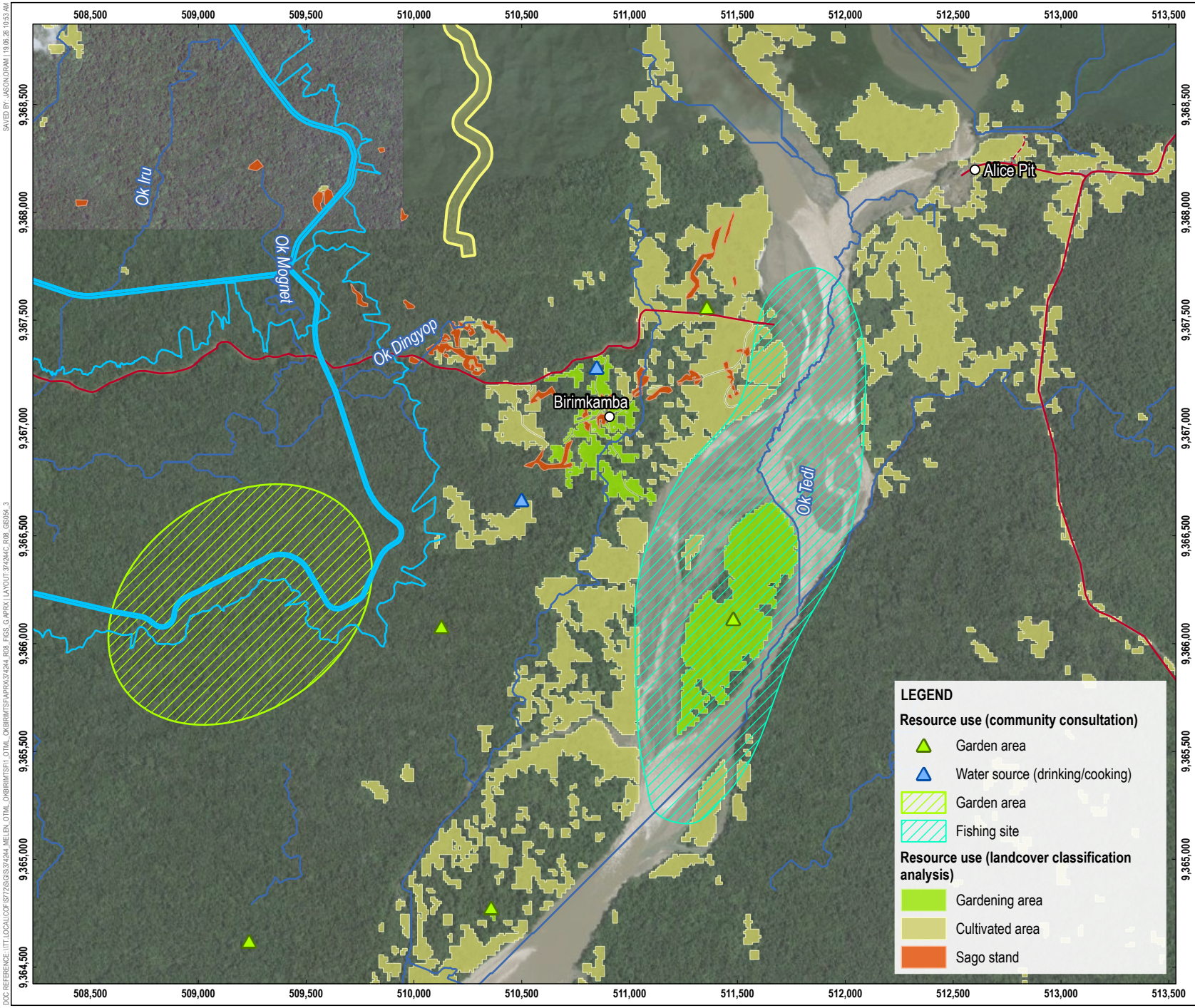
Community resource use areas identified through consultation with TSF communities indicates that land and waterways directly impacted by the TSF development area are mainly used by people from communities closest to the TSF site, including Kungembit, Birimkamba, Ambaga and Karandimok. Figure 11.7 to Figure 11.10 shows areas of natural resource use for these four communities based on community feedback and analysis of satellite imagery.

Land within the TSF development area includes gardening areas and potential sago areas used by people from:

- Birimkamba, located within the TSF footprint, and along the TSF perimeter road.
- Kungembit, located along the Ok Yep and smaller creeks, including areas that will be directly impacted by surface water diversion drains.
- Ambaga, including within the TSF footprint, along the TSF perimeter road and the Ok Yep.
- Karandimok, located within the TSF footprint and along the proposed pipeline access road and TSF perimeter road.

Land used for growing cash crops is generally located away from the TSF footprint closer to Ambaga, although there is potential for some cash crop areas to be directly impacted by the TSF perimeter road between Kungembit and Ambaga, and surface water diversions near Kungembit. Cash cropping is an important source of income for households in the TSF communities with approximately 50% or more of households in each TSF village selling cash crops in the last year.

Bush resources are collected from forested areas to provide food, medicinal plants, building materials and materials for household use. Consultation for this assessment identified one area used by Karandimok for the collection of bush resources, although the TSF development area will result in the loss of a large area of tropical forest that are expected to be used for the collection of a variety of bush resources.



OK TEDI MINING

LEGEND

- Study area community
- Road
- Track
- Watercourse
- Proposed TSF footprint
- Proposed Infrastructure Corridor route alignment (to be finalised)

SOURCE
Resource use mapping and villages from Tetra Tech Coffey.
Proposed infrastructure from KCB and OTML.
Topographic features from OSM.
DEM from OTML (captured 2012). Imagery from ESRI.

0 250 500 m

SCALE **1:25,000**
PAGE SIZE: **A4**
PROJECTION: **PNG94 PNGMG94 Zone 54**

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.7

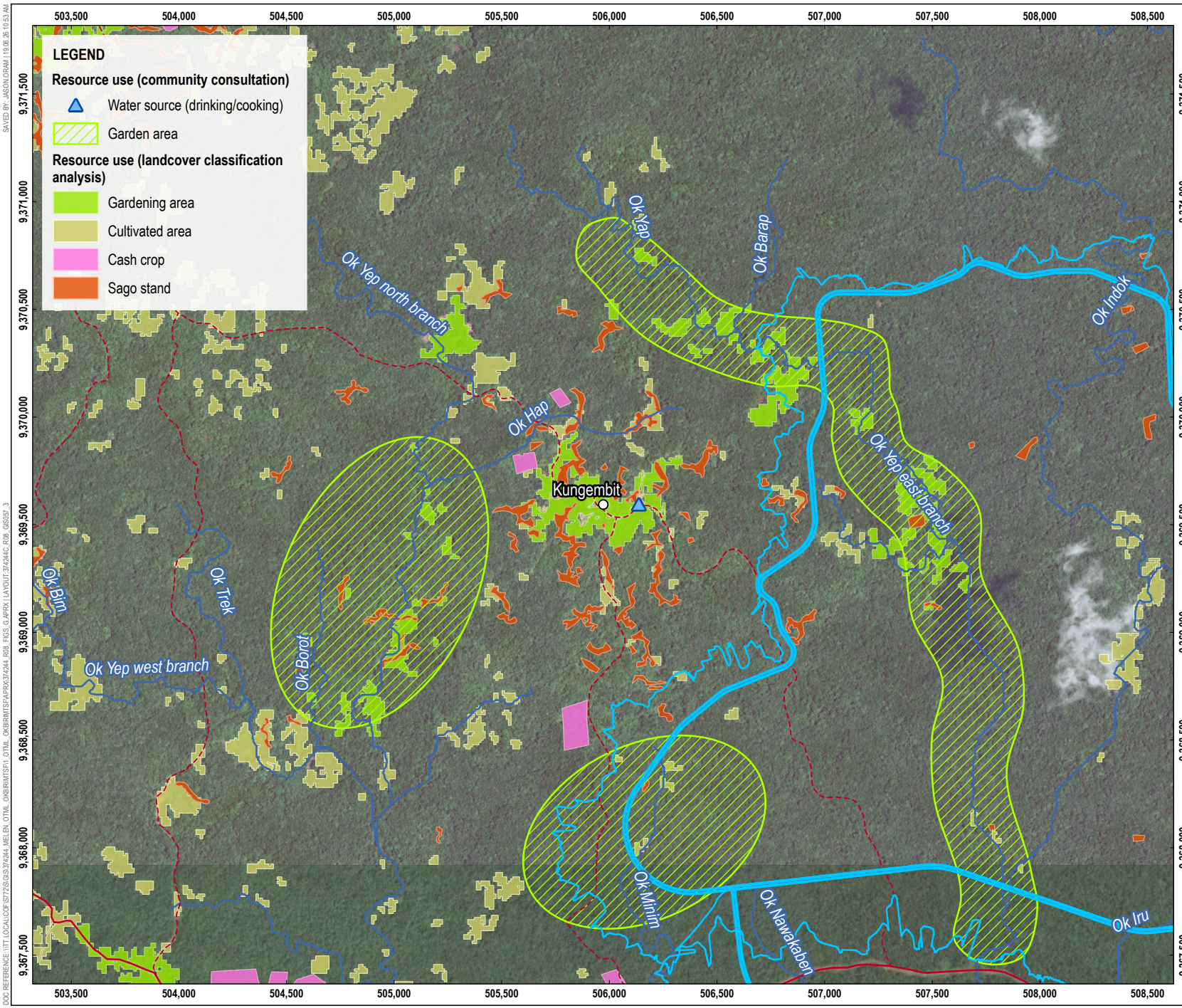
Community resource use in Birimkamba

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.07_GIS

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

SAVED BY: JASON.ORAM | 19.06.26 10:53 AM
DOC REFERENCE: \\TT-LOCAL\COF\ST27\SIG\SIG374244_MELEN_OTML_OK\BIRIM\TSF\APRX\374244_R08_FIGS_G.APRX | LAYOUT: 374244C_R08_08054_3



LEGEND

- Study area community
- Road
- Track
- Watercourse
- Proposed TSF footprint

SOURCE
Resource use mapping and villages from Tetra Tech Coffey.
Proposed infrastructure from KCB and OTML.
Topographic features from OSM.
DEM from OTML (captured 2012). Imagery from ESRI.

0 250 500 m

SCALE **1:25,000**
PAGE SIZE: **A4**
PROJECTION: **PNG94 PNGMG94 Zone 54**

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.8

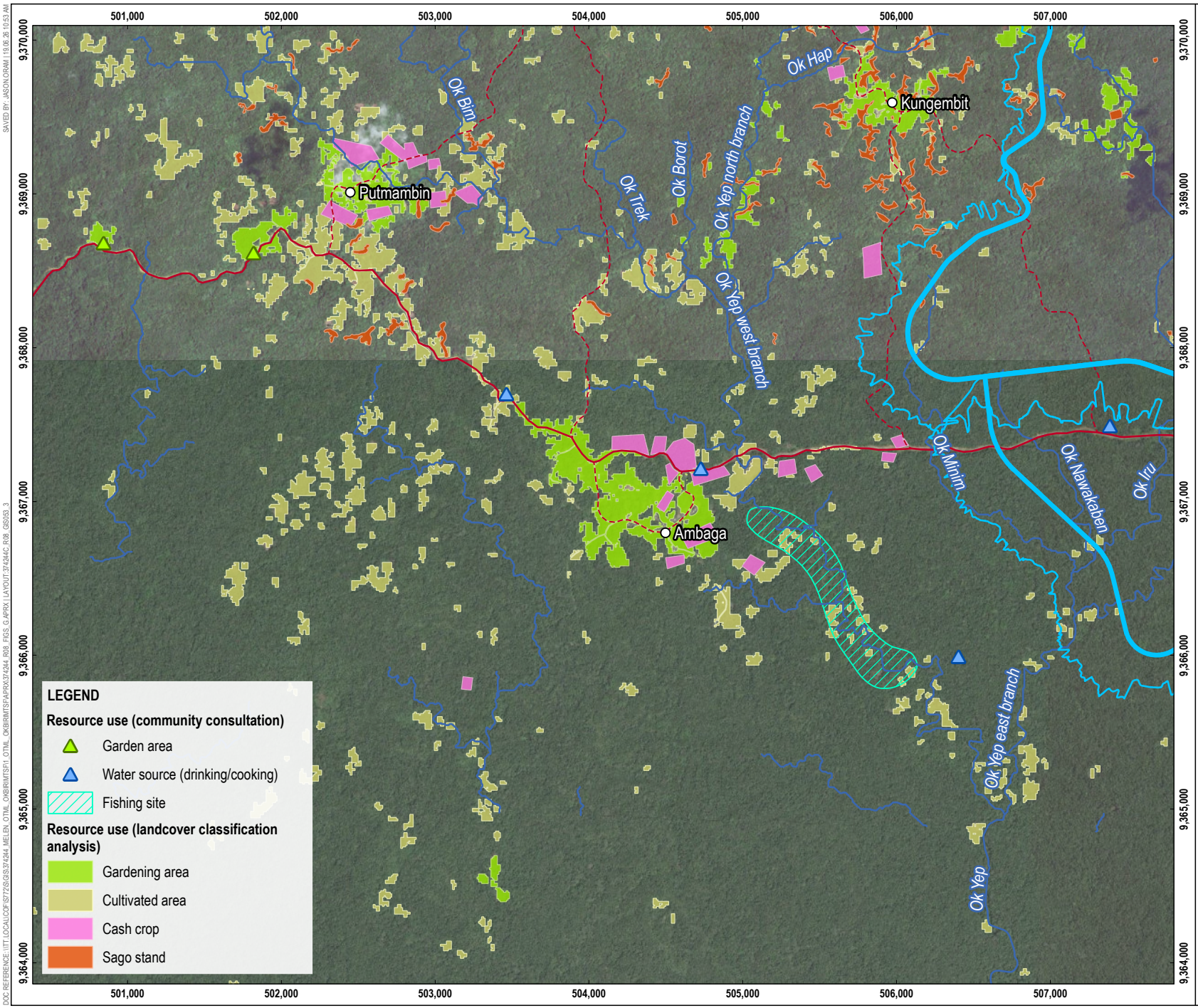
Community resource use in Kungembit

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.08_GIS

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

SAVED BY: JASON.ORAM | 19.06.26 10:53 AM
DOC REFERENCE: \\TT-LOCAL\COF\SI72\GIS\374244_MELEN_OTML_OK\BIRIM\TSF\01_OTML_OK\BIRIM\TSF\APRX\374244_R08_FIG5_G.APRX | LAYOUT: 374244C_R08_GIS057_3



LEGEND

- Study area community
- Road
- Track
- Watercourse
- Proposed TSF footprint

SOURCE
Resource use mapping and villages from Tetra Tech Coffey.
Proposed layouts from KCB and OTML (indicative only).
Topographic features from OSM.
DEM from OTML (captured 2012). Imagery from ESRI.

0 0.5 1 km

SCALE **1:35,000**
PAGE SIZE: **A4**
PROJECTION: **PNG94 PNGMG94 Zone 54**

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.9

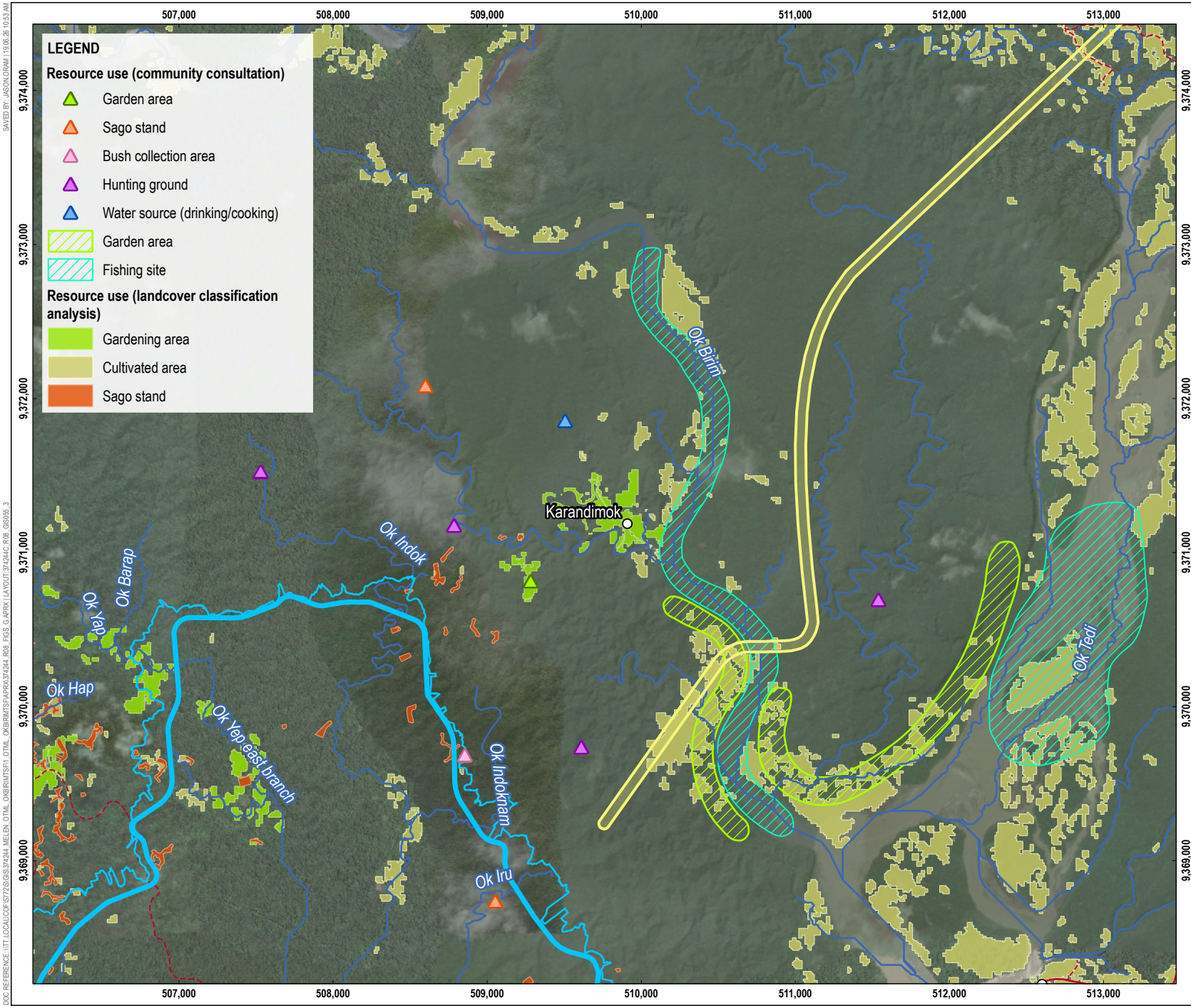
Community resource use in Amabga

TETRA TECH COFFEY

DATE: **19.06.26** PROJECT: **754-MELEN374244** FILE: **374244C_R08_F11.09_GIS**

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

SAVED BY: JASON.ORAM | 19.06.26 10:53 AM
DOC REFERENCE: \\TT-LOCAL\COF\ST726\GIS\374244_MELEN_OTML_OK\BIRIM\TSF\1_OTML_OK\BIRIM\TSF\APRX\374244_R08_FIG5_G.APRX | LAYOUT: 374244C_R08_GIS053_3



OK TEDI MINING

LEGEND

- Study area community
- Road
- Track
- Watercourse
- Proposed TSF footprint
- Proposed infrastructure corridor

SOURCE
Resource use mapping and villages from Tetra Tech Coffey.
Proposed infrastructure from KCB and OTML.
Topographic features from OSM.
DEM from OTML (captured 2012). Imagery from ESRI.

0 0.5 1 km

SCALE **1:35,000**
PAGE SIZE: **A4**
PROJECTION: **PNG94 PNGMG94 Zone 54**

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 11.10

Community resource use in Karandimok

TETRA TECH COFFEY

DATE: 19.06.26 PROJECT: 754-MELEN374244 FILE: 374244C_R08_F11.10_GIS

DISCLAIMER: THIS FIGURE HAS BEEN PROVIDED FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE. THE CREATORS DO NOT WARRANT THAT THIS FIGURE IS DEFINITIVE NOR FREE OF ERROR AND DO NOT ACCEPT LIABILITY ARISING FROM RELIANCE ON INFORMATION PROVIDED HEREIN. © COPYRIGHT TETRA TECH COFFEY 2026.

SAVED BY: JASON.ORAM | 19.06.26 10:53 AM
DOC REFERENCE: \\TT-LOCAL\COF\ST2\GIS\374244_MELEN_OTML_OK\BIRIM\TSF\1_OTML_OK\BIRIM\TSF\APRX\374244_R08_FIG5_G.APRX | LAYOUT: 374244C_R08_GIS05_3

Construction activities within the Ok Birim and Ok Tedi such as construction of the bridge across the Ok Birim, and gravel extraction activities in the Ok Tedi near Birimkamba also have potential to impact on areas within or adjacent to these rivers used for livelihood activities. These include areas:

- Within the Ok Tedi, or along the banks of the river, that are used by people from Birimkamba for fishing, gardening and alluvial mining.
- Within or along the Ok Birim near the bridge location, that are used for fishing and gardening by people from Karandimok.
- Within the Ok Tedi used for alluvial mining activities by people from Birimkamba, Putmambin, and possibly Komokpin.

Potential impacts on food security due to changes in fishing and gardening areas are discussed in Section 11.1.3.4, while impacts on alluvial mining within the Ok Tedi are discussed in the following section (employment and income).

Community feedback from TSF communities raised several concerns about potential impact on land used for livelihood activities, for example:

> *The water sources will be disturbed. Waters will be contaminated. Garden areas will be destroyed. Sago areas will be disturbed. Land that provides source of timbers for building houses will be destroyed.*
>
> *Concern about decline in natural resources from the bush. There are special tress that locals look for when they are out in the bush…they source the tree's bark to preserve or carry sago in it, also wrapping pig's meat inside it for cooking. Worried that these trees will become scarce if the bush is cleared for the Project.*
>
> *In the past and currently, I know that this lifestyle, this is my land – I can go visit other villages or places, but when I come back I know that I have my land where I can go visit my gardens or the bush for hunting, I can go fishing and diving/swimming – but I know when the project comes this will be no more. The lifestyle will change and I won't be able to do these things anymore – to enjoy the environment and fresh air, walk through the forests.*

Infrastructure corridor communities

Construction of the infrastructure corridor will directly impact up to 400 ha of land, including forested areas, river corridors and alluvial floodplains. Livelihoods in the infrastructure corridor communities are primarily dependent on the use of natural resources, including for food and water, housing and income generation. Subsistence gardening is the main livelihood activity and source of staple foods for households in the infrastructure corridor communities with hunting, fishing, sago harvesting, and ASM also key livelihood activities. Small-scale marketing of surplus garden produce and cash crops also contribute to household incomes. Potential impacts on food security due to changes in hunting, fishing and gardening areas are discussed in Section 11.1.3.4, while impacts on alluvial mining within the Ok Tedi are discussed in the following section (employment and income).

Construction of the tailings pipeline and pipeline access road have potential to result in temporary and permanent impacts on livelihoods for households within the infrastructure corridor communities, due to the loss of, or disruption to land used for:

- Growing cash crops and garden food for consumption and to sell at markets.
- Collection of resources to support activities such as house construction, canoe making, firewood, and medicinal plants.

Community feedback noted that garden areas are typically located close to villages for easy access or along river terraces and low ridges where soil conditions are favourable. The project has potential to impact on gardening areas where the infrastructure corridor passes near to villages and waterways. The infrastructure corridor passes through areas used for gardening by community members of Digam, Wogam, and Kolebon, with review of satellite imagery also indicating potential impact on gardening areas at Ok Ma, Ok Teditau, Kumkit and Ankit, and Seven Kona.

Hunting and collecting bush resources are important livelihood activities for people in infrastructure corridor communities and form part of their traditional way of life. Areas used for hunting and collecting bush resources such as firewood, timber, sago leaves, and plants for traditional medicine are located within clan boundaries. Community feedback from people who have migrated away from their village to Ningerum, Ok Ma, or settlements along the highway, return to their villages on a weekly or daily basis for these activities. Apart from near Kolebon and Wogam, areas identified by community members for these activities are generally located away from the corridor, although review of satellite imagery shows cleared forest areas along the infrastructure corridor, including in locations away from villages, that are likely to be used for collection of timber and other bush resources.

Construction and operation of the project also have potential to cause localised impacts on rivers and creeks used by communities for fishing and water for drinking and cooking. The infrastructure corridor will cross a range of rivers, creeks and smaller tributaries, including the Ok Taub near Digam, Ok Nong, Ok Dine, Ok Iluk, Ok Ma west of the confluence of Ok Maom and Ok Hwie at Seven Kona. Rivers identified by community members during focus group discussions that are used for fishing or to source drinking water include the Ok Maom, Ok Arik, Oktap, Okam, and Ok Hwie. Potential impact on food and water security from the loss of or impact on land and water used for household consumption are assessed in Section 11.1.3.4.

River communities

The river communities are closely tied to the river system for transport, fishing, water access, and subsistence gardening. Livelihoods for households reflect a mix of informal and subsistence economic activities, with primary income sources including rubber farming, alluvial mining and fishing, and secondary income sources including subsistence gardening and trade stores (OTDF 2018).

Changes to the riverine environment due to the removal of discharge of approximately 90% of tailings from the Ok Tedi will have positive impacts on natural resources used for river communities downstream of the Ok Tedi Mine. In particular, the project will result in less sediment discharged into the Ok Tedi with corresponding reduced concentrations of total suspended sediment riverbed aggradation. This will support longer term improvements in fish habitat with positive impacts on aquatic health and productivity (Appendix E).

Study area wide impact

Enhanced access and connectivity provided by the project for communities west of the Ok Tedi, and direct and indirect economic opportunities related to the project are anticipated to encourage population movement into project communities. The potential for PIIM will depend on a range of factors, particularly proximity to the project, opportunities for project-related compensation, and existing in-migration. Communities with a high potential for PIIM include Birimkamba, Seven Kona, Ok Ma, Alice Pit and Ningerum, with in-migrants likely to include a mix of family members returning to their village due to the project, providers of goods and services to local populations and the project, and opportunistic migrants seeking direct and indirect project-related opportunities.

Population increase due to PIIM into project communities has potential to increase demand and pressure on land and natural resources within the study area. Demand for housing will result in direct impacts on land, particularly within or near to villages and settlements, possibly impacting on existing gardening areas. Increased demand for housing will also increase demand for bush resources to support housing construction, household consumption, and daily household activities, with potential to reduce the availability of these resources for existing households.

Management measures

Land access and project-related livelihood disruption for the project will be managed in accordance with PNG laws and regulations, OTML guidance and international standards and guidelines, including IFC PS5 Land Acquisition and Involuntary Resettlement and IFC PS7 Indigenous Peoples. Livelihood Restoration Plans (LRPs) will be prepared for directly affected people impacted by temporary or permanent livelihood disruptions. The objective of these plans will be to restore and ideally improve the livelihoods and living standards of affected households compared to pre-project levels. Compensation for livelihood disruption may include a combination of non-cash compensation and cash compensation, where land-for-land is not possible. Examples of non-cash compensation may include measures such as re establishment of gardens and cash crop areas at locations not impacted by the project, or education and training to improve agricultural productivity and intensification.

Table 11.9 outlines proposed measures to mitigate and manage potential impacts of the project on natural resource use.

Table 11.9 Proposed management measures – natural resource use

ID#	Potential impact	Key measures
SIA-21	Reduced livelihoods due to loss of land within the TSF development area used for: • Growing cash crops or garden food sold at markets • Collecting bush resources used to support activities such as house construction, canoe making, firewood, and traditional medicine use.	• Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor grievances and complaints relating to land access and livelihoods (MM197).
SIA-22	Reduced livelihoods due to the loss of or temporary disruption to land within the infrastructure corridor used for: • Growing cash crops or garden food sold at markets • Collecting bush resources used to support activities such as house construction, canoe making, firewood, and traditional medicine use.	• Design the tailings pipeline and pipeline access road to avoid or minimise impacts on land used for livelihood development, where possible (MM198). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor grievances and complaints relating to land access and livelihoods (MM197).
SIA-23	Increased demand and pressure on land for housing and natural resource use due to population increase associated with in-migration in response to construction related employment and business opportunities and improved access provided by the project.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in migration and develop solutions and community assistance for limiting PIIM (MM167). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor community complaints and grievances related to PIIM and develop strategies to respond to emerging issues (MM186).
SIA-24	Positive impacts on livelihoods for river communities downstream of the Ok Tedi Mine due to beneficial changes to the riverine environment due to cessation of riverine tailings discharge (e.g., water quality, fish health and aquatic productivity).	N/A

Note: shaded cells indicate positive social impacts

Residual impact assessment

Construction and operation of the project will result in the temporary and permanent loss of, or disturbance to land and water resources used to support livelihood activities. Livelihoods in the TSF communities are primarily derived from natural resources and land to support participation in the cash economy and to harvest bush resources is **highly sensitive**.

Within the TSF development area, the project will result in the permanent loss of land used for growing cash crops and garden foods, and collecting bush resources to support household activities. Impacts will occur for households in communities closest to the project, including Birimkamba, Kungembit, Ambaga and Komokpin, although the level of impact on individual households depend on the level of reliance on terrestrial resources and household access to cash incomes. Following the implementation of management measures, particularly LRP that seek to restore and ideally improve the livelihoods and living standards of affected households compared to pre-project levels, the project will result in a small change in livelihoods relating to the growing of cash crops and garden foods, and collection of bush resources. The magnitude of impact will be **moderate**, with the residual significance **high** (SIA-21).

Construction of the infrastructure corridor also has potential to result in the permanent loss of land to support livelihood activities for households, although at a considerably smaller scale compared to the TSF development area. Following the implementation of management measures, particularly consideration of avoiding or minimising direct impacts on land used livelihood activities where possible, and implementation of LRP, the magnitude of impact will be marginal and the magnitude of impact **minor**. Based on the high sensitivity of land for livelihood activities, the residual significance of impact is **moderate** (SIA-22).

Demand for land and natural resources due to population increase from PIIM has potential to impact on the livelihoods and natural resource use of notable numbers of people in project communities. PIIM is most likely to occur during the construction phase, although population growth is likely to occur across the construction and operation phases. Following the implementation of management measures, in-migration related to the project is likely to have a small change in livelihoods, with the magnitude of change **moderate**. Based on the high sensitivity of land to support livelihood activities, the significance of impact is **high** (SIA-23).

River communities are closely tied to the river system for transport, fishing, water access, and subsistence gardening. The riverine environment of the Ok Tedi is currently degraded and there is **low sensitivity** of existing subsistence livelihood values. Beneficial changes to the riverine environment due to the removal of discharge of approximately 90% of tailings from the Ok Tedi have potential to result in a marginal change to the livelihoods of people across river communities. The magnitude of impact is anticipated to be **minor**, with a **low** significance of impact on livelihoods (SIA-24).

Employment, income and expenditure

The project has potential for positive and negative impacts on local employment, income and expenditure for individuals and households in the study area and wider region, related to generation of local employment opportunities, distribution of compensation and lease payments, increased business activity, changes to ASM activities, and increased household costs.

Local employment opportunities

Construction and operation of the project will generate formal employment opportunities within the study area, including directly with the project and indirectly with local contractors and businesses supplying goods and services to the project, workers and local communities.

The project will require a workforce of about 300 people over the 36-month construction phase, including OTML staff and contractors. Construction jobs will include approximately:

- 140 unskilled roles, which are anticipated to be filled by workers from project communities, the North Fly District and Western Province, and other parts of PNG if required.
- 160 skilled roles, which are expected to comprise about 90 international workers, and 70 workers from project communities, the North Fly District and Western Province, and other parts of PNG if required.

The project will require an operational workforce of about 150 people, including contractors. Roles will involve management, operation, maintenance and monitoring activities over a period of about 20 years. OTML will seek to prioritise Papua New Guineans for operational roles, including workers from project communities, the North Fly District and Western Province, and other parts of PNG if required.

Project investment and procurement activities during construction and operation will also provide formal employment opportunities for local workers with local contractors and suppliers of goods and services to the project.

Based on OTML's existing workforce, and those of similar construction and resource projects in PNG and elsewhere, the project workforce will comprise mainly males. This is also anticipated to be the case for many local contractors and suppliers to the project. However, the creation of project-related employment will provide opportunities for women in the study area to gain formal employment. Approximately 5.3% of females in the Western Province were engaged in wage job employment (i.e., formal employment) in 2011 (NSO 2011). This was consistent with feedback from women during engagement for this assessment, which indicated that very few women in the study area were employed in formal employment, with a lack of education and family commitments identified as barriers to women's participation in formal employment. OTML actively supports the recruitment, retention and promotion of women in its operations (OTML 2025g), with females comprising approximately 18% of OTML's total workforce in 2024 (OTML 2024f). Women across the TSF and infrastructure communities identified an interest in working on the project, including in project security, construction, heavy machinery and transport operations, and support roles such as housekeeping (e.g., cleaning, laundry, cooking). The need for support with education and training, and priority given to women in project recruitment were identified as ways to increase participation of women in the project.

The creation of formal employment opportunities with the project or with local contractors and suppliers will support enhanced social and economic outcomes for individuals within the study area engaged in project related employment including:

- Improved individual and household incomes through wage-based employment.
- Training and skills development in the construction and mining sector, through formal project training, on the-job training, and work experience gained, increasing their future employment opportunities.

Maximising the number of people from project communities, the North Fly District and the Western Province will also help to manage potential social impacts related to social cohesion (Section 11.1.3.1).

Compensation and lease payments

The project will provide direct financial payments, such as compensation and lease payments, for directly affected landowners and other users of land directly impacted by the project. OTML will negotiate lease and land access arrangements including compensation payments and other benefit arrangements in accordance with the Part VII of the *Mining Act 1992, Land Act 1996, Valuation Act 1967,* and the requirements of the IFC PS.

Compensation and lease payments received for the project will support improved household incomes of directly affected people, across the life of the project. The value of payments and scale of economic benefits for individual households will depend on the outcomes of negotiations between OTML and affected people.

Mine related compensation payments are an important source of income for households in the TSF and infrastructure communities. Approximately half of households surveyed within the TSF communities reported that they received income from compensation, including CMCA benefit payments and OTML general compensation for environmental impact payments, with this contributing to household expenses.

Increased business activity

The project will support an increase in business activity within the study area related to project procurement opportunities for local contractors and businesses supplying goods and services to the project. This includes contractors and suppliers to support site-based activities such as transport and civil construction, and project support activities such as management of worker accommodation facilities, and administrative and security services.

An increase in individual and household incomes due to project wages, and compensation and lease payments to community members, and population growth due to PIIM will also support increased demand for goods and services and increased expenditure in project communities. This is expected to support increased business activity and subsequent employment with:

- Larger local retailers, for example supermarkets, hardware stores and fuel suppliers, and service providers (e.g., transport operators).
- Informal economy, including sale of garden produce, and cooked and processed food, through local markets and trade stalls.

This is consistent with experience from other resource projects in PNG, where a spillover effect of increased income has resulted in increased demand for transport services, health services, trade stores and informal sector activities like marketing (Bainton and Macintyre 2013; Kuir-Ayuis 2016).

An increase in business activity will provide economic benefits for business owners and employees of contractors and suppliers, including:

- Improved business income and opportunities for business growth and development.
- Improved individual incomes for business owners and employees.

Increased business growth directly related to the project is likely to be focused in Tabubil and Kiunga, which are main existing commercial centres within the North Fly District. As the operational hub for the Ok Tedi Mine, Tabubil has a range of contractor and supplier businesses that support existing mining operations. Kiunga is also an important hub for business and industry within the North Fly District. Local industry in Kiunga is centred on haulage and freight of goods and supplies through the port, which is owned by OTML. Ningerum is also likely to experience a growth in business activity related to the project, due to its proximity to the project and location for worker accommodation. Ningerum has also been identified as an important service hub for OMTL's future activities, which is also likely to drive increased business activity.

TSF and infrastructure corridor communities are also likely to experience increased business activity, particularly in the informal sector in response to increased incomes, presence of project workers, and population increase from PIIM. An increase in local business may occur across the study area, although Birimkamba is likely to be a focus mainly driven by its location on the ITCS Road, proximity to Indonesia and the project and the presence of project workers.

Increased household costs

An increase in individual and household incomes from project wages, and compensation and lease payments to community members, coupled with population growth due to PIIM will increase demand for goods and services within the study area. Loss of access to natural resources due to construction of the TSF development area and infrastructure corridor, may also increase demand for bought garden produce due to a perceived or actual shortage of some produce.

Community feedback included concerns about the high cost of purchasing staple foods and goods from stores in Ningerum and villages. It was also noted that the price of food and goods bought from Yetetkun PLBN in Indonesia had also increased, although it was reported that prices become more affordable the further inland people travel from the border.

The higher prices at the border were attributed to the community members' access to money from CMCA payments, as indicated by the following quote.

> *It's always been the same price. Because these people, these middle villages here, they know that we have the money from the CMCA. They know that we have money, so they keep the prices high.*

Individuals and households that do not receive compensation or lease payments from the project, or who may not be able to benefit from project-related employment, such as elderly people, people with disability, or women who may not be able to work due or are discouraged to work due to education levels, family commitments or cultural customs, will be more vulnerable to increased prices of basic food and household goods.

ASM activities

ASM for gold is an important economic activity for individuals and communities across PNG (Bainton et al. 2020). In the Ok Tedi context, ASM is reported to largely involve reworking mine derived tailings and tailings-laden river sediments that have been discharged under the mine's riverine disposal regime; these materials are rewashed/panned by residents of tailings affected communities along the river. Advice from OTML suggests that most gold in the Ok Tedi that is targeted by ASM is from both historic and current waste rock disposal, and historical accumulation of tailings; there is a very low concentration of gold in the final tailings discharged to the river system now due to low head grades and gravity separation and pyrite flotation in the process plant.

Community feedback noted that ASM activities by people in the study area generally occur down river of Tabubil to about Bige. Gold from ASM was generally taken to Ningerum for sale to local buyers, with some people reporting that up to about PGK 7,000 can be earnt from the sale of gold in less than two weeks. Income from ASM is a key source of household income for people in the study area, particularly for those in communities closest to the Ok Tedi upstream of Bige.

> *Gold panning is our main source of income now – we know the risk but that is the only thing we can do to survive.*

Community feedback reported that money earnt is used to assist family needs including *'school fees, food, survival needs and wants*'.

Gravel extraction activities in the Ok Tedi will be conducted during construction and operation from south of Birimkamba to the confluence of the Ok Birim and Ok Tedi. This may result in temporary disruption to ASM activities that occur in this section of the river, due to exclusion of the public from these areas for safety. Temporary disruptions to ASM activities may also occur in areas near to the bridge construction over the Ok Tedi at Tabubil.

Once constructed, the TSF will reduce the amount of sand and silt being discharged into the Ok Tedi and transported to the lower Ok Tedi due to most of the tailings being placed in the TSF. Community concerns were raised during consultation for this assessment about potential impacts of this on ASM activities in the river. In particular, it was noted that locals currently:

> *Benefit from the mine waste down the Ok Tedi through alluvial mining. If all the mine waste is captured and sent through the pipeline to the TSF site, we will have a major impact on the communities that live along the river and depend entirely on alluvial mining as it could lead to social and other related issues.*

The levels of gold in the tailings currently discharged into the Ok Tedi are understood to be very low due to the high levels of gold recovery in the processing plant. However, based on community feedback, the reduction of sediment in the system may be perceived as cause of any future decline in ASM-related income.

Potential changes to the project that result in impacts on ASM activities in the Ok Tedi, either actual or perceived, may impact on individual and household incomes and also lead to potential impacts relating to social tension and community conflict (Section 11.1.3.1).

Management measures

Table 11.10 outlines measures to mitigate and manage the potential impacts on employment, income and household expenditure from the project. The blue shaded cells indicate positive social impacts.

Table 11.10 Proposed management measures – employment, income and expenditure

ID#	Potential impact	Key measures
SIA-25	Increased incomes for households and individuals, including women, within the study area due to direct and indirect project-related employment (positive).	• Prioritise employment of local people (e.g., from project communities and the North Fly District) (MM169). • Identify job opportunities for women (MM200).
SIA-26	Skills development for individuals within the study area, including women, due to project-related employment and training (positive).	• Prioritise employment of local people (e.g., from project communities and the North Fly District) (MM169). • Implement training programs (MM199). • Identify job opportunities for women (MM200).
SIA-27	Increased incomes for landowners due to lease compensation payments for the TSF development area and infrastructure corridor (positive).	• Implement financial literacy training for compensation recipients and project workers (MM176).
SIA-28	Increased business activity within the study area due to project investment and local procurement activities (positive).	• Prepare and implement local content policy for the project (MM177).
SIA-29	Increased business activity within the study area, including within the informal economy, due to increased spending by households and workers (positive).	N/A
SIA-30	Decline in affordability of basic food and household items due to increased demand related to population increase from PIIM, and increased individual and household incomes.	• Implement community complaints and grievance mechanism for the project (MM171). • Monitor grievances and complaints relating to land access and livelihoods (MM197).
SIA-31	Reduced livelihoods due to temporary disruptions to ASM activities within the Ok Tedi near the proposed river crossings at Tabubil and Alice Pit and gravel extraction activities.	• Engage with potentially affected people about timing and duration of potential disturbance, including exclusion zones (MM201). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196).
SIA-32	Perceived reduction in ASM-related livelihoods due to removal of most tailings discharge from the Ok Tedi.	• Engagement with people participating in ASM to clarify concerns relating to perceived impacts on ASM (MM187).

Note: shaded cells indicate positive social impacts

Residual impact assessment

Construction and operation of the project will have positive impacts for communities in the study area relating to job creation, and increased business activity related to project investment and local procurement and increase in local spending by individuals and households. Opportunities to participate in the cash economy related to income from compensation and lease payments and wages from employment was identified as important by communities in the study area, with this value of **moderate sensitivity**.

Project employment

The project will generate direct and indirect employment opportunities across the construction and operation phase. With the implementation of management measures, this will have a noticeable positive impact on individual and household incomes for a notable number of people across the study area, including women. The magnitude of this impact would be **moderate**, and the residual impact **moderate** (SIA-25).

Construction and operation of the project will support increased employment in the construction and mining industries, with opportunities for increased skills development through the delivery of formal project training and on-the-job training. Following the implementation of management measures, including maximising the use of people from project affected communities in employment, the project will have noticeable, long-term benefits on skills development for a notable number of people across the study area. The magnitude of potential benefits for people in local communities is **moderate**, with a **moderate** residual salience of impact (SIA-26).

Compensation and lease payments

Compensation and lease payments for the project will have positive impacts on household incomes for small groups of directly affected people in the TSF and infrastructure corridor communities, across the life of the project. Income from compensation payments were identified as an important source of income for households, although this is expected to be relatively modest compared with that received from other livelihood activities such as ASM or wages from employment with OTML. As such, the magnitude of the change on household incomes will be **minor**, with the significance of this positive impact **low** (SIA-27).

Increased business activity

Construction and operation of the project will support increased business activity for communities in the study area, through project investment and local procurement activities, With the implementation of management measures, this will support a noticeable long-term business activity leading to increased business income, and higher incomes for a notable number of people, particularly within regional centres such as Tabubil, Kiunga and Ningerum. The magnitude of benefits on business growth and development will be **moderate**, with the significance of this impact **moderate** (SIA-28).

Increased spending by local communities due to higher individual and household incomes, presence of project workers, and population growth from PIIM will also support increased business activity in the informal economy, such as marketing of garden produce and local trade stalls. This will have positive impacts over the life of the project for a people in project communities close to areas that are a focus of project activity, such as Birimkamba and Ningerum. The scale of the change for local communities is expected to be noticeable, with a moderate magnitude of impact on business activity. The residual impact is **moderate** (SIA-29).

Increased household costs

The project has potential to influence the cost of household goods and services in project communities due to increased individual and household incomes from project wages, compensation and lease payments, and population growth from PIIM. This has potential to impact on the affordability of goods and services, particularly for households that do not receive compensation or are not able to benefit from project related employment. Potential impacts on affordability of household goods and services, have potential to affect a notable number of people across the study area over the life of the project. The magnitude of potential impacts on affordability will be **moderate**, with the significance of residual impact **moderate** (SIA-30).

ASM activities

ASM for gold is an important economic activity and source of income for individuals and households within the study area. Income earnt from the sale of gold supports general household expenses such as food, and school fees, and the value of livelihoods of the Ok Tedi for ASM is a **very high sensitivity**.

Project works within the Ok Tedi for gravel extraction and construction of the bridge crossing at Tabubil, have potential to disrupt ASM activities with potential for reduced livelihoods. Potential disruptions will most likely occur during the construction phase, although potential impacts related to gravel extraction may be ongoing periodically across the life of the project. Following the implementation of management measures, such as early engagement with ASM workers about potential changes from the project, potential impacts on disruptions to ASM activities are likely to result in a small change for small groups of people across the study area. The magnitude of people impacts on ASM activities in the Ok Tedi will be **moderate**, with the residual significance **high** (SIA-31).

Perceived changes in gold levels from the reduction of sediment in the Ok Tedi system has potential to impact on ASM-related livelihoods for small groups of people across the study area. Advice from OTML on ASM activities within the Ok Tedi, suggests the scale of change will be **negligible**, with the residual significance of impact **moderate** (SIA-32).

11.1.3.3 Infrastructure and services

This section assesses potential project impacts on infrastructure and services that serve communities in the study area, including health and education services, and access and connectivity.

Health and education services

The project will have positive impacts on access to health and education for project communities west of the Ok Tedi due to construction of the pipeline access road and bridges over the Ok Tedi and Ok Birim. Potential adverse impacts on health and education services will mainly be associated with population changes due to in-migration of people into project communities, including by people looking to return to their village either temporarily or permanently to take advantage of project opportunities, people from other parts of PNG seeking access to project benefits through marriage, and providers of goods and services to the project, workers or local populations. The potential for PIIM is expected to vary across the study area, with Birimkamba, Ningerum, Alice Pit, Ok Ma, and Seven Kona anticipated to have the highest potential for PIIM due to factors such as their proximity to the project, opportunities for project-related compensation, and existing in-migration.

Health services

Construction of the pipeline access road and bridge crossing of the Ok Tedi at Tabubil will support improved access to health services in locations such as Tabubil and Ningerum for communities along the infrastructure corridor. Accessibility to health services is a key issue for project communities. Health facilities are currently limited in the infrastructure corridor communities and include a non-functioning aid post at Ok Ma, and an aid post staffed by a volunteer health worker at Wogam, with communities also accessing health services at Tabubil Hospital, Ningerum, Migalsimbip and Sisimakam. Access to these facilities is by walking via the old Ok Ma road or bush tracks, with community feedback reporting that access to:

- Tabubil currently takes about 3 to 4 hours from Ok Ma.
- Ningerum takes about 2 to 3 hours from Wogam, and 4 or 5 hours from Kolebon.

With the project, travel between Tabubil and Ok Ma by vehicle is likely to take about 30 minutes, assuming an average speed of about 40 km per hour. At the same speed, travel from Kolebon to Ningerum is likely to take about an hour, with a similar travel time between Kolebon and Tabubil.

Community feedback during consultation for this assessment noted that the lack of a road connection was a key barrier for people accessing health care, especially during emergencies. Feedback from one community noted that sick people needing health care are carried to Ningerum, with deaths occasionally occurring during the trip. It was also noted that women faced risks during childbirth due to a lack of timely access to medical care or emergency transport. OTML currently support medivac by helicopter during emergencies, including for women experiencing difficulties during childbirth. The pipeline access road will support quicker and easier access for people in communities west of the Ok Tedi to Tabubil Hospital and other larger health care services, particularly during emergencies.

Population growth into project communities due to PIIM is likely to lead to an increase in demand for health care. Consistent with the Western Province as a whole, the capacity of some government health services within the study area is currently challenged with consultation feedback noting issues such as a lack of trained personnel and equipment, and shortages in medical supplies. Increased demand for health care services due to PIIM will increase pressure on already constrained health services, potentially impacting the ability of services to respond to the existing health care needs of people in the study area.

Education services

Improved access and connectivity supported by the construction of the pipeline access road and bridges over the Ok Tedi and Ok Birim will improve access to schools for families in the TSF and infrastructure corridor communities. Schools in the TSF and infrastructure corridor communities are at Kungim, Komokpin, Ok Ma, Kolebon and Wogam. Ambaga also has an elementary school, although this was not operational at the time of engagement for this assessment in July 2025. Consultation feedback for this assessment noted that many young families have moved away from TSF and infrastructure corridor communities for better access to schools at Ningerum, Tabubil, Ok Ma, and in communities along the Kiunga-Tabubil Highway (e.g., at Sisimakam and Migalsimbip). Construction of the pipeline access road and bridge crossings may improve access to schools at Tabubil and Ningerum, and at Ok Ma, Kolebon, and Wogam in infrastructure corridor communities allowing some people to return to villages and settlements west of the Ok Tedi. Enhanced road access may also support easier and quicker access for school teachers and staff from nearby communities to schools at Ok Ma, Kolebon and Wogam.

Growth in population in project communities associated with PIIM into communities such as Ningerum, Alice Pit, Ok Ma, and Seven Kona, may increase demand for schooling at Ningerum, Tabubil and Ok Ma. Population increase relating to people returning to villages in response to project benefits and opportunities and improved access and connectivity, may also increase demand for schooling at Kungim, Ok Ma, Kolebon, and Wogam. Apart from Birimkamba, Seven Kona and Ok Ma, the potential for PIIM into TSF and infrastructure communities, is generally expected to be low to moderate. However, small increases in young families moving into these communities has potential to increase demand for education services, impacting the capacity of schools to meet the demands of the existing populations.

Management measures

Table 11.11 outlines proposed measures to manage the potential impacts of the project on education and health services.

Table 11.11 Proposed management measures – health and education services

ID#	Potential impact	Key measures
SIA-33	Enhanced health levels due to improved access to community services (e.g., health) for people within TSF and infrastructure corridor villages from the establishment of the pipeline access road and bridge crossings of the Ok Tedi and Ok Birim (positive).	N/A
SIA-34	Reduced capacity of health services to meet the needs of existing populations due to increased demand for services related to population growth from PIIM and subsequent increase in communicable diseases (e.g., from overcrowding and increased pressure on water and sanitation infrastructure).	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in migration and develop solutions and community assistance for limiting PIIM (MM167). • Implement health and WASH programs, including education and awareness activities, in TSF and infrastructure communities, and other communities at high risk of PIIM (MM202). • Consult with relevant stakeholders to investigate opportunities to prioritise the upgrade of aid posts at Birimkamba, Ambaga, and Ok Ma, and complete the aid post at Karandimok (MM203). • Engage with provincial government and Monfort Catholic Mission and ECPNG Church to monitor the capacity of health services in Kungim, Ningerum, Matkomnai, and Rumginae and investigate any reductions in service capacity (MM204).
SIA-35	Enhanced education levels due to improved access to education services for people within TSF and infrastructure corridor communities from the establishment of the pipeline access road and bridge crossings of the Ok Tedi and Ok Birim (positive).	N/A
SIA-36	Reduced capacity of education services to meet the needs of existing populations due to increased demand for schooling related to population increase from PIIM.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in migration and develop solutions and community assistance for limiting PIIM (MM167). • Work with the provincial government to address staffing issues at Ambaga school (MM205). • Engage with provincial government and Monfort Catholic Mission to monitor the capacity of education services and investigate any reductions in service capacity (MM206).

Note: shaded cells indicate positive social impacts

Residual impact

Construction of the pipeline access road, including bridges over the Ok Tedi and Ok Birim, will support improved access to health and education services for communities west of the Ok Tedi.

Feedback from consultation with community members for this assessment identified access to health services as an important issue for TSF and infrastructure corridor communities, with access to services that support community health and wellbeing **highly sensitive**.

Construction of the pipeline access road and bridge crossing of the Ok Tedi at Tabubil and Ok Birim near Karandimok will permanently improve access to existing health services for people in infrastructure corridor communities through quicker and easier access to health services in Tabubil and Ningerum, particularly during emergencies. This will have a considerable change on access to health care for large numbers of people. Consequently, the magnitude of this positive impact on health and wellbeing for community members is expected to be **severe**, with the significance of this positive residual impact **major** (SIA-33).

Population growth from PIIM is expected to increase demand for health services within project communities, increasing pressure on already constrained health services and impacting the capacity of services to respond to the health care needs of people in the study area. This has potential to impact on access to health services for notable numbers of people across the life of the project. Following the implementation of management measures, population growth related to the project is anticipated to result in a marginal reduction in the capacity of health services with a **minor** impact on access to health care for project communities. The residual significance of this impact will be **moderate** (SIA-34).

Change to services that support education for communities in the study area is **moderate sensitivity**. The pipeline access road and bridge crossings will permanently improve access to schools in Tabubil and Ningerum, and at Ok Ma, Kolebon and Wogam for students and staff. This will result in a noticeable change in access to education for notable numbers of people across the infrastructure corridor. Consequently, the magnitude of this impact is **major**, with a positive residual impact of **high** significance (SIA-35).

Growth in population related to PIIM has potential to increase demand for schooling in Ningerum, Tabubil and Ok Ma, and increased demand for schools in Kungim, Ok Ma, Kolebon and Wogma from people returning to TSF and infrastructure corridor communities in response to project benefits and opportunities. This has potential to impact on a notable number of people across project communities across the life of the project. Following the implementation of management measures, population changes from PIIM is anticipated to have a marginal reduction in the capacity of schools to meet the needs of students. This is anticipated to have a **minor** impact on access to education facilities, with the residual significance of this impact being **low** (SIA-36).

Access and connectivity

Construction of the pipeline access road and bridges across the Ok Tedi and Ok Birim will have positive impacts on transport access and connectivity for communities west of the Ok Tedi. However, construction and operation of the project will result in temporary and permanent changes to access and connectivity due to changes in local access routes, and river travel.

The project will support improved access and connectivity for communities west of the Ok Tedi by making travel to villages and centres across the study area quicker and easier. A road previously connected Ok Ma settlement to Tabubil via a bridge over the Ok Tedi, although vehicle access across the Ok Tedi has not been possible since the collapse of the bridge in 2013. Currently, transport access for people in infrastructure corridor communities to villages and centres is by walking via bush tracks or the old Ok Ma road, or by boat along the lower reaches of the Ok Ma. Footbridges currently provide access across the Ok Tedi at Tabubil and north of Ningerum, with crossings of the Ok Tedi elsewhere by boat, tube, or walking.

Travel between TSF and border communities, and to areas used for livelihood activities mainly occurs on foot via bush tracks. The ITCS Road, which is currently under construction, also provides access for pedestrians to villages of Putmambin, Ambaga and Birimkamba, and to Yetetkun PLBN in Indonesia. Once completed, the road will provide vehicle access between the border and the Kiunga-Tabubil Highway east of the Ok Tedi. During consultation, community members reported that they occasionally travel to other TSF villages to visit family, for gatherings such as community events, funerals and 'haus krai'.

Construction of the project will result in the loss of existing bush tracks in the TSF footprint, and realignment of the ITCS Road prior to the construction of Cell 2. Access to surrounding communities, including Birimkamba, Karandimok, Kungembit and Ambaga will be maintained via a publicly accessible perimeter road constructed as part of the TSF cell development. The road will be designed to cater for pedestrians, and project and private vehicles, including heavy vehicles, light vehicles, cars, and motorbikes. Changes to local access may require some people travelling on foot to travel further, taking longer for them to reach their destination. However, construction of the road will allow community members to travel between communities by vehicle, allowing quicker and easier trips.

People in TSF communities and southern infrastructure corridor communities also travel between villages and communities such as Alice Pit and Ningerum by motorised dinghy and canoe. The main rivers and creeks that were reported by community members to be used for transport access included:

- Ok Tedi, for travel by dinghy and canoe to and from Birimkamba, Alice Pit, and Ningerum, and to provide river access to the Ok Birim.
- Ok Birim for travel by motorised dinghy to and from Kungim and Karandimok.
- Ok Yep, for travel by canoe between Ambaga and Komokpin when river levels are high enough.
- Lower reaches of the Ok Ma, for transport between Wogam and Ningerum.
- Tributary of the Ok Tedi, for travel to and from Digam by canoe and dinghy.

River conditions in the upper sections of the Ok Tedi and Ok Ma mean that these areas are not used for boat transport.

During construction, temporary access changes may be required for safety near to construction activities for the bridge crossing of the Ok Birim, the bridge crossing of the Ok Taub and road crossings of tributaries in the lower sections of the Ok Tedi, and the gravel extraction area within the Ok Tedi near Birimkamba. This has potential to result in disruptions in river and creek access for people from TSF communities such as Kungim, Karandimok, Birimkamba, and villages in the southern part of the infrastructure corridor such as Wogam and Digam. Should temporary closures of the river and creeks be required, this will require people to find alternative transport routes for local access, possibly leading to longer travel times or some people choosing not to make some trips for short periods.

Management measures

Table 11.12 outlines the proposed measures to mitigate and manage the potential impacts on access and connectivity.

Table 11.12 Proposed management measures – access and connectivity

ID#	Potential impact	Key measures
SIA-37	Improved access and connectivity for communities west of the Ok Tedi, including quicker and easier travel, due to construction of the pipeline access road and bridge crossings of the Ok Tedi and Ok Birim (positive).	N/A
SIA-38	Impacts on local access and connectivity for communities surrounding the TSF site, due to the loss of existing bush tracks in the TSF footprint, and realignment of the ITCS Road prior to the establishment of Cell 2.	• Maintain access between TSF communities by progressively developing local access roads around the TSF site prior to the closure of existing bush tracks (MM207). • Provide public use of the TSF access road as it is progressively developed, when safe to do so (MM208). • Conduct early consultation and awareness with local communities prior to changes in local access (MM209).
SIA-39	Temporary disruptions to river and creek users due to construction activities within the Ok Tedi and its tributaries, the Ok Birim and the Ok Ma.	• Where possible, maintain access for canoes and dinghies near to construction activities in creeks and rivers used for transport (e.g., Ok Birim, Ok Tedi, Ok Ma) (MM210). • Conduct early consultation and awareness with local and regional communities about any changes or restrictions on boat travel near to construction activities within rivers and creeks (MM211).

Note: shaded cells indicate positive social impacts

Residual impact assessment

Construction and operation of the project will change access and connectivity for TSF and infrastructure corridor communities, including for land and river transport access routes.

Access to safe and easy transport routes support community livelihood activities, and access to essential services such as health and education and changes to the safety and efficiency of transport access and connectivity are **moderately sensitive**.

Construction of the pipeline access road and bridge crossings of the Ok Tedi and Ok Birim will permanently improve access and connectivity for communities in the infrastructure corridor, allowing easier and safer access to local and regional communities. This will have a considerable change for a large number of people from communities west of the Ok Tedi that currently rely on travel on foot via bush tracks or by dinghy or canoe on creeks and rivers. Consequently, the magnitude of this positive impact on safe and efficient transport access for community members is expected to be **severe**, with the significance of this **positive** impact **major** (SIA-37).

The loss of existing bush tracks within the TSF footprint will result in permanent changes to access routes for people in TSF communities, including to areas used for livelihood activities and surrounding communities. However, disruptions caused to community members will be largely mitigated through the establishment of a new perimeter road around the TSF that will provide access for private vehicles and pedestrians resulting in a marginal change to local access for small groups of people closest to the TSF. Consequently, the magnitude of potential impacts from the loss or disruption of access for communities around the TSF site will be **minor** and the residual significance of any potential impacts **low** (SIA-38).

Construction activities within the Ok Tedi, Ok Birim, Ok Taub, Ok Ma and other tributaries will result in temporary disruptions for travel by canoe and dinghy due to the implementation of safety and exclusion zones near to waterway crossings and gravel extraction sites. Following the implementation of management measures, the project will result in noticeable, short-term impacts for small groups of people, resulting in a **minor** change to boat and canoe access. The residual significance of this impact will be **low** (SIA-39).

11.1.3.4 People's productive capacity

This section considers how the project may impact people's productive capacity, including community health, and food and water security.

Community health

Distance to access health facilities and lack of transportation, as well as the lack of health facility were commonly reported barriers across the study area for access to health care, particularly for women and children. Improved access to health services for project communities west of the Ok Tedi from enhanced transport access and connectivity provided by the pipeline access road and bridges is expected to contribute to improved health outcomes for community members (see Section 11.1.3.3). In particular, enhanced road access will make it easier for people who may avoid or be unable to seek medical help due to factors such as distance or inability to travel long distances, to access medical care.

Potential adverse impacts on community health will mainly be associated with population changes due to PIIM into project communities and the project workforce, and social changes due to increased incomes and influx of male workers.

Respiratory, vector and water and sanitation related diseases

The project workforce will be accommodated in existing camps and project worker accommodation with appropriate sanitation facilities. However, population changes due to PIIM, may lead to overcrowding in houses and strain on existing water and sanitation conditions in project communities. This will increase the incidence and transmission of water, sanitation-related, vector-related and respiratory diseases. Engagement with health providers noted that tuberculosis (TB), malaria, and sexually transmitted infections (STIs), and human immunodeficiency virus (HIV) are key health concerns for local communities, with TB being the biggest concern. The region has one of the highest rates of TB in the country, which health providers have partly attributed to migration into the area.

Community feedback for this assessment also reported diarrhoea, stomach pains and respiratory diseases as common illnesses in the TSF and infrastructure corridor communities. These diseases are spread from living in close contact with others, and having poor housing, water and sanitation conditions. Most households in the TSF villages use unimproved sanitation facilities that are either owned or shared with other households, with this expected to be similar in other project communities.

Non-communicable diseases

Non-communicable diseases or lifestyle-related diseases, such as diabetes and cardiovascular disease may arise when communities shift from a subsistence-based lifestyle to one that involves increased reliance on store goods and more sedentary patterns of living. Store goods consumed in the communities tend to be more energy-dense, and nutrient-poor foods and drinks and also harmful substances such as alcohol and tobacco. Engagement with health workers identified that the level of lifestyle diseases was higher in the more developed parts of the study area such as Tabubil and Ningerum, but currently was minimal for smaller rural villages such as the TSF and infrastructure communities. The project has potential for indirect contribution to changes in community health outcomes through altered livelihood patterns, including those created by loss of subsistence resources, increased individual and household incomes, wage employment and business activity, and the associated greater accessibility and consumption of store-bought, processed and convenience foods.

As has been observed in other major development contexts in PNG, a transition away from traditional subsistence diets and physically active livelihoods toward greater reliance on market and store foods and reduced physical activity can increase the risk of overweight, obesity and longer-term chronic health conditions. These effects are likely to be more pronounced in areas that will receive the most benefits and compensation and in project accommodation facilities.

Sexually transmitted disease and sexual health issues

The increase in disposable income associated with project compensation and employment, the influx of male workers, and population increase from PIIM, may lead to an increase in the level of transactional sex and sex work, both in communities and with sex workers that migrate into the area. The increase in transactional sex and sex work can have adverse health impacts, particularly for women and girls, such as increased transmission sexually transmitted diseases (e.g., HIV), unwanted pregnancies and harm from sexual violence. These adverse impacts are often associated with construction and resource projects in PNG and elsewhere in the world, particularly where local health services and social safeguards are limited (Kirkham 2013; World Bank 2021).

Management measures

Table 11.13 outlines the proposed measures proposed to mitigate and manage the potential impacts on community health.

Table 11.13 Proposed management measures – community health

ID#	Potential impact	Key measures
SIA-40	Increase in water, sanitation-related, vector-related and respiratory diseases, such as diarrhoea, and TB, due to overcrowding and increased strain on water and sanitation infrastructure due to population increase from PIIM.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM (MM167). • Monitor community complaints and grievances related to PIIM and develop strategies to respond to emerging issues (MM187). • Implement health and WASH programs, including education and awareness activities, in TSF and infrastructure communities, and other communities at high risk of PIIM (MM202). • Implement tuberculosis prevention and control program for the project workforce (MM212). • Design surface water management systems to avoid creation of mosquito habitat (MM213). • Implement vector control programs around project facilities and worker accommodation (MM214).
SIA-41	Increase in non-communicable diseases such as diabetes and cardiovascular disease, due to lifestyle changes induced by the project away from traditional subsistence living.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM165). • Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM (MM167). • Monitor community complaints and grievances related to PIIM and develop strategies to respond to emerging issues (MM186). • Collaborate with relevant NGOs, and government organisations to promote health and wellness of project communities, particularly relating to the prevention and management of communicable and non-communicable diseases, women's health, nutrition, hygiene and sanitation (MM215). • Provide nutritious and culturally appropriate food options within workforce accommodation facilities (MM216).

ID#	Potential impact	Key measures
SIA-42	Increase in incidence of reproductive and sexual health issues, such as STIs, and unwanted pregnancies, due to population increase from in-migration into project communities, and increased disposable incomes from project employment and compensation payments, leading to increased demand for commercial sex and enticement to transactional sex for women and girls.	• Implement worker Code of Conduct and conduct workforce education and awareness about expected standards in relation to community interactions (MM171). • Implement community complaints and grievance mechanism for the project (MM172). • Implement health and WASH programs, including education and awareness activities, in TSF and infrastructure communities, and other communities at high risk of PIIM (MM202). • Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM (MM167).

Residual impact assessment

Respiratory, vector and water and sanitation related diseases

PIIM may lead to overcrowding and increase pressure on existing community water sources and sanitation facilities, resulting in the potential increase in the occurrence of water and sanitation diseases, such as cholera, typhoid fever, and diarrhoea and respiratory diseases such as TB. Population increase from PIIM and changes to surface water flows from the project may also create conditions that are more suitable for spread of malaria, noting it is already endemic. Health of project communities is a **highly sensitive** social value that is integral to overall wellbeing. Measures to reduce PIIM and ongoing monitoring of PIIM along with community development initiatives such as health education, vector management and WASH programs will minimise the potential for PIIM to lead to adverse health outcomes. The magnitude of potential impacts on community health due to increases in diseases associated with overcrowding and poor water and sanitation considering the success of mitigation and management measure and the potential for PIIM is **minor**, with the residual significance of impact being **moderate** (SIA-40).

Non-communicable diseases

The project has the potential to contribute to an increased prevalence of non-communicable diseases due to changes in livelihood practices, including reduced dependence on bush food and other traditional food sources, increased reliance on purchased food items and a corresponding shift toward less physically active lifestyles. Health of project communities in relation to non-communicable diseases is a social value of **moderate sensitivity**, noting that incidence of non-communicable disease is already prevalent in major centres such as Tabubil. The magnitude of potential impacts on community health due to an increase in non-communicable disease from the project are **minor** for the majority of the project area however, for those communities, that will have the most impact to subsistence resources coupled with the highest rates of compensation (i.e., Birimkamba and Kungembit) the magnitude of the impact will be **moderate**. On this basis, the residual significance of the impact is **low** for most of the project area and **moderate** for Birimkamba and Kungembit (SIA-41).

Sexually transmitted disease and sexual health issues

PNG has some of the highest prevalence of STIs including HIV and syphilis in the Asia Pacific region (Vallely et al. 2016; Vallely et al. 2010). Community health, particularly for women and girls is a **highly sensitive** social value across the study area. The project will result in an influx of males associated with the construction workforce and PIIM, and increased disposable incomes from project employment and compensation payments. This has the potential to result in an increased demand for commercial sex and enticement to

transactional sex for women and girls, leading to an increase in incidence of reproductive and sexual health issues (i.e., STIs, unwanted pregnancies).

The larger townships and regional centres are likely to experience more interaction with the workforce and non-locals. In communities such as Tabubil, Ningerum, Alice Pit, and Ok Ma, the presence of construction workforce accommodation, and the likelihood of increased in-migration and business activity will create greater opportunities for contact between workers, non-locals, and locals. People, particularly women and girls, from smaller villages who reside part time in the larger towns are more likely to interact with the workforce and non-locals, therefore increasing their likelihood of engaging in commercial and transactional sex and exposure to associated reproductive and sexual health issues. With the implementation of appropriate management measures, the magnitude of impacts on community health relating to STIs and sexual health issues are anticipated to be **moderate**, and more prevalent during the construction phase with a residual significance of impact of **high** (SIA-42).

Food and water security

Construction and operation of the project will impact on land and water resources used by communities to support their livelihoods (see Section 11.1.3.2). This section discusses the related social impacts relating to food and water security.

Food security

TSF communities

Construction of the TSF will result in approximately 1,500 ha of land cleared within the TSF development area. Potential impacts on food security will be associated with:

- Permanent loss of gardening areas identified by the Birimkamba (Figure 11.7) and Kungembit (Figure 11.8) communities. Gardens are the primary source of food for households in the TSF communities, and their loss represents a significant reduction in gardening areas.
- Permanent loss of some sago crops within the TSF development area and potential for further loss of sago crops due to the changes to the surface water drainage of the area around the TSF. The establishment of the TSF and permanent surface water diversions in the Ok Yep catchment may create localised flooding and areas of dieback that affect sago and other gardening land. Sago is the main staple crop for households most sago crops are located close to the villages.
- Permanent loss of a hunting ground and bush collection areas identified by Karandimok participants (Figure 11.10). No other hunting or bush collection sites were identified within the TSF development area, although hunting was observed in the vicinity during field work (Appendix G).
- Permanent impacts to aquatic fauna within the TSF development area, include the loss of aquatic fauna living in the small creek lines and springs that will be directly disturbed by the TSF (Appendix E). Additionally, the construction and operation of the TSF will adversely affect water quality and stream habitat in the Ok Yep and smaller drainages, downstream of the TSF, through increased sediment load and TSF seepage. The intensity and extent of sedimentation are expected to be greatest during construction, with some reduction during the operational phase. These changes will affect aquatic species abundance and diversity, including aquatic resources in the Ok Yep that are used by communities, particularly households in Ambaga (Figure 11.9), to support their diet.

The TSF development area is expected to have the greatest food security impacts through the permanent loss of gardening areas for Birimkamba and Kungembit, with additional potential impacts to aquatic resource use for Ambaga that rely on the Ok Yep and its tributaries. Birimkamba is also like to be impacted due to loss or disturbance to fishing and garden areas that are located along the Ok Tedi and in the area that will be used for gravel extraction to support TSF construction. Impacts to sago, hunting, and bush resources are expected to be more limited.

Infrastructure corridor communities

Subsistence gardening, fishing and hunting is the primary food source for infrastructure corridor communities. Gardening land is found in areas surrounding villages and along river terraces. Freshwater and riverine ecosystems, including the Ok Ma, Ok Hwie, Ok Kameng, Ok Birim and other smaller waterways, are used for fishing (Chapter 9).

The infrastructure corridor development area west of the Ok Tedi will have a construction footprint of around 400 ha extending over a linear distance of 65 km. Where possible, the tailings pipeline and pipeline access road has been sited to avoid directly impacting land used for livelihood activities, although permanent or temporary impacts on some food source areas will occur, particularly where the corridor passes near to villages and waterways. Disturbance of gardens and crops in the infrastructure corridor development area will be permanent if it is within the footprint of infrastructure (~410 ha) or temporary if it is for construction laydown and work areas (~70 ha).

Construction of the pipeline access road and tailings pipeline will include three permanent bridge crossings over the Ok Tedi, Ok Taub and Ok Birim, plus additional crossings of minor waterways and drainage lines. Construction of the infrastructure corridor is anticipated to increase sediment and potential contaminant runoff in highly localised sections of the Ok Ma and may result in localised impacts to the water quality and aquatic fauna in the Ok Ma and its tributaries (Appendix E). Additionally, the construction of bridge crossings on the Ok Tedi (near Tabubil), Ok Taub and Ok Birim (near Karandimok) will result in localised habitat disturbance and sedimentation during construction.

The loss of gardening land and impeded access to gardens and localised disturbance to aquatic fauna due to run-off and bridge construction, has potential to contribute to a reduction in food security for some households in infrastructure corridor communities.

Project affected communities

The project development (including workforce employment, land acquisition, compensation payments, and in-migration) is expected to accelerate the transition from subsistence-based livelihoods to a cash-based local economy. This transition can have adverse impacts on food security due to reduced household reliance on subsistence food production such as gardening, fishing, and hunting, increased dependence on purchased food from local markets and stores, and exposure to fluctuations in food prices and household income. Communities that have the largest transition from subsistence to cash-based economies will be most susceptible to this impact, particularly where local food production declines, market prices increase (e.g., due to inflation or supply constraints), and cash incomes are not sustainable, insufficient, or unreliable. PIIM into areas can also lead to higher household reliance on markets and stores for foods as land available for in-migrants for cropping and gardening may be limited.

Water security

This section discusses the social impacts relating to water quality and access to water sources. The biophysical impacts of the construction and operation of project on soils, landform stability, surface water and groundwater are discussed in Chapter 10.

Water security is defined as the capacity of communities to access reliable and safe water sources for drinking, washing, laundering and recreational use (WHO 2022). Potential impacts of the project's construction on water security of the TSF and infrastructure corridor communities will mainly be associated with the:

- Loss of water sources within the TSF footprint, including creeks, rivers, wells and springs.
- Changes in surface water quality following diversion of existing streams and surface water flows from establishment of the TSF.
- Changes in groundwater quality and levels from establishment of the TSF.
- Changes in surface water quality due to construction of the infrastructure corridor.

TSF communities

Construction and operation of the TSF have the potential to affect both surface water and groundwater resources within and around the TSF footprint. Construction of the TSF will require extensive clearing within the Ok Yep headwaters, resulting in the permanent loss of spring-fed creeks, small watercourses and associated aquatic habitats. Construction activities are also expected to increase sediment mobilisation and total suspended solids (TSS) in receiving waters, particularly the Ok Yep, with potential downstream effects on water quality, stream habitat and aquatic ecology (Appendix E).

During operations, the TSF will create significant localised changes in groundwater flows and generate seepage that may contribute to localised elevation of concentrations of dissolved salts and metals in groundwater and connected surface water systems. Model predictions indicate that elevated concentrations of most contaminants from the seepage will be confined to within approximately 300 to 500 m of the TSF, with more mobile parameters such as sulfate extending to about 1 km at low concentrations (Appendix D). The migration of contaminants will mostly be within the deeper groundwater system more than 10 m below ground level with limited interaction with the shallow groundwater system that the local community water supplies use. Groundwater modelling predicts no change to levels or groundwater quality at nearby villages such as Ambaga, Kungembit, Birimkamba and Karandimok or their community water sources (Appendix D).

The changes to surface and groundwater systems may affect water availability and water quality for TSF communities that rely on dug wells, creeks, rivers and springs for drinking, cooking, washing and other domestic uses. Household reliance on different sources varies by village and season, with wells generally forming the most common source, followed by surface water. Ambaga households may be particularly exposed where they rely on the Ok Yep during dry periods, while Kungembit households may be more vulnerable if groundwater or nearby drainage lines are affected by TSF seepage. In addition to direct effects on domestic water use, reduced water quality and altered creek health may also affect broader community water security, especially where alternative water sources are limited or less reliable during extended dry periods. Overall, the TSF construction and operation may reduce water security and increase reliance on less preferred water sources for some TSF communities.

Infrastructure corridor

The Ok Ma, Ok Maom, Ok Nong, Ok Iluk, Ok Hwie, Ok Birim and other smaller creeks and streams found in forested areas are used by infrastructure communities for drinking and other domestic purposes, including washing and cooking.

Construction will increase sediment and potential contaminant runoff in highly localised sections of the Ok Ma and may result in localised impacts to the water quality and acceptability. The road and pipeline construction will be sited to avoid impact to community water sources were possible, but there is potential for some water sources such as wells and springs to be adversely impacted. Additionally, the construction of bridge crossings on the Ok Tedi (near Tabubil), Ok Taub and Ok Birim (near Karandimok) and other crossings of smaller creeks and streams may result in localised sedimentation and reduction of accessibility of water sources during construction. During operation, there is also potential for runoff from the road which will be unsealed to impact water quality of nearby rivers, streams and creeks in highly localised areas.

Therefore, there is potential for some households in the infrastructure corridor communities to experience reduced water security due to changes in water quality and acceptability of community water sources within or near to the infrastructure corridor.

Management measures

Table 11.14 outlines the proposed measures to mitigate and manage the potential impacts on food and water security.

Table 11.14 Proposed management measures – food and water security

ID#	Potential impact	Key measures
SIA-43	Reduced food security due to loss or disturbance of land and waterways within the TSF development area and downstream environment used for food production and food gathering (e.g., sago areas, gardens, hunting areas, fishing).	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM092). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196). • Implement surface water, erosion management and sediment management controls as outlined in Chapter 10 (MM217). • Design, construct and operate TSF to minimise and manage seepage as outlined in Chapters 6 and 10 (MM218). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor success of livelihood restoration programs (MM219). • Monitor food security levels and cost of store and market goods in affected communities, including grievances and complaints relating to food security (MM222).
SIA-44	Reduced food security due to loss or disturbance of land and waterways within the infrastructure corridor development area used for food production and food gathering (e.g., sago areas, gardens, hunting areas, fishing).	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM055). • Align route to avoid and minimise impacts to food resource areas where possible (MM220). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM193). • Implement surface water, erosion management and sediment management controls as outlined in Chapter 10 (MM217). • Design, construct and operate TSF to minimise and manage seepage as outlined in Chapters 6 and 10 (MM218). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor success of livelihood restoration programs (MM219). • Monitor food security levels and cost of store and market goods in affected communities, including grievances and complaints relating to food security (MM222).
SIA-45	Decline in food security due to shift from subsistence activities and food self-sufficiency to cash economy and reliance on market and store food, due to job opportunities and compensation payments during construction and operation.	• Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM (MM167). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196). • Educate workforce and affected communities on risks of reducing levels of food self-sufficiency and shifting from subsistence lifestyle to cash-based provisioning for food (MM221). • Monitor food security levels and cost of store and market goods in affected communities, including any grievances and complaints relating to food security (MM222). • Monitor success of livelihood restoration programs (MM219).

ID#	Potential impact	Key measures
SIA-46	Reduced water security due to loss or degradation of water sources (e.g., creeks, rivers, springs) in the TSF development area and downstream environment.	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM055). • Make an alternative, equally suitable source of drinking water available to communities in the event that drinking water sources used by local villages become contaminated by the project (MM032). • Align route to avoid and minimise impacts to water sources, particularly drinking water sources such as springs and wells, where possible (MM227). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Implement surface water, erosion management and sediment management controls as outlined in Chapter 10 (MM217). • Implement good practice controls in the prevention and management of any spills or leaks to minimise impact to water sources (MM223). • Design, construct and operate TSF to minimise and manage seepage as outlined in Chapters 6 and 10 (MM218). • Monitor quality and reliability of community water sources (MM224). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor grievances and complaints relating to water security (MM225).
SIA-47	Reduced water security due to changes in the water quality and acceptability of creeks, springs and other waterways within or near to the infrastructure corridor used for community water sources (e.g., due to increased sedimentation and potential contamination from road runoff or direct construction disturbance).	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM055). • Make an alternative, equally suitable source of drinking water available to communities in the event that drinking water sources used by local villages become contaminated by the project (MM032). • Implement erosion and sediment control measures and contamination control measures outlined in Chapter 10 (MM226). • Align route to avoid and minimise impacts to water sources (particularly drinking water sources such as springs and wells) where possible (MM227). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Implement surface water, erosion management and sediment management controls as outlined in Chapter 10 (MM217). • Implement good practice controls in the prevention and management of any spills or leaks to minimise impact to water sources (MM223). • Monitor quality and reliability of community water sources (MM224). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor grievances and complaints relating to water security (MM225).

Residual impact assessment

Food security

The significance of residual impacts on food security will depend on the extent to which households rely on natural resource-based food sources, their access to cash income, and the availability of alternative resource use areas. Households with limited access to customary land or waterways, and with low cash income, are likely to remain more vulnerable to food security impacts following implementation of mitigation measures.

TSF Communities

Food security within the TSF communities is of **high sensitivity:** subsistence gardening, hunting and fishing remains the principal source of food for most households. Food insecurity is already present across the TSF communities, with some households impacted more than others. Birimkamba and Komokpin reported higher rates of food insecurity than the other villages. Where households experience food shortages, the most common coping strategy is to travel further to harvest food, including sago and other bush foods. More than half of households in Birimkamba, Karandimok and Komokpin also reported a decline in the availability and abundance of hunting and bush resources, partly due to population pressures. Communities also indicated flooding, high rainfall and fertility of the soil as issues that affected food yields and contributed to food security issues.

The TSF will require clearing of approximately 1,500 ha, including land for the hydro-cyclone house and laydown areas. Construction of the TSF will also involve realignment of waterways and changes to surface drainage, which may adversely affect aquatic food resources in affected streams and drainage lines and the Ok Yep. Despite the implementation of mitigation measures such as compensation and livelihood restoration, the permanent loss of significant gardening and bush resource areas for Birimkamba and Kungembit is expected to remain the most important residual impact on food security. Additional residual impacts may also occur for Ambaga through reduced access to aquatic resources. On this basis, the residual magnitude of impact on food security from the loss of land and food resource areas within the TSF development area and surrounds is **major**, resulting in a residual impact significance of **high** (SIA-43).

Infrastructure Corridor Communities

Food security for infrastructure corridor communities is also considered to be of **high** sensitivity, as households continue to rely primarily on garden produce, with fish and prawns from rivers and streams also contributing to local diets. Communities have identified several existing concerns related to food security, including reduced soil fertility, declining garden productivity, rising food prices and reduced fish catches over recent years. The gradual shift from subsistence livelihoods toward greater reliance on purchased food has already begun in some communities, increasing vulnerability to further disruption.

Construction of the infrastructure corridor, including the pipeline access road, bridges, river crossings, tailings pipeline and support facilities, will result in temporary and, in some locations, permanent disturbance to gardens, sago stands and fishing sites. While construction impacts on resources and access to resources will be temporary in most areas, some garden areas within the permanent disturbance footprint will be lost. However, these areas represent a relatively small proportion of total available gardening land, and alternative areas remain available to affected communities. With mitigation measures such as avoiding key food resources where possible, good practice erosion and sediment control, compensation and rehabilitation of temporary disturbance areas, the residual magnitude of impact on food security from temporary disturbance, disruption to access and loss of resources is **minor**, resulting in a residual impact significance of **moderate** (SIA-44).

Decline in Food Security Due to Shift from Subsistence Activities and Food Self-Sufficiency to a Cash Economy

Construction and operation of the project may accelerate a shift in local livelihoods from subsistence-based food production toward greater dependence on cash income, market purchases and store-bought food. This change is likely to occur where households receive compensation payments or benefit from employment opportunities and subsequently reduce reliance on gardening, hunting, fishing and other traditional food sources. While increased cash income may improve short-term food security, it may also weaken household food self-sufficiency over time if subsistence production declines and regular access to affordable market food becomes more important. Following construction and also following operation, when project-related employment and compensation payments reduce or cease, food security issues may arise for some households, particularly if they have become less engaged in subsistence food production and if market food prices are unaffordable or supply unreliable.

Food security for TSF communities and infrastructure corridor communities is also of **high** sensitivity. The significance of this residual impact will vary by community and household depending on the extent of livelihood transition, the sustainability of alternative income sources, and the continued availability of gardening land, fishing areas and other customary resource use areas. Households that retain access to subsistence resources are expected to be less affected, whereas households with limited land access or weaker subsistence options may experience a greater long-term decline in food security. With the implementation of mitigation and management measures the overall magnitude of impact is **minor** and the significance of the residual impact is **moderate** (SIA-45).

Water security

Water security is influenced by the availability, quality and reliability of community water sources, as well as household dependence on wells, creeks, rivers and springs for domestic use. Residual impacts will vary depending on the location of the community, seasonal conditions, and the extent to which households rely on sources that may be affected by the Project.

TSF Communities

TSF communities commonly rely on dug wells and surface water sources, including creeks, rivers and springs, for drinking, cooking, washing and other domestic uses. All TSF communities have access to at least two different water sources that were used throughout the year. Water security is a **high sensitivity** social value, although communities have more than one source currently the availability of water sources is vulnerable to seasonal conditions. Communities reported that alternative water sources are used during different seasons to account for changes in water levels or quality. Most water sources were reported as good quality with sedimentation after rains the most reported water quality issue. With the construction and operation of the TSF Ambaga households may be particularly vulnerable to water quality impacts where they rely on the Ok Yep during dry periods. Groundwater modelling suggests the risk of contamination of village water supplies is low to negligible under the modelled scenarios. A program of groundwater and seepage monitoring will be put in place to confirm modelling predictions. There will also be direct water impacts through construction of the TSF that will permanently remove some surface water sources and spring-fed creeks within the footprint.

With mitigation measures in place, including seepage management, surface water controls, monitoring, and the provision of alternative water sources where required, the residual magnitude of impact on water security is **moderate**. This results in a residual impact significance of **high** for the most exposed TSF households, particularly those relying on affected wells or surface water sources during dry periods (SIA-46).

Infrastructure Corridor Communities

Infrastructure corridor communities use creeks, rivers, wells and springs for drinking and other domestic purposes. Water security is a **high sensitivity** social value for infrastructure corridor communities. Construction of the access road, pipeline and bridge crossings may result in localised sedimentation, temporary restriction of access to water sources, and potential localised deterioration in water quality in the Ok Ma and other nearby waterways. During operations, runoff from the road may also affect some water sources in highly localised areas. While the corridor has been aligned to avoid key water sources where possible, some households may still experience reduced access or reduced acceptability of water sources close to the project footprint.

With mitigation measures in place, including avoidance of direct disturbance to water sources where possible, erosion and sediment controls, spill prevention, rehabilitation of disturbed areas, and monitoring of community water sources, the residual magnitude of impact on water security is **negligible**. The residual significance of impact is **low** (SIA-47).

11.1.4 Summary of key measures

Table 11.15 summarises the proposed measures to be implemented by OTML to manage potential social impacts during each phase of the project.

Table 11.15 Summary of proposed management measures for social impacts

Measure ID	Key measure	C*	O*	D*
Cultural heritage				
MM163	Implement management measures outlined in the CHMP	X	X	X
MM164	Site project infrastructure, including the hydro-cyclone house, tailings pipeline, laydown areas, access roads and surface water diversions to avoid cultural sites of high significance, where possible.	X		
MM165	Conduct consultation with affected landowners and communities around methods for managing impacts on cultural heritage values, including getting FPIC where triggered.	X	X	X
MM168	Work with communities and relevant NGOs or CSOs to implement programs to preserve cultural traditions and practices of high value, including documentation of cultural traditions and practices.	X	X	
PIIM management				
MM166	Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM.	X	X	
MM167	Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM.	X	X	
MM186	Monitor community complaints and grievances related to PIIM and develop strategies to respond to emerging issues.	X	X	
MM202	Implement health and WASH programs, including education and awareness activities, in TSF and infrastructure communities, and other communities at high risk of PIIM.	X	X	
MM203	Consult with relevant stakeholders to investigate opportunities to prioritise the upgrade of aid posts at Birimkamba, Ambaga, and Ok Ma, and complete the aid post at Karandimok.	X	X	
MM204	Engage with provincial government and Monfort Catholic Mission and ECPNG Church to monitor the capacity of health services in Kungim, Ningerum, Matkomnai, and Rumginae and investigate any reductions in service capacity.	X	X	
MM205	Work with the provincial government to address staffing issues at Ambaga school.	X	X	
MM206	Engage with provincial government and Monfort Catholic Mission to monitor the capacity of education services and investigate any reductions in service capacity.	X	X	

Measure ID	Key measure	C*	O*	D*
Project workforce, employment and procurement				
MM169	Prioritise employment of local people (e.g., from project communities and the North Fly District).	X	X	X
MM170	Implement a workforce Code of Conduct, which includes provisions that prohibit workers' use of local areas for activities such as fishing and hunting.	X	X	X
MM171	Implement worker Code of Conduct and conduct workforce education and awareness about expected standards in relation to community interactions.	X	X	X
MM199	Implement training programs.	X	X	X
MM200	Identify job opportunities for women.	X	X	X
MM177	Prepare and implement local content policy for the project.	X	X	X
Stakeholder engagement				
MM172	Implement community complaints and grievance mechanism for the project.	X	X	X
MM174	Monitor grievances and complaints regarding distribution of project benefits to identify escalating tensions.	X	X	X
Benefits				
MM173	Provide community-wide opportunities for project communities to participate in project benefits outside of compensation for land access (e.g., employment, business opportunities).	X	X	X
MM176	Implement financial literacy training for compensation recipients and project workers	X	X	X
MM184	Implement community development initiatives to support community safety.	X	X	
Traffic management				
MM175	Implement traffic management measures, including use of traffic controllers (e.g., near work areas, at entries/exits to construction sites); driver training, education and awareness about potential road safety risks; and notification of communities about periods of high traffic movements.	X	X	X
MM178	Implement road safety education and awareness with local communities, particularly with children.	X	X	X
MM179	Implement traffic management measures, including road signage and speed limits near to villages and settlements.	X	X	X
MM180	Implement site management and safety measures (e.g., exclusion zones near construction works).	X	X	X
MM181	Implement education and awareness with local communities, including children, about potential safety risks of construction activities.	X		
MM201	Engage with potentially affected people about timing and duration of potential disturbance, including exclusion zones.	X	X	
MM207	Maintain access between TSF communities by progressively developing local access roads around the TSF site prior to the closure of existing bush tracks.	X		
MM208	Provide public use of the TSF access road as it is progressively developed.	X		
MM209	Conduct early consultation and awareness with local communities prior to changes in local access.	X	X	
MM210	Where possible, maintain access for canoes and dinghies near to construction activities in creeks and rivers used for transport (e.g., Ok Birim, Ok Tedi, Ok Ma).	X		
MM211	Conduct early consultation and awareness with local and regional communities about any changes or restrictions on boat travel near to construction activities within rivers and creeks.	X		
Community safety				
MM182	Locate laydown areas and construction facilities away from villages and major settlements where possible.	X		
MM183	Implement safety and exclusion zones near works within the Ok Tedi and Ok Birim.	X	X	X
MM190	Implement security measures at project sites to manage public access.	X	X	X

Measure ID	Key measure	C*	O*	D*
Community conflict				
MM185	Work with provincial, district and local government to strengthen response to law and order within project communities.	X	X	X
MM188	Implement education programs regarding SARV in collaboration with national and provincial governments, and other stakeholders (e.g., non-government organisations, civil society organisations).	X	X	
Landscape and amenity				
MM054	Restore and rehabilitate disturbed areas no longer required for use as early as possible and progressively throughout project construction.	X	X	
MM189	Minimise extent of clearing where possible and maintain vegetation buffers around the perimeter of the TSF and ancillary infrastructure (e.g., laydown areas), and the infrastructure corridor and nearby villages and settlements.	X	X	
MM191	Avoid villages and settlements through the design and siting of the infrastructure corridor, including the bridge across the Ok Birim.	X		
MM055	Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas.	X		
MM192	Implement noise and dust management measures outlined in the CESMP sub-plans.	X	X	X
MM193	Implement site-specific noise mitigation and management measures to minimise disruption to people at night, when night-time operational activities are conducted within 1,500 m of Kungembit	X	X	X
MM194	Site and design lighting to minimise light spill into surrounding areas.	X	X	
Land access and livelihoods				
MM032	Make an alternative, equally suitable source of drinking water available to communities in the event that drinking water sources used by local villages become contaminated by the project.	X	X	
MM187	Engagement with people participating in ASM to clarify concerns relating to perceived impacts on ASM.	X	X	X
MM195	Engage with directly affected persons regarding the final project footprint and land access process.	X	X	
MM196	Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs.	X	X	
MM197	Monitor grievances and complaints relating to land access and livelihoods.	X	X	X
MM198	Design the tailings pipeline and pipeline access road to avoid or minimise impacts on land used for livelihood development, where possible.	X		
MM219	Monitor success of livelihood restoration programs.	X	X	X
MM220	Align route to avoid and minimise impacts to food resource areas where possible.	X		
MM221	Educate workforce and affected communities on risks of reducing levels of food self-sufficiency and shifting from subsistence lifestyle to cash-based provisioning for food.	X	X	
MM222	Monitor food security levels and cost of store and market goods in affected communities, including grievances and complaints relating to food security.	X	X	
MM224	Monitor quality and reliability of community water sources.	X	X	X
Community health				
MM212	Implement tuberculosis prevention and control program for the project workforce.	X	X	X
MM213	Design surface water management systems to avoid creation of mosquito habitat.	X	X	X
MM214	Implement vector control programs around project facilities and worker accommodation.	X	X	X
MM215	Collaborate with relevant NGOs and government organisations to promote health and wellness of project communities, particularly relating to prevention and management of communicable and non-communicable diseases, women's health, nutrition, hygiene and sanitation.	X	X	

Measure ID	Key measure	C*	O*	D*
MM216	Provide nutritious and culturally appropriate food options within workforce accommodation facilities.	X	X	X
Construction management				
MM217	Implement surface water, erosion management and sediment management controls as outlined in Chapter 10.	X	X	X
MM218	Design, construct and operate TSF to minimise and manage seepage as outlined in Chapters 6 and 10.	X	X	
MM223	Implement good practice controls in the prevention and management of any spills or leaks to minimise impact to water sources.	X	X	X
MM225	Monitor grievances and complaints relating to water security.	X	X	X
MM226	Implement erosion and sediment control measures and contamination control measures outlined in Chapter 10.	X	X	X
MM227	Align route to avoid and minimise impacts to water sources, particularly drinking water sources such as springs and wells where possible.	X		

*C = Construction; O = Operations; and D = Decommissioning and closure.

11.2 ARCHAEOLOGY AND CULTURAL HERITAGE IMPACT ASSESSMENT

An archaeology and cultural heritage impact assessment has been prepared to identify and evaluate project related risks and impacts on cultural heritage values within the project area. The includes consideration of potential impacts on critical cultural heritage with reference to IFC PS 7 and IFC PS8. This section summarises the outcomes of the archaeology and cultural heritage assessment prepared by IHM Consultancy Limited provided in Appendix L.

11.2.1 Assessment method

The approach used to assess archaeology and cultural heritage impacts for the project involved:

- Identifying potential impacts to archaeological, cultural and indigenous cultural heritage values resulting from project construction, operation and decommissioning activities
- Evaluating potential impacts to cultural heritage values within project area
- Assessing direct and indirect impacts
- Determining impact significance
- Identifying management measures to avoid, minimise or mitigate potential impacts on cultural heritage values
- Assessing residual impacts assuming effective implementation of the identified management measures.

Impact significance was evaluated with reference to the significance and sensitivity of affected cultural heritage values, including the heritage receptors summarised in Table 11.16. Consideration was given to the nature and extent of the impact, the potential for permanent disturbance or loss, and the effectiveness of proposed avoidance, mitigation and management measures. Professional judgement was used to determine the sensitivity of heritage values and the magnitude of potential impacts, with reference to cultural significance, field verification results and community consultation outcomes.

Table 11.16 Heritage sensitivity framework

Heritage sensitivity	Heritage receptors
High	Burial grounds, sacred places, cemeteries, spiritually restricted natural features, and intact ancestral settlement sites.
Moderate	Former settlements, ceremonial areas, clan boundaries, historical tracks, and traditional use areas.
Low	Isolated artefacts in disturbed contexts, low-integrity modern land-use areas, and previously disturbed non-sensitive ground.

11.2.2 Impact assessment

This section summarises the key archaeology and cultural heritage impacts identified for the project.

11.2.2.1 TSF development area

The TSF development area contains a concentration of archaeological, cultural and indigenous cultural heritage values and presents the highest potential for direct impacts on cultural heritage associated with the project. Cultural heritage values identified within and adjacent to the TSF development area include archaeological sites, burial grounds, cemeteries, sacred sites, clan boundaries, former settlements, cultural

landscapes and oral traditional sites associated with the communities of Ambaga, Birimkamba, Komokpin, Karandimok, Kungembit, Kungim and Putmambin.

The TSF development area represents the largest permanent disturbance footprint associated with the project and includes the proposed TSF impoundment, embankments, hydro-cyclone house, access roads and associated infrastructure. The assessment identified the potential for direct disturbance, loss or modification of cultural heritage values located within the permanent disturbance footprint. Potential impacts include disturbance of burial grounds, cemeteries, sacred sites and former settlement areas, loss of culturally significant landscape features, changes to access arrangements and impacts on cultural practices, customary land use and cultural continuity.

The assessment identified four recorded cultural heritage sites within the TSF footprint that will be directly affected by the project (see Figure 9.16). These include ancestral settlement areas, culturally significant landscape features and sacred sites. Additional impacts may occur where project activities affect heritage values identified through consultation that are yet to be field verified. The assessment also identified the potential for previously unrecorded archaeological materials or cultural heritage values to be encountered during vegetation clearing, excavation and earthworks.

Impact significance varies according to the type, sensitivity and location of identified heritage values relative to the proposed disturbance footprint. Burial grounds, cemeteries, sacred sites and intact ancestral settlement areas are **high** sensitivity receptors and have potential to experience significant impacts if disturbed. Archaeological sites, clan boundaries, traditional pathways and customary use areas are generally of **moderate** sensitivity but may also experience significant impacts where direct disturbance occurs.

Table 11.17 provides a summary of cultural heritage values and potential impact significance within the TSF development area.

Table 11.17 Cultural heritage values and potential impact significance – TSF development area

Community	Cultural heritage value	Number of sites	Relationship to TSF development area	Heritage sensitivity	Potential impact significance
Birimkamba	Archaeological sites	1	Located within or adjacent to areas potentially affected by TSF construction and associated infrastructure.	Moderate	Moderate
	Oral traditional sites (sacred sites, spirit places and clan boundaries)	8	Several sites occur within or near the proposed TSF development area.	High	High
	Settlement sites (former settlements, burial areas, and customary use areas)	18	Several sites occur within areas potentially affected by project activities.	Moderate to high	High
Ambaga	Archaeological sites	3	Some sites occur within the TSF development area.	Moderate	Moderate
	Oral traditional sites	2	Sites located within areas of cultural significance that may be affected by project activities.	High	High
	Settlement sites	31	Numerous sites recorded within and surrounding the TSF development area, including burial sites and customary land use areas.	Moderate to high	High

Community	Cultural heritage value	Number of sites	Relationship to TSF development area	Heritage sensitivity	Potential impact significance
Karandimok	Oral traditional sites	2	Sites located outside the main TSF footprint but within customary areas associated with the project.	High	Moderate
	Settlement sites	11	Primarily located outside the TSF footprint but within the broader area of influence.	Moderate	Moderate
Komokpin	Archaeological sites	1	Located outside the principal TSF disturbance area.	Moderate	Moderate
	Oral traditional sites	2	Includes culturally sensitive locations associated with oral traditions and customary values.	High	Moderate
	Settlement sites	5	Located within customary areas associated with the project.	Moderate	Moderate
Kungim	Archaeological sites	1	Located outside the TSF footprint but within the wider customary landscape associated with the project.	Moderate	Moderate
	Oral traditional sites	8	Includes sacred sites, culturally important places and oral history locations within customary lands connected to the TSF area.	High	Moderate
	Settlement sites	9	Includes former settlements and customary use areas outside the principal disturbance footprint.	Moderate	Moderate
Kungembit	Oral traditional sites	4	Includes sacred and culturally significant places located in proximity to the TSF development area.	High	Moderate–High
	Settlement sites	3	Includes customary land use areas and culturally significant occupation sites potentially affected by project activities.	Moderate to High	Moderate–High
Putmambin	Oral traditional sites	6	Includes sacred sites and places of continuing cultural significance within customary lands associated with the project area.	High	Moderate
	Settlement sites	6	Includes former settlements and customary use areas located outside the principal TSF footprint.	Moderate	Moderate

11.2.2.2 Infrastructure corridor

The infrastructure corridor traverses a culturally significant landscape occupied and used by Awin, Ningerum and Yonggom communities. Cultural heritage values identified within the corridor include archaeological sites, ancestral settlement areas, burial grounds, cemeteries, sacred sites, spirit places, clan boundaries, customary use areas and locations associated with oral traditions and cultural practices.

Chapter 9 identifies cultural heritage sites associated with the infrastructure corridor, within the customary lands of communities located west of the Ok Tedi. These values form part of an active cultural landscape that continues to support community identity, customary land tenure, cultural practices and intergenerational knowledge transfer.

Construction of the tailings pipeline and pipeline access road has potential to result in direct disturbance of cultural heritage values where project activities intersect with identified sites and places. Potential impacts include disturbance or loss of archaeological deposits, former settlement areas, burial grounds, sacred sites and other places of cultural significance. Indirect impacts may also occur through changes to access arrangements, temporary restrictions on customary land use, disturbance of culturally important landscape features and disruption of cultural activities associated with identified heritage places.

Consultation and cultural mapping conducted for the cultural heritage assessment identified a large number of sites potentially impacted by the infrastructure corridor, including settlement sites, cemeteries, ancestral burial places, sacred sites and spirit places. These locations are yet to be verified through archaeological field survey and remain known primarily through oral history and customary knowledge. Consequently, site locations and boundaries are indicative and subject to refinement through ongoing consultation and pre-construction verification surveys.

Potential impacts are expected to vary along the corridor according to the density, significance and location of identified heritage values. Sites associated with burial grounds, sacred places and spiritually restricted locations are high sensitivity and have the greatest potential to result in significant cultural heritage impacts if disturbed. Archaeological sites, former settlement areas, customary use areas and clan boundary locations are generally of moderate sensitivity, although significance may increase where sites contribute to cultural identity, customary land ownership or community history.

Implementation of avoidance measures, detailed design refinement, pre-construction verification surveys, ongoing consultation with customary landowners and cultural custodians, and application of the CHMP will be important in reducing potential impacts on cultural heritage values within the infrastructure corridor.

Table 11.18 summarises cultural heritage values and potential impact significance within the infrastructure corridor.

Table 11.18 Cultural heritage values and potential impact significance – infrastructure corridor

Community	Cultural heritage value	Number of sites	Heritage sensitivity	Potential impact significance
Kumkit and Ankit	Sacred and spirit sites	7	High	High
	Burial site/community cemetery	1	High	High
	Garden and subsistence use area	1	Moderate	Moderate
Ok Ma	Sacred and spirit sites, mythical sites and sacred lake	11	High	High
	Burial sites and cemeteries	7	High	High
	Cave sites and hunting shelters	4	Moderate	Moderate
	Garden and subsistence use area	1	Moderate	Moderate

Community	Cultural heritage value	Number of sites	Heritage sensitivity	Potential impact significance
Kolebon	Sacred and spirit sites, ancestral sites and sacred lake	22	High	High
	Burial sites and cemeteries	15	High	High
	Garden and subsistence use area	1	Moderate	Moderate
Digam	Sacred and spirit sites, spirit lake and sacred water source	35	High	High
	Ancient boundary sites	5	Moderate	Moderate
	Burial sites and cemeteries	9	High	High
Ningerum-Tamaro	Sacred and spirit sites and spirit swamp	22	High	High
	Fishing site	1	Moderate	Moderate
	Burial sites and cemeteries	3	High	High
Wombon	Burial sites and cemeteries	3	High	High
Bolewogam	Sacred and spirit sites, mythical sites, ceremonial sites, ritual sites and sacred lake	23	High	High
	Burial sites and cemeteries	11	High	High
	Hunting sites	2	Moderate	Moderate
	Garden and subsistence use area	1	Moderate	Moderate
Wogam	Sacred and spirit sites, sacred rivers, waterfalls, mountains, ritual sites and mythical swamp sites	97	High	High
	Ancestral sites	3	High	High
	Burial sites and cemeteries	12	High	High
	Cave sites and sacred stone sites	5	Moderate	Moderate
Walawam	Sacred and spirit sites, sacred lakes, sacred waterfalls, sacred mountains and ancestral sites	44	High	High
	Burial sites and cemeteries	5	High	High
Wirimkanatko	Burial sites and cemeteries	4	High	High

11.2.2.3 Existing disturbed areas

Parts of the project area have been subject to previous disturbance associated with historical and recent infrastructure development, including construction and upgrading of the Kiunga–Tabubil Highway and the new ITCS Road extending toward the Indonesian border. Within the TSF development area, the ITCS Road traverses portions of the cultural landscape between Birimkamba and Ambaga villages, while additional disturbances associated with historical access roads, construction camps, gardens and village expansion have modified sections of the broader project area.

Despite this disturbance, many identified cultural heritage values continue to retain high cultural, spiritual and customary significance. Sacred sites, burial grounds, ancestral settlement areas, clan boundaries and oral traditional sites remain important components of the living cultural landscape and continue to support cultural identity, customary land tenure and traditional knowledge systems. Previous disturbance does not necessarily diminish the cultural significance of these places or their importance to affected communities.

The assessment does not assume that previously disturbed areas are of low heritage value. Cultural heritage values located within disturbed environments remain sensitive receptors where ongoing project activities may result in additional impacts. Appropriate avoidance, mitigation and management measures will therefore be required where identified cultural heritage values occur within or adjacent to existing disturbed areas.

11.2.2.4 Critical cultural heritage assessment

The assessment considered whether identified archaeological sites, burial grounds, sacred places, ceremonial locations, ancestral settlement areas, culturally significant landscapes and other indigenous cultural heritage values could meet the threshold for Critical Cultural Heritage based on their cultural, archaeological, scientific, spiritual or customary significance. The assessment considered heritage values identified within both the TSF development area and infrastructure corridor development area.

Based on available information and verification undertaken during the assessment, no identified heritage values within the project area were determined to meet the criteria for Critical Cultural Heritage in IFC PS7 or IFC PS8. Notwithstanding, the assessment identified numerous burial grounds, cemeteries, sacred sites, ceremonial locations, ancestral settlement areas, customary boundaries and culturally significant landscape features that retain high cultural, spiritual and customary significance for affected communities. These heritage values are not currently considered Critical Cultural Heritage under IFC PS7 or IFC PS8, although they remain highly sensitive receptors that require avoidance where practicable and appropriate management throughout the project lifecycle.

Given that a substantial proportion of heritage values identified within the infrastructure corridor development area are consultation-derived and have not yet been field verified, additional cultural heritage investigations and consultation prior to construction will confirm site significance and support implementation of appropriate management measures.

11.2.3 Cultural heritage management and mitigation

11.2.3.1 Mitigation hierarchy

Management of archaeology and cultural heritage impacts follows the mitigation hierarchy. The approach prioritises avoidance of impacts to cultural heritage values where practicable, followed by minimisation, mitigation and ongoing management measures where impacts cannot be completely avoided.

Avoidance is the primary management measure for high-sensitivity heritage receptors, including burial grounds, cemeteries, sacred sites, ceremonial locations and other culturally significant places. Avoidance measures include refinement of project layouts, micro-siting of infrastructure, establishment of exclusion zones and retention of culturally important access routes where practicable.

Where avoidance is not feasible such as within the TSF footprint, measures are implemented to minimise impacts through reduction of disturbance footprints, use of existing disturbed areas where suitable, management of workforce access and maintenance of community access arrangements. Minimisation measures are intended to reduce the extent and severity of impacts on identified cultural heritage values.

Mitigation measures are applied where direct impacts cannot be avoided and may include documentation of affected sites, recording of oral history values, archaeological recording and implementation of culturally appropriate management measures developed in consultation with affected communities and customary custodians. Ongoing management measures include implementation of a CHMP, workforce induction and awareness training, cultural heritage monitoring, continued consultation with affected communities, and implementation of a Chance Finds Procedure. Together, these measures are intended to reduce residual impacts on cultural heritage values.

11.2.3.2 Cultural heritage management plan

A project-specific CHMP (Attachment 2) will be implemented to managing cultural heritage values throughout the project lifecycle. The CHMP will support implementation of the mitigation hierarchy and includes measures for the identification, protection and management of cultural heritage values in accordance with applicable PNG legislative requirements such as *National Cultural Property (Preservation) Act 1965* and international standards such as IFC PS7 and IFC PS8.

The CHMP outlines procedures for cultural heritage site management, pre-construction verification surveys, establishment of exclusion zones and buffers, construction clearance processes, management of culturally sensitive information, cultural heritage monitoring, consultation with affected communities and implementation of a Chance Finds Procedure. The plan also defines roles and responsibilities, reporting requirements and corrective actions to support effective implementation during construction, operation and decommissioning.

The CHMP will be maintained as a live management document and updated as project design progresses, additional cultural heritage information becomes available and consultation with customary landowners and cultural custodians continues. Implementation of the CHMP will provide the primary mechanism for managing residual impacts on archaeological, cultural and indigenous cultural heritage values associated with the project.

11.2.3.3 Management measures

Management measures have been developed to avoid, minimise and mitigate impacts on cultural heritage values during project construction, operation and decommissioning. These measures will be incorporated into the proposed CHMP and are intended to protect identified cultural heritage values, support ongoing engagement with customary landowners and cultural custodians, and ensure compliance with applicable legislative and lender requirements.

Table 11.19 summarises the key archaeology and cultural heritage management measures proposed for the project.

Table 11.19 Archaeology and cultural heritage management measures

Management area	Management measures
Pre-construction requirements	Undertake verification surveys of final disturbance areas; confirm heritage constraints against final project layouts; establish exclusion zones and buffers around identified heritage sites to be protected; complete community confirmation meetings; implement workforce induction and awareness training; and finalise the CHMP.
Construction phase controls	Implement permit-to-clear procedures; establish exclusion zones around identified heritage sites to be protected; undertake cultural heritage monitoring in sensitive areas; restrict unauthorised access to cultural heritage sites; implement stop-work procedures where heritage values are identified; and manage spoil placement and clearing activities to avoid unnecessary impacts.
Operational phase controls	Maintain exclusion zones and access arrangements; inspect and maintain heritage protection measures; manage maintenance activities in accordance with cultural heritage procedures; and update the cultural heritage register where additional heritage values are identified.
Closure and rehabilitation	Consider cultural heritage constraints during decommissioning and rehabilitation activities; maintain protection of retained heritage sites; and consult affected communities regarding post-closure land access and land use arrangements.
Burial grounds and cemeteries	Prioritise avoidance of burial sites and cemeteries; establish exclusion buffers around sites to be protected; undertake consultation with affected communities and custodians; and implement culturally appropriate management measures where impacts cannot be avoided.
Sacred sites and culturally restricted places	Avoid disturbance where practicable; establish exclusion zones around sites to be protected; restrict workforce access; protect confidential cultural information; and implement culturally appropriate consultation and management protocols with custodians.

Management area	Management measures
Former settlements and ancestral occupation areas	Avoid disturbance where practicable; undertake documentation and recording where impacts cannot be avoided; and implement archaeological verification where settlement areas demonstrate archaeological potential.
Clan boundaries and customary areas	Confirm customary boundaries with landowners prior to construction; avoid creating access restrictions or land tenure conflicts; and maintain ongoing consultation regarding boundary-related matters.
Archaeological finds	Record and protect archaeological materials where practicable; establish temporary exclusion zones around discoveries; undertake specialist assessment where required; and manage discoveries in accordance with the Chance Finds Procedure.
Training and awareness	Provide cultural heritage induction training to all project personnel, including cultural heritage responsibilities, identification of heritage materials, culturally sensitive behaviours and reporting requirements.
Monitoring and reporting	Monitor compliance with cultural heritage management measures; inspect exclusion zones and protected sites; record incidents and corrective actions; and maintain ongoing consultation with affected communities.
Chance Finds Procedure	Implement project-specific Chance Finds Procedure requiring immediate cessation of works, establishment of exclusion zones, notification of relevant personnel, specialist assessment and approval prior to recommencement of activities where previously unidentified heritage values are encountered.

11.2.4 Residual impact assessment

Residual impacts were assessed assuming effective implementation of the mitigation and management measures described in Section 11.2.3, including application of the mitigation hierarchy, implementation of the CHMP, completion of pre-construction verification surveys, ongoing consultation with customary landowners and cultural custodians, and implementation of the Chance Finds Procedure. Following implementation of these measures, most potential impacts on archaeological, cultural and Indigenous cultural heritage values are expected to be reduced to **low** or **minor** residual significance. Residual impacts associated with the infrastructure corridor development area are expected to be largely avoided or minimised through detailed design refinement, micro-siting of infrastructure and implementation of exclusion zones around identified cultural heritage values to be protected.

The greatest residual impact remains associated with unavoidable disturbance within the TSF development area where permanent infrastructure may overlap culturally sensitive locations for which complete avoidance is not feasible. In such circumstances, residual impacts are expected to remain localised and managed through site-specific mitigation measures, ongoing consultation and implementation of agreed cultural heritage management controls.

No residual impacts of confirmed national or international cultural heritage significance are predicted. Similarly, no residual impacts on identified heritage values are expected to result in impacts to Critical Cultural Heritage as defined under IFC PS 7 or IFC PS 8.

Table 11.20 summarises the anticipated residual archaeology and cultural heritage impacts associated with the project.

Table 11.20 Residual archaeology and cultural heritage impacts

Impact category	Residual significance
Infrastructure corridor interactions where heritage values are avoided through design refinement and management controls	Minor
Temporary disruption to customary access, movement pathways or land use practices	Minor
Sacred sites protected through avoidance measures, exclusion zones and buffers	Low
Burial grounds and cemeteries protected through avoidance and design refinement	Low
Archaeological sites managed through verification surveys, monitoring and Chance Finds Procedure	Low
Unavoidable disturbance of culturally sensitive locations within the TSF development area	Moderate
Residual impacts of national or international cultural heritage significance	Not anticipated
Residual impacts to Critical Cultural Heritage under IFC PS7 or IFC PS8	Not anticipated

11.3 ECOSYSTEM SERVICES IMPACT ASSESSMENT

An ecosystem services assessment has been prepared in accordance with IFC PS 6 (2019) to identify and evaluate project-related risks and impacts on ecosystem services that communities rely on for their livelihoods and wellbeing. This section describes the ecosystem services impact assessment of type 1 ecosystem services identified in Chapter 9.

11.3.1 Assessment method

An ecosystem services screening was used to determine whether further assessment of impacts to certain ecosystem services was required (Chapter 9). This assessment relates the predictions made through relevant environmental and social assessments conducted for this ESIA to ecosystem services.

The following assessment describes the impacts to ecosystem services for each of the affected communities based on information presented in:

- Relevant sections of the ESIA, including social impact assessment (Section 11.1) and archaeology and cultural heritage impact assessment (Section 11.2)
- Appendix F: Terrestrial Biodiversity Characterisation Report
- Appendix E: Aquatic Ecology Technical Report
- Appendix L: Archaeology and Cultural Heritage Assessment
- Appendix M: Social Characterisation Report.

11.3.2 Ecosystems services impact assessment

The following discussion first describes predicted impacts to terrestrial, freshwater and riverine, and cultural environments with respect to ecosystem service, following the implementation of management measures described in the relevant assessments. Predicted impacts on ecosystem services are presented for each potentially affected village in accordance with IFC PS6.

11.3.2.1 Mitigation and management

Where the proponent has direct management control or significant influence over impacted ecosystem services, they should avoid the impacts as a first preference. Where avoidance is not possible, the proponent should minimise impacts and implement mitigation measures to maintain the value and functionality of the ecosystem services. Table 11.21 outlines key measures for managing potential impacts on ecosystems services. These are in addition to those included in the relevant sections in Chapter 10.

Table 11.21 Management measures – ecosystem services impacts

Ecosystem service impacted	Key management measures
Cultural services	• Site project infrastructure, including the hydro-cyclone house, tailings pipeline, access roads and surface water diversions to avoid cultural sites of high significance, where possible (MM164). • Conduct consultation with affected landowners and communities around methods for managing impacts on cultural heritage values, including getting FPIC where triggered (MM165). • Consult with landowners, Ningerum LLG and provincial government, and other relevant stakeholders about potential strategies for managing potential impacts of PIIM (MM166). • Engage with communities in areas with higher potential for PIIM about their concerns with in-migration and develop solutions and community assistance for limiting PIIM (MM167). • Work with communities and relevant NGOs or CSOs to implement programs to preserve cultural traditions and practices of high value, including documentation of cultural traditions and practices (MM168). • Implement management measures outlined in the CHMP (MM163).
Provisioning services	• Minimise vegetation clearance and ground disturbance as far as practicable, including locating project infrastructure, including vehicle parks, laydown areas, storage sites, fuel storage, non-mining waste dumps in cleared areas, in secondary and/or degraded forest areas (MM055). • Engage with directly affected persons, regarding the final project footprint, land access process (MM195). • Develop and implement LRPs for affected people outlining compensation and livelihood restoration programs (MM196). • Design the tailings pipeline and pipeline access road route to avoid or minimise impacts on land used for livelihood development, where possible (MM198). • Implement surface water, erosion management and sediment management controls as outlined in Chapter 10 (MM217). • Design, construct and operate TSF to minimise and manage seepage as outlined in Chapter 10 (MM218). • Monitor success of livelihood restoration programs (MM219). • Implement community complaints and grievance mechanism for the project (MM172). • Monitor grievances and complaints relating to land access and livelihoods (MM197).

11.3.2.2 Description of predicted impacts

This section describes the predicted impacts to ecosystem services from the construction and operation of the project, prior to the application of site-specific mitigation or compensation measures. The assessment is undertaken in accordance with IFC PS6, with a focus on priority provisioning and cultural ecosystem services where the project has direct management control or significant influence.

Impacts to ecosystem services vary according to the location of project infrastructure relative to communities, the degree of reliance on ecosystem services for subsistence and income, and the spatial overlap between project components and customary land and water use areas. As such, predicted impacts differ between communities associated with the TSF and those located along the infrastructure corridor. This assessment does not assess supporting ecosystem services, such as habitat provision, nutrient cycling or ecological connectivity, which are addressed under the terrestrial and aquatic ecology assessments (see Chapter 10). Regulating services are addressed through specialist technical assessments, including surface water, groundwater and air quality presented in Chapter 10.

Terrestrial environment

The primary predicted impact to terrestrial provisioning services is the reduction in bushland available for gardening, hunting and the collection of bush resources, including food, medicinal plants, and building materials. These impacts arise from vegetation clearance associated with the TSF footprint, buffer zones, access roads and the tailings pipeline.

For many affected communities, bushland resources support both subsistence livelihoods and household income, with surplus garden produce, sago and cash crops such as betel nut sold at markets. Sago is an important traditional crop for communities within the project's area of influence. Sago palms are used for roofing and walling materials, and their starch-rich trunks are processed as a staple food source.

Sago palms are generally found in low lying swamp areas and along small streams and creeks. Community feedback indicated that sago was generally widespread with palms intentionally planted by earlier generations or occurring naturally in the wild, which continue to be harvested for daily consumption and market use. Prolonged inundation due to high levels of sedimentation may affect the health of sago stands, particularly juvenile sago palms. Consequently, loss or reduced access to land used for these purposes has the potential to affect food security, income generation and customary land-use practices, particularly for communities located within or adjacent to the TSF development area and tailings pipeline.

The magnitude of impact is expected to be highest where:

- Large areas of customary land are located within the project footprint.
- Gardening areas extend into riverine zones affected by project infrastructure (e.g. along the Ok Yep).
- Communities rely heavily on bush resources for daily subsistence and cultural practices.

For communities located further from project infrastructure, or where land-use areas are spatially separated from the TSF and infrastructure corridor, impacts to terrestrial provisioning services are predicted to be minor or negligible.

Freshwater and riverine environment

Construction and operation of the TSF and infrastructure corridor will impact freshwater ecosystem services, including rivers, creeks, springs and groundwater accessed via dug wells. These water sources are used for drinking, domestic purposes, fishing, and harvesting of aquatic fauna, and in some locations are associated with culturally significant practices, including protection of crocodiles and traditional knowledge of turtle nesting areas. Impact pathways include:

- Changes to water quality due to fugitive sediment or contamination during construction and operation.
- Altered surface water flows or groundwater connectivity.
- Restricted access to water sources during construction.

Downstream communities, particularly those located along the Ok Tedi and Middle Fly River systems, will experience long-term improvements in ecosystem services due to improvements in river health, fisheries productivity and aquatic habitat quality from less sediment discharge into the Ok Tedi and corresponding reduced concentrations of total suspended sediment and reduced riverbed aggradation. This is expected to support downstream community ecosystem services including subsistence fisheries, aquatic food security, waterway transport, and culturally important aquatic resource use.

Cultural environment

Cultural heritage surveys and community consultations have identified a high density of tangible and intangible cultural sites, including ancestral burial grounds, sacred sites, oral-historical locations, clan boundaries, settlement areas and sites associated with traditional practices. In several locations, limited survey access or the absence of mapped data means that undiscovered cultural heritage sites are likely to be present within areas of planned disturbance. As a result, construction activities have the potential to disturb or destroy cultural sites unless appropriately managed.

In addition to physical disturbance of sites, cultural services may also be indirectly impacted through:

- Reduced access to culturally important landscapes and resources.
- Loss of traditional plants used for medicine, dress or ceremony due to vegetation clearing.
- Social change associated with in-migration, which may affect the continuation of traditional practices.

Given these risks, impacts to cultural ecosystem services are predicted to be moderate to high in areas of direct project interaction, and low where separation distances from project infrastructure are sufficient.

11.3.2.3 Summary of predicted impacts

Impacts to ecosystem services differ depending on the location of people that benefit from the services. In other words, impacts will differ depending on the community or people in question. This study has considered impacts to provisioning and cultural services to the potentially affected villages.

TSF communities

Table 11.22 presents a summary of predicted impacts on ecosystem services for TSF communities. Supporting services such as habitat are addressed in the Terrestrial Biodiversity Impact Assessment (Chapter 10 and Appendix G).

Table 11.22 Ecosystems services summary of impacts – TSF communities

Village	Predicted impact to ecosystem services
Birimkamba	*Provisioning services* Impacts of the project on provisioning services for Birimkamba will mainly be due to vegetation clearing within the TSF development area resulting in the reduction of bushland available for gardening, hunting and collecting bush resources such as food, medicine, firewood, and materials for house construction. Surplus produce from gardening is sold at markets to support household income. Consequently, reduced availability of bushland for these ecological services will impact food security and household income. Water quality of creeks, rivers and springs will be affected by the construction and operation of the TSF, with the most substantial impacts predicted to occur within the Ok Yep catchment area and immediately downstream of the TSF. A decrease in water quality or flow will impact water availability for domestic use, or impact abundance of aquatic fauna captured for food. Diversion of tailings from the Ok Tedi will also support long-term benefits for water quality and aquatic fauna in the Ok Tedi. *Cultural services* Four cultural sites are located within the TSF footprint, therefore without mitigation, these cultural services will be disturbed or destroyed. The four sites include two customary clan boundary areas, the former access road camp, and the spiritually significant Mt Mongatbit Gungotim. Although the mountain has been previously disturbed by roadworks, it remains important to local belief systems and oral traditions. These sites will be affected by vegetation clearing, bulk earthworks, embankment construction, permanent land loss, and restricted future access. Traditional cultural practices, including dancing, food preparation and the use of traditional medicine, may be impacted by the project due to in-migration into the communities or loss of access to cultural sites.

Village	Predicted impact to ecosystem services
Kungembit	*Provisioning services* The project is expected to significantly affect the provisioning services for Kungembit, primarily due to the reduction of bushland available for gardening, hunting and collecting bush resources including food, medicine and resources. Large stretches of the Ok Yep within the project footprint are used for gardening. Therefore, the decrease in availability of land for these ecological services will likely impact local food production, subsistence practices and food security. The construction of the project will limit access to key water sources for Kungembit, including parts of the Ok Yep. The project may also impact water quality of other creeks or springs due to increased sediment runoff from construction and operational activities of the TSF. This will impact water availability for domestic use, or impact abundance of aquatic fauna captured for food consumption. *Cultural services* Consultation with Kungembit communities identified culturally significant places and customary landscape values, although the locations of these have yet to be verified through field surveys. Given the immediate proximity of the community to the TSF it is assumed that many cultural sites exist within the TSF and buffer zone and it is almost certain that cultural services will be impacted by the project. Cultural traditions, dress and traditional medicine practices are expected to be impacted due to potential decreased access to resources within the TSF footprint, as well as to in-migration into the communities or loss of access to cultural sites.
Ambaga	*Provisioning services* The main impact of the project to provisioning services for Ambaga will be the reduction of bushland available for gardening, hunting and collecting bush resources for food and medicine. Garden produce, sago and cash crops are sold to support household income, and the decrease in availability of land for these ecological services is expected to impact food security and household income. During construction, clearing of the TSF footprint is expected to increase sediment runoff into the Ok Yep, affecting water quality and river conditions within the catchment. These impacts are expected to be major and concentrated in the Ok Yep catchment. Water quality of creeks, rivers (including the Ok Yep) and groundwater accessed via dug wells may be impacted by the construction and operation of the TSF. During operations, the Ok Yep is expected to continue to experience reduced environmental conditions due to ongoing sedimentation and seepage from the TSF, with potential for impacts on water availability for domestic use and abundance of aquatic fauna for food. *Cultural services* Surveys identified a dense cluster of cultural sites within the buffer zone of TSF development area, including ancestral burial grounds, sacred oral-historical sites, economic and agricultural zones, clan boundaries, and one potential archaeological site. These sites will likely be impacted by the construction and operation of the project. Traditional cultural practices and customary resource use including hunting, fishing, gardening, sago processing, and medicinal plant collecting will be moderately impacted by the project due to in-migration into the communities or loss of access to cultural sites.
Karandimok	*Provisioning services* The main impact of the project to provisioning services for Karandimok will be the reduction of bushland available for gardening, hunting, and collecting bush resources including food and medicine. Surplus produce is sold at markets to support household income, and the decrease in availability of land for these ecological services will likely impact food security and income. Water quality of creeks, rivers and springs will be impacted by the construction and operation of the TSF and associated infrastructure. Construction activities will cause short-term increases in sediment runoff. Diversion of tailings from the Ok Tedi will also support long-term benefits for water quality and aquatic fauna in the Ok Tedi. *Cultural services* Six cultural heritage sites were recorded during cultural heritage surveys. None were identified within the TSF footprint, but may be impacted by ancillary facilities such as access roads and laydown areas. Undiscovered sites may also be present due to the proximity of the community to the site. Cultural traditions and practices, including use of medicinal plants, may be impacted due to decreased availability of resources from vegetation clearing for the project or from PIIM into project communities, or the loss or disturbance of cultural sites.

Village	Predicted impact to ecosystem services
Komokpin	*Provisioning services* Areas used by people from Komokpin for hunting, gardening, and collection of bush resources are located away from the TSF and will not be directly affected. Some indirect impacts to provisioning ecosystem services may occur through changes in access, increased project activity, or broader environmental changes within the surrounding landscape. Similarly, water quality of creeks and springs used for domestic use and aquatic resource harvesting will not be directly impacted by the project. Komokpin is downstream of and in a separate catchment from the TSF and associated Ok Yep discharge pathway; it is located just upstream of where the Ok Kaman joins the Ok Tedi, about 3 km downstream of the confluence of the Ok Yep and Ok Tedi. Diversion of tailings from the Ok Tedi will also support long-term benefits for water quality and aquatic fauna in the Ok Tedi that may benefit the village of Komokpin. *Cultural services* Nine cultural heritage sites within the village and its surrounding customary lands were identified in the cultural heritage surveys. No sites were recorded near project infrastructure, and it is unlikely that currently unrecorded cultural heritage sites will be impacted by the project based on the separation distance of the project to Komokpin.
Kungim	*Provisioning services* No direct disturbance of areas used for hunting, gardening or collecting bush resources are predicted from construction and operation of the TSF. Further, the location of Kungim upstream of the project means that water quality of creeks and rivers used for domestic use or fishing will not be impacted by the project as there is no surface water connection and groundwater generally flows to the southeast. *Cultural services* Consultation with Kungim communities identified a range of culturally significant places and customary landscape values, including burial areas, sacred sites, hunting grounds, ceremonial resource areas, and customary boundary markers. These areas were not verified through field surveys due to fieldwork constraints. Given the separation distance between Kungim and the TSF, direct impacts to unverified cultural heritage sites are expected to be limited.
Putmambin	*Provisioning services* No direct disturbance of areas used for hunting, gardening or collecting bush resources are predicted from construction and operation of the TSF. Further, water quality of creeks and rivers used for domestic use or fishing will not be impacted by the project as there is no immediate surface water connection between the project and creeks and rivers surrounding Putmambin and groundwater generally flows to the southeast. *Cultural services* Consultation with Putmambin communities identified a range of culturally significant places and customary landscape values, including burial areas, sacred areas, hunting grounds, ancestry tracks, and customary resource use areas. These sites could not be verified through field work due to fieldwork constraints. Given the separation distance between Putmambin and the TSF, direct impacts to unverified cultural sites are expected to be limited.

Infrastructure corridor communities

Table 11.23 presents a summary of predicted impacts on ecosystem services for infrastructure corridor communities. Supporting services such as habitat, are addressed in the terrestrial biodiversity impact assessment (Chapter 10).

Table 11.23 Ecosystems services summary of impacts – infrastructure corridor

Community	Predicted impact to ecosystem services
Northern infrastructure corridor communities • Kumkit/Ankit • Ok Teditau • Derongo • Nioksikwi • Bolewogam • Boungkim	*Provisioning services* The main impact of the project to provisioning services for northern infrastructure corridor communities will be the minor reduction of bushland available for gardening, hunting and collecting bush resources including food and materials. Surplus produce is sold to support household income and the decrease in availability of land for these ecological services may impact food security and income. Increased erosion and sedimentation from vegetation clearing, earthworks, and construction of waterway crossings during construction of the infrastructure corridor may result localised impacts to the water quality and aquatic fauna in the Ok Ma and its tributaries. *Cultural services* More than 100 tangible and intangible cultural heritage sites were noted during consultation with communities along the infrastructure corridor, including oral tradition sites, archaeological sites, and settlement sites. It is likely that cultural sites will be intercepted by the project.
Southern infrastructure corridor communities • Walawan • Kolebon • Wogam • Wombon • Digam • Ningerum Tamaro	*Provisioning services* The main impact of the project to provisioning services for southern infrastructure corridor communities will be the minor reduction of bushland available for gardening, hunting and collecting bush resources including food, medicinal plants and natural materials. Surplus produce is sold to support household income. Therefore, the decrease in availability of land for these ecological services may impact food security and income. Increased erosion and sedimentation from vegetation clearing, earthworks, and construction of waterway crossings during construction of the infrastructure corridor may result localised impacts to the water quality and aquatic fauna in the Ok Ma and its tributaries. Additionally, the construction of bridge crossings on the Ok Taub and Ok Birim (near Karandimok) will result in localised habitat disturbance and sedimentation during construction. *Cultural services* More than 100 tangible and intangible cultural heritage sites were noted during consultation with communities along the infrastructure corridor, including oral tradition sites, archaeological sites, and settlement sites. It is likely that cultural sites will be intercepted by the project.

11.3.2.4 Summary of ecosystem services assessment

Communities within the study area are heavily reliant on the natural environment for their livelihoods and wellbeing, and primarily live subsistence-based lives. The project will ultimately affect provisioning services for communities, particularly due to reduced bushland availability to garden, hunt and collect bushland resources. Water resources for some TSF communities, such as Kungembit and Ambaga, will also be affected. However, the severity of these impacts can be minimised or managed by adopting and implementing the mitigation measures, including livelihood restoration plans.

Impacts on cultural services will result from construction within the TSF footprint and potentially the infrastructure corridor, and possibly reduced access to cultural sites. However, impacts can be minimised or managed by adopting and implementing mitigation measures including implementation of the CHMP.

11.4 HUMAN RIGHTS IMPACT ASSESSMENT

This section presents the human rights impact assessment (HRIA) for the project. The HRIA identifies and assesses potential impacts on the human rights of various rightsholders, including customary landowners, community members, project workers, and other stakeholders. It also outlines measures for avoiding or mitigating the identified human rights impacts.

11.4.1 Assessment method

This HRIA has been prepared to meet the requirements of Equator Principles 4 (EP4) (Equator Principles Association 2020a), the United Nations' Guiding Principles on Business and Human Rights (UNGPs) (UN 2011) and the IFC PS. Principle 2 of EP4 requires proponents to assess potential adverse human rights impacts in a manner consistent with the UNGPs (Equator Principles Association 2020). The UNGPs sets out a framework for addressing and preventing adverse human rights impacts associated with business activities. Within this framework, businesses are expected to assess the actual and potential human rights impacts of their activities, and communicate how these impacts will be addressed. The IFC PS notes that businesses should respect human rights and avoid infringing on the human rights of others and address adverse human rights impacts the business may cause or contribute to.

11.4.1.1 Identifying potential human rights impacts

Potential human rights impacts were identified by:

- Defining relevant human rights aspects and the relevant human rights within these based on internationally recognised human rights instruments.
- Scoping potential human rights impacts through a review of project information, the existing human rights context in Papua New Guinea, and relevant technical studies.
- Identifying potentially affected rightsholder groups, including vulnerable groups.
- Consulting with potentially affected rightsholders to validate the scoped human rights impacts identified and identify any additional potential impacts.

In line with the UNGPs (UN 2011) and the Equator Principles Association guidance (2020b), this HRIA focuses on the project's potential adverse human rights impacts.

11.4.1.2 Defining the human rights aspects and relevant human rights

The following internationally recognised human rights instruments have been considered in the HRIA:

- The International Bill of Human Rights, comprising:
  - Universal Declaration of Human Rights (UDHR) (UN 1948).
  - International Covenant on Economic, Social and Cultural Rights (ICESCR) (UN 1966), acceded by Papua New Guinea 21 July 2008.
  - International Covenant on Civil and Political Rights (ICCPR) (UN 1976), acceded by Papua New Guinea 21 July 2008.
- The International Labor Organization's (ILO) Declaration on Fundamental Principles and Rights at Work (ILO 1988), including the ten[2] fundamental ILO Conventions.

[2] Papua New Guinea is an ILO member and has ratified eight of the fundamental ILO Conventions, covering forced labour, freedom of association, collective bargaining, non-discrimination, and child labour. It has not ratified ILO Convention 155 *Occupational Safety and Health Convention* or ILO Convention 187 *Promotional Framework for Occupational Safety and Health Convention*, which were added as fundamental conventions in 2022.

- United Nations' Declaration on the Rights of Indigenous Peoples (UNDRIP) (UN 2007) and ILO Convention No. 169 on Indigenous and Tribal Peoples (ILO 1989) as the principal international instruments relating to Indigenous peoples.
- Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (UN 1979), acceded by Papua New Guinea in 1995, as the international benchmark for women's rights.
- Convention of the Rights of the Child (CRC) (UN 1990), acceded by Papua New Guinea in 1993, as the primary international instrument defining the rights of children.

The Government of Papua New Guinea recognises and protects human rights through its regulatory framework. The *Constitution of the Independent State of Papua New Guinea 1975* (PNG Constitution) is the primary legal document that sets out the rights and freedoms of individuals, including fundamental rights that apply to all persons regardless of their nationality, race, ethnicity, colour, creed, religion or gender. The PNG Constitution also specifies rights that can be restricted or regulated by law, which apply to all persons in PNG or that apply to citizens of PNG (UNHRC 2021).

Additional legislation relevant to the project and the protection of human rights includes:

- *Ok Tedi Environment Management Act 2019 (OTEMA).*
- *Mining Act 1992.*
- *Land Act 1996.*
- *Family Protection Act 2013.*
- *Criminal Code Act 1974.*
- *Employment Act 1978.*
- *Lukautim Pikinini Act 2015*.

Table 11.24 outlines the human rights that have been identified as potentially impacted by the project along with the relevant core international human rights instruments.

Table 11.24 Potentially impacted human rights and core international instruments and standards

Human rights area	Right	Relevant core international human rights instruments and standards								
		UDHR	CEDAW	CRC	UNDRIP	ILO	ILO 169	ICCPR	ICESCR	UNGPs
Community health and education	Right to health	X	X	X	X				X	
	Right to education	X	X	X	X				X	
Community safety	Right to life	X		X	X			X		
	Right to health	X	X	X	X				X	
Standard of living	Right to an adequate standard of living	X	X	X	X				X	
	Right to adequate food	X		X	X				X	
	Right to water	X	X	X	X				X	
	Right to adequate housing	X	X	X	X		X		X	
	Right to property	X	X		X					
	Rights of Indigenous Peoples, including right to self-determination				X		X	X	X	
Cultural rights	Right to take part in cultural life	X	X	X	X				✓	
	Right of Indigenous Peoples to maintain, control, protect, and develop their cultural heritage, traditional knowledge, and traditional cultural expressions	X	X	X	X		X	X	X	
Consultation, engagement and consent	Rights of Indigenous Peoples including right to self-determination				X		X	X	X	
	Right to participation and information	X		X	X			X		X
	Right to freedom of opinion and expression	X		X	X			X	X	X
	Right to effective remedy	X			X			X		X
Public and private security	Right to liberty and security of person	X		X	X			X		
	Right to protection from exploitation, violence and abuse	X	X	X	X			X		
Community violence	Right to protection from exploitation, violence and abuse	X	X	X	X			X		
	Right to liberty and security of person	X		X	X			X		

Human rights area	Right	Relevant core international human rights instruments and standards								
		UDHR	CEDAW	CRC	UNDRIP	ILO	ILO 169	ICCPR	ICESCR	UNGPs
Workers' rights	Right to non-discrimination	X	X			X	X	X	X	
	Right to just and favourable conditions of work	X	X		X	X	X		X	
	Right to freedom of association and collective bargaining	X	X			X		X	X	
	Right to rest, leisure and reasonable working hours	X							X	
	Freedom from the worst forms of child labour			X	X	X			X	
	Right not to be submitted to slavery, servitude, forced labour or bonded labour	X	X	X	X	X		X	X	
	Right to fair wages and equal pay for equal work	X	X						X	
	Right to effective remedy	X						X		X
Cross cutting rights	Rights of women	X	X			X		X	X	
	Rights of children		X	X		X				

Note: UDHR = Universal Declaration of Human Rights; CEDAW = Convention on the Elimination of All Forms of Discrimination against Women; CRC = Convention on the Rights of the Child; UNDRIP = United Nations Declaration on the Rights of Indigenous Peoples; ILO = International Labour Organization; ICCPR = International Covenant on Civil and Political Rights; ICESCR = International Covenant on Economic, Social and Cultural Rights; UNGPs = United Nations Guiding Principles.

Scoping potential human rights impacts

A preliminary scoping exercise was undertaken to identify credible potential human rights impacts to be investigated further in the assessment. This considered:

- The project description, including proposed design, layout and activities.
- Feedback from consultation with communities and other stakeholders.
- Potential impacts from the existing Ok Tedi Mine operations, and similar resource-related projects in PNG and elsewhere.
- Findings from the social characterisation study (detailed in Chapter 9 and Appendix M).
- Preliminary outcomes from technical studies undertaken for the ESIA.

Identifying potentially affected rightsholders

A potentially affected rightsholder is an individual or group of individuals whose human rights may be affected, either positively or negatively, by a project or business activity (IPIECA and DIHR 2013). Table 11.25 lists the potentially affected rightsholders identified for this HRIA.

Duty bearers are those who have the responsibility to respect, promote, and realise human rights. Under international human rights law, States are the primary duty bearers required to respect, protect and fulfil the human rights of individuals within their territories (UN 2011). OTML and project contractors are also duty bearers for the project. Under the UNGPs, businesses and project proponents have responsibility to respect human rights in their operations.

Table 11.25 Identified rightsholders

Rightsholder category	Relevant stakeholders
Communities	People living in villages within the study area including: • TSF communities. • Infrastructure corridor communities. • Construction haulage route communities. • River communities. • Regional centres (Kiunga, Ningerum, Tabubil).
Individuals and groups	Customary landowners, including people from specific language or ethnic groups. Vulnerable groups, such as: • Women. • Children. • In-migrants and their families. • Physically vulnerable people, such as elderly people or those with a disability.
Workers	Project employees, including workers hired through recruitment contractors. • Contractor employees. • Employees of project suppliers (i.e., supply chain workers).

Consultation

Consultation with potentially affected rightsholders and other stakeholders was undertaken as part of the social characterisation study. Social researchers from Tetra Tech Coffey, with support from OTML Community Relations and Sustainability (CR&S) team members consulted rightsholders on four occasions in May-June, July-August and October 2025, and April-May 2026. Feedback from rightsholders informed the identification of human rights impacts, analysis of the existing human rights context within the study area, and assessment of potential human rights impacts of the project. Detail on the consultation conducted is provided in Chapter 5 and Chapter 9.

Assessment of potential human rights impacts

The UNGPs requires that all adverse human rights impacts be addressed, although priority should be given to the most salient (or most severe) human rights issues (UN 2012b). Salient human rights issues are those that present the greatest risk of severe adverse impacts on human rights.

An evaluation matrix (Table 11.26) was used to assess the salience of each potential impact and identify those human rights most at risk from the project. The assessment of salience is based on the:

- Severity of the impacts as determined by the:
  - **Scope:** the affected area and the population within it.
  - **Scale:** the gravity or seriousness of the impact.
  - **Remediability:** the ability to restore the human rights that have been impacted.
- Likelihood of the impact occurring.

Table 11.26 Evaluation matrix for salience of potential human rights impacts

		Severity				
		Minimal	**Minor**	**Moderate**	**Major**	**Severe**
Likelihood	**Almost certain**	Low	Medium	High	Very high	Very high
	Likely	Low	Medium	High	High	Very high
	Possible	Very low	Low	Medium	High	Very high
	Unlikely	Very low	Low	Low	Medium	High
	Rare	Very low	Very low	Low	Medium	High

Table 11.27 describes the criteria used to assign the level of severity for each impact, and Table 11.28 describes the criteria used to evaluate the likelihood of each impact. Severity and likelihood were evaluated based on professional judgement with reference to environmental and social studies undertaken for the project, project information, and consultation undertaken for the social characterisation and this HRIA.

Table 11.27 Severity description and criteria for HRIA

Level	Description	Definition		
		Scope – the number of rightsholders affected	Scale – the gravity or seriousness of the impact on human rights	Remediability – the ability to restore the human right/s that have been impacted
Severe	Severe, permanent or otherwise irremediable adverse impact to the human rights of a major proportion of rightsholders or people within a vulnerable group.	Affects a major proportion of rightsholders in an area of impact, or the workforce, or affects most people within a vulnerable group.	The scale of impact would be fundamental and may cause death or adverse health consequences that lead to a significant reduction in quality of life or longevity. The realisation of right/s will be severely impaired by the project impact.	Restoration of the impacted human right/s has complex technical requirements and there is no viable replacement for the loss caused. There is no remedy pathway established locally or cross-jurisdictionally.
Major	Substantial adverse impact to the human rights of a large proportion of rights holders or people within a vulnerable group. Complete restoration of the impacted right/s is unlikely.	Affects large proportion of rightsholders in an area of impact, a large proportion of a vulnerable group, or the workforce.	The scale of impact would be large. Realisation of right/s will be materially impaired by the project impact.	Restoration of the impacted human right/s is likely to be difficult, complex, lengthy and the right is unlikely to be restored completely. The remediation measures may be difficult to implement and access to remedy requires multiple parties and may be across jurisdictions.
Moderate	Moderate adverse impact to the human rights of a notable proportion of rights holders or significant proportions of a vulnerable group. Complete restoration of the impact right/s is possible.	Affects notable proportions of rightsholders in an area of impact, or the workforce, or affects significant proportions of a vulnerable group.	The scale of impact would be noticeable. Realisation of right/s will be noticeably impaired by the project impact.	Restoration of the impacted human right/s is achievable with implementation of established good practices and the right is likely to be restored completely or with no material difference expected. The access to remedy can be provided locally.
Minor	Minor adverse impact to the human rights of discrete proportions of rights holders or people within a vulnerable group. Complete restoration of the impacted right/s is likely.	Affects discrete proportions of rightsholders in an area of impact, in vulnerable group, or the workforce.	The scale of impact would be minor. Realisation of right/s will be minimally impaired by the project impact.	Restoration of the impacted human right/s is readily achievable with implementation of well established, and standard industry practices and the right is able to be restored completely. The access to remedy can be achieved through use of Company mechanisms or other agreed protocols.
Minimal	Very low adverse impact to the human rights of a small number of rights holders. Complete restoration of impacted right/s is readily achievable.	Affects a small number of individual rightsholders.	The scale of impact would be marginal. Realisation of right will not be noticeably impaired by the project impact.	Restoration of the impacted human right/s is readily achievable with simple, established practices, and the right is able to be restored completely.

Source: adapted after Gotzmann et al. 2020 and ICMM 2023

Table 11.28 Likelihood description for HRIA

Level	Description
Almost certain	The impact has occurred, is occurring, or is expected to occur and has frequently occurred before in similar circumstances.
Likely	The impact has occurred in similar circumstances, or it is more likely than not that it will occur.
Possible	The impact might occur and there have been some instances where it occurred in similar circumstances.
Unlikely	The impact is not expected to occur and generally has not occurred in similar circumstances; however, there is a slight possibility that it may occur.
Rare	The impact is rare or practically impossible; it may occur in exceptional circumstances. The impact has very rarely if ever occurred.

Principle 13 of the UNGPs require that businesses avoid causing or contributing to human rights impacts through their own activities and seek to prevent or mitigate human rights impacts that are directly linked to their operations (UN 2011). This HRIA categorises the nature of the project's connection to each potential human rights impact as caused, contributed, or directly linked to identify the company's obligations in relation to addressing potential impacts (Table 11.29).

Table 11.29 Definitions of project connection to an impact

Connection	Definition	Obligation
Caused	A human rights impact is caused by the project if it results from its own activities including actions and omissions.	The project should avoid causing the impact. If the impact does occur, the project should take necessary steps to cease or prevent the impact. The project should provide for or cooperate in their remediation through legitimate processes.
Contributed	A human rights impact is contributed to by the project if it results from its own activities including actions and omissions, either directly or through some outside entity (e.g., government, business or other).	The project should avoid contributing to the impact. If the impact does occur, the project should take necessary steps to cease or prevent its contribution and use its leverage to mitigate any remaining impact to the greatest extent possible. The project should provide for or cooperate in their remediation through legitimate processes.
Directly linked	A human rights impact is directly linked to the project if it is caused by an entity with which it has a business relationship, even if the project did not cause or contribute to the human rights impact.	If the project has leverage to prevent or mitigate the impact, it should exercise it. If it lacks leverage there may be ways for the project to increase it (e.g., through capacity building or collaboration with other stakeholders that have leverage). If the impact does occur the project is not required to provide for remediation; however, it may take a role in doing so.

Source: The definitions for caused, contributed and directly linked are based on the UNGPs (UN 2011).

11.4.1.3 Assumptions and limitations

The following assumptions and limitations apply to this HRIA:

- The assessment is based on currently available information on the project design, construction, and operation. Modifications to the project may lead to changes in the human rights impacts identified, and/or changes to the salience of potential human rights impacts.
- This assessment has been conducted at a point in time and has sought to use the most recently available information at this time. Changes to communities and social conditions from external social factors unrelated to the project may result in changes to human rights over time.

- This assessment considers potential impacts of the project on workers' rights, including for direct employees, contractors and subcontractors and suppliers. This was based on desktop review and no engagement was conducted with employees, contractors or suppliers about potential impacts.
- This assessment is focused on the Ok Birim TSF project and project area and has not involved assessment of potential human rights impacts of the broader Ok Tedi Mine operations or supply chains.

11.4.2 Potential human rights impacts

This section describes the project's potential human rights impacts organised by relevant human rights aspects. The SIA and HRIA consider many of the same impact pathways, particularly where project activities may affect communities through changes to access, livelihoods, health, safety, culture, and social conditions. To minimise repetition, readers are referred to the relevant sections of the SIA, which describe the impact pathway and social context in full. Where the SIA does not address the same impact pathways, additional context is provided in this section to support the human rights impact assessment.

Each sub-section then sets out the relevant right or rights, the existing human rights context in the study area, the project's potential adverse impacts, the management measures proposed to avoid, mitigate or manage those impacts, and the residual significance of potential impacts. Where relevant, the assessment distinguishes between different communities or rightsholders in the study area to reflect differences in baseline conditions, exposure to project activities, and the scale or nature of potential impacts.

11.4.2.1 Community health and education

This section presents an assessment of the potential human rights impacts of the project on community health and education. Community health and education rights potentially impacted by the project include the right to health and the right to education.

The right to health is a fundamental human right. It refers to 'the right to the enjoyment of the highest attainable standard of physical and mental health' (OHCHR and WHO 2008). The right to health includes entitlements such as the right to equal and timely access to basic health care services; access to essential medicines; the right to prevention, treatment and control of diseases; and maternal, child and reproductive health (OHCHR and WHO 2008). The right to health does not guarantee that a person is healthy, but that they have access to the conditions, services, and protections necessary to support health and wellbeing (OHCHR and WHO 2008).

The right to education is enshrined in various international instruments. Education is both a human right and a means for realising other human rights, including the rights of children. Education is critical for the empowerment of women, safeguarding children from exploitation and hazardous working conditions and protecting the environment (OHCHR 1999).

Human rights context and potential impacts

Information on existing health services and prevalent health conditions within the study area is provided in Chapter 9.

Community health

In this assessment, the right to health is considered in relation to the existing health context in the study area, including the availability and accessibility of health services, baseline health conditions, and the extent to which rightsholders already experience barriers to accessing care. It also considers the project's potential to affect health directly and indirectly, including through changes to population movement, employment and income, environmental exposure, and the availability of health services and infrastructure. Access to functioning health services is limited within the TSF and infrastructure corridor communities. Access to higher

order services is provided though health centres and hospitals in larger communities such as Ningerum, Tabubil, Kiunga, Matkomnai, and Rumginae. Consultation feedback indicates that access is limited in practice because government health services often lack staff, medicine, and equipment. Engagement with health providers noted that TB, malaria, STIs, and HIV are key health concerns for local communities, with TB being the biggest concern.

Enhanced access and connectivity provided by the project for communities west of the Ok Tedi, and direct and indirect economic opportunities such as land compensation, employment and business opportunities are anticipated to encourage population movement into project communities. The potential for PIIM into project communities will depend on a range of factors, particularly proximity to the project, opportunities for project related compensation, and existing in-migration. Communities with a high potential for PIIM include Birimkamba, Seven Kona, Ok Ma, Alice Pit and Ningerum, with in-migrants likely to include a mix of family members returning to their village due to the project, providers of goods and services to local populations and the project, and opportunistic migrants seeking direct and indirect project-related opportunities. Improved access provided by the project is also likely to attract people for ASM activities in the Ok Tedi.

The project has the potential to enhance rights to health for community rightsholders in the study area through improved access to health services for communities west of the Ok Tedi due to the construction of the pipeline access road and bridge crossings, implementation of worker health programs and initiatives, and increased incomes related to compensation and wages from employment. However, the project may also create additional pressure on existing limited health services and health outcomes through population movement, higher cash incomes, workforce influx, and increased exposure to respiratory, vector and water and sanitation related diseases, and STIs. The social changes associated with shifting from a subsistence to a cash-based economy can also increase non-communicable or lifestyle diseases.

Potential adverse impacts of the project on the right to health include:

- Reduced access to health care in local and regional communities due to increase in demand and occurrence of communicable diseases related to population growth from PIIM.
- Increased levels of respiratory, vector, and water and sanitation-related diseases.
- Increased sexual and reproductive health issues, including STIs, HIV and unwanted pregnancies, due to in migration and higher disposable incomes from project jobs and compensation payments.
- Increased levels of non-communicable diseases due to lifestyle changes associated with the project.

The air quality assessment determined that changes to air quality from construction and operation of the project will not cause health impacts. As such, potential impacts on right to health due to changes in air quality are not assessed in this HRIA.

Education

In this assessment, the right to education is considered in relation to the extent to which project activities may affect access to education directly or indirectly, including through changes in population and demand for local services. Education services within the TSF and infrastructure corridor communities are at Kungim, Komokpin, Ok Ma, Kolebon and Wogam. Students also attend primary school in communities along the Kiunga-Tabubil Highway, including primary and secondary schools in Ningerum, Tabubil and Kiunga. During consultation, rightsholders noted that many families move to larger settlements to provide better access to schools for their children. In addition, a lack of education was identified as a barrier to women's participation in formal employment.

The project has the potential to enhance the right to education through improvements to:

- Access and connectivity for communities west of the Ok Tedi from the construction of the pipeline access road and river crossings.
- Project related skill development and training opportunities.

Potential adverse impacts on education services will mainly be associated with PIIM-related population changes. This may increase the number of school-age children in the study area, placing pressure on school capacity and reducing the availability or quality of education services, which could affect communities' right to education.

Mitigation and management

Measures to avoid, mitigate, or manage the potential impacts on this right are outlined in the social impact assessment (see Table 11.11 and Table 11.13), and include measures for managing PIIM, and engagement with communities, government and non-government stakeholders to monitor the capacity of existing health and education services and to investigate any reductions in service capacity.

Residual assessment of human rights impacts

The following assesses potential impacts on the right to health and the right to education following the implementation of the mitigation and management measures.

Community health

Further discussion on potential impacts of the project on community members' access to health care services and community health is in sections 11.1.3.3 and 11.1.3.4 of the social impact assessment.

Access to health care

Population growth due to PIIM may increase the incidence of communicable diseases, leading to increased pressure on health services and reduced access to timely and adequate health care for communities within the study area, resulting in potential impacts on the right to health ***directly linked*** to the project.

Access to health care within the study area is currently challenged by limited infrastructure at a village level, and challenges with the capacity of some government health services in terms of a lack of trained personnel and equipment, and shortages in medical supplies. Increase in the incidence of communicable disease related to PIIM has potential for a noticeable impact on the rights of notable proportions of rightsholders, including significant proportions of vulnerable groups such as women, children and elderly, who may require health care. Restoration of potential impacts on the right to health is achievable with the implementation of established practices. Consequently, the severity of the potential impact is **moderate.** However, following the implementation of management measures that manage PIIM, support health service providers, improve awareness of health risks, and support improvements in WASH, potential impacts on the right to health due to reduced access to health care is **unlikely** and the residual salience on the right to health of community rightsholders is **low**.

Respiratory, vector, and water and sanitation-related diseases

Population growth associated with PIIM may result in overcrowded housing and increased pressure on existing water and sanitation systems in project communities, with potential to increase the incidence and transmission of water-related, sanitation-related, vector-borne and respiratory diseases.

Consultations with health providers identified TB, malaria, STIs and HIV as key health concerns for local communities. Following the implementation of management measures, the potential for impacts on the right to health due to an increase in respiratory, vector, and water and sanitation-related diseases is **possible**. The severity of this impact is **moderate**. The restoration of potential impacts is likely to be achievable with the implementation of established good practices. However, there is potential for a noticeable impact to a notable proportion of rightsholders, including vulnerable groups, in areas most affected by PIIM. The residual salience of this impact, **directly linked** to the project, is **medium**.

Increased sexual and reproductive health issues

Consistent with other resource development projects, population changes due to PIIM and the influx of a predominantly male workforce, coupled with increases in disposable incomes of workers, are anticipated to increase the occurrence of commercial and transactional sex. This is most likely to occur in communities with higher potential for PIIM, such as Birimkamba, Seven Kona, Ok Ma, Alice Pit and Ningerum, and where interaction between the workforce and communities is higher. Any increase in transactional sex has potential to increase community transmission of HIV and other STIs. The health consequences of HIV and untreated STIs can be significant, particularly for women for whom untreated STIs can cause health issues such as infertility, ectopic pregnancies, and cervical cancer.

Following the implementation of management measures, potential for impacts **directly linked** to the project on the right to health of community rightsholders, particularly women and girls, is **likely**. Restoration of rights are likely to be achievable through measures such as delivery of health education and awareness programs, including women's health programs and supporting health service providers. However, potential impacts directly linked to the project are expected to be noticeable for a notable number of rightsholders, including significant proportions of women and girls. Consequently, the severity of the impact is **moderate,** and the residual salience is **high**.

Increased levels of non-communicable diseases

The project has the potential to contribute to an increased prevalence of non-communicable diseases, such as diabetes, cardiovascular disease and obesity related health issues, through:

- Changes in livelihood practices, including reduced dependence on bush food and other traditional food sources.
- Increased reliance on store-bought foods, and a corresponding shift toward less physically active lifestyles.

These changes may result from increased incomes related to project benefits such as compensation and lease payments, and employment, and reduced access to subsistence resources, particularly for TSF communities. Health workers noted that lifestyle-related diseases are already more common in developed parts of the study area, such as Tabubil and Ningerum, while they remain minimal in the smaller rural TSF and infrastructure corridor villages.

The directly linked impact is **possible** and **minor** in severity across much of the study area, but **likely** and of **moderate** severity in those communities most affected by the loss of subsistence resources and higher compensation payments, particularly Birimkamba and Kungembit. These communities are expected to experience the greatest livelihood change, and therefore the greatest exposure to diet- and lifestyle-related health effects. The salience of the impact is **low** for most of the study area and **high** for the villages that will have the most drivers of change from subsistence lifestyles.

Education

Enhanced access and connectivity provided by construction of the pipeline access road and bridges over the Ok Tedi and Ok Birim is expected to benefit access to schools in Tabubil, Ningerum, Ok Ma, Kolebon, and Wogam for families in communities west of the Ok Tedi. Population growth from PIIM may increase school demand in some centres, although the project's in-migrant profile is expected to be predominantly working-age adults rather than large numbers of families. As a result, PIIM is **unlikely** to create a substantial burden on education service capacity across the study area. Restoration of potential impacts are expected to be achieved through the implementation of established good practices, and following the implementation of management measures, potential impacts are expected to be minor and affect discrete proportions of rightsholders. Consequently, the severity of the potential impact is **minor** and the residual salience of the impact on the right to education that is **directly linked** to the project is **low**.

11.4.2.2 Community safety

The project's potential impacts on community safety have been considered against the right to life. The right to life means that people have the inherent right to live and that their lives should not be endangered or ended prematurely, intentionally or accidently, by the actions of others (OHCHR 2019). The right to life is recognised as a fundamental right and a prerequisite for the enjoyment of all other rights.

Human rights context and potential impacts

The Kiunga–Tabubil Highway is the main road in the region and connects the service centres from Tabubil in the north to Kiunga in the south. Consultation feedback and field observations identified existing road safety concerns along the highway, including blind spots over crests and bends, narrow road sections and limited facilities that provide safe access for pedestrians. When complete, the ITCS Road will provide access for pedestrians and motorists between the PNG border with Indonesia at Yetetkun PLBN and the Kiunga-Tabubil Highway at Alice Pit. Existing travel between TSF and infrastructure corridor communities to areas used for livelihood activities and to regional centres mainly occurs on foot via bush track, or by motorised dinghy and canoe.

Transport activities for construction and operation of the project will involve a mix of light vehicles, buses for transport of workers, and trucks for the haulage of materials, supplies, plant and equipment. The ITCS Road will be used during construction and operation to provide access to the TSF site, including for haulage of gravel for the TSF embankments from gravel extraction sites in the Ok Tedi. This will require up to 207 vehicles per day during the construction of Cell 1, 62 vehicles per day during construction of Cell 2, and five vehicles per day for ongoing maintenance. Once constructed, the pipeline access road will be used to support construction of the tailings pipeline, including the transport of workers from Tabubil and Alice Pit. Public use of the pipeline access road will also be available following its construction. The Kiunga-Tabubil Highway will be used to transport materials, supplies, plant and equipment between Kiunga Port, Tabubil and Ningerum.

Public access to project worksites will be restricted, although works within the road reserve, across the Ok Birim and Ok Tedi, and near areas used by the public will create risks to personal safety through vehicle movements, machinery, changed access arrangements and other temporary changes to local conditions such as trenching. These risks are expected to be greatest during construction and into the early phase of operation. Risks may arise for users of the Ok Birim and Ok Tedi, including people undertaking transport, fishing and ASM activities near construction works and river crossings.

Potential impacts on the right to life may be associated with potential serious injuries or fatalities to rightsholders from:

- Project-related traffic, including heavy vehicles, using the Tabubil-Kiunga Highway, ITCS Road, and pipeline access road.
- Interaction with construction activities and equipment for the TSF, infrastructure corridor and within the Ok Birim and Ok Tedi.
- Project-related unplanned event risks.

Mitigation and management

Measures to avoid, mitigate, or manage the potential impacts on this right are outlined in the social impact assessment (see Table 11.6). Specific design controls and management measures for potential impacts relating to natural hazards, climate change and unplanned events are also outlined in Chapter 13. These include, among other things, implementation of measures for traffic management, site management and safety, and community and worker education and awareness about potential safety risks associated with the project.

Residual assessment of human rights impacts

The likelihood and severity of the impacts to the right to life are discussed below. These vary across the study area due to differences in existing infrastructure, proximity to project infrastructure and baseline social and economic conditions.

Traffic accidents

Use of the Kiunga-Tabubil Highway, ITCS Road, and pipeline access road by traffic associated with the project's construction and operation has the potential to increase road safety risks (refer Section 11.1.3.1). These roads are or will be used by pedestrians, motorists and PMV for access to markets, schools, health services and regional centres.

Use of roads in the study area by project-related traffic may increase the risk of road traffic incidents resulting in serious injury or fatality. The impact is expected to be greatest during construction, although some risk will continue during operation, particularly for that section of the ITCS Road between Alice Pit and the TSF site, past Birimkamba. With the implementation of management measures, including traffic controls, vehicle scheduling, segregation of project and community traffic where practicable, speed restrictions, signage, driver training and community awareness programs, impacts on the right to life from incidents **caused** by project traffic is **possible**. Since the potential harm includes death or long-term disability and would be irreversible, the severity is **major**. Accordingly, the residual salience of the project's potential impact on the right to life is **high**.

Community interactions with construction activities

The presence of construction works for the project will introduce risks to personal safety, particularly for people from TSF and infrastructure corridor communities, with potential to impact on community members' right to life. Following the implementation of management measures, including restricted site access, traffic controls, worker and community awareness, supervision of high-risk activities, and measures to manage temporary changes to access and river conditions, the likelihood of community interactions with construction works that **cause** impact on the right to life due to serious injury or fatality is **rare**. Based on the severity being **major**, the residual salience of the project's potential impact on the right to life is **medium**.

Project-related unplanned event risks

The project considers a range of credible unplanned events triggered by natural causes or incidental factors such as equipment failure or accidents, which have potential for environmental, social and operational impacts (see Chapter 13). This section considers project-related incidents that have potential to impact on the right to life of community rightsholders, including TSF failure, tailings pipeline failure, hazardous materials spills, and fires or explosions. Potential impact relating to transport and machinery accidents is discussed above, and project-related civil unrest in Section 11.4.2.6. With the implementation of management measures, including design standards, monitoring, emergency preparedness and response arrangements, and operating procedures, the potential that project-related unplanned events will **cause** serious injury or fatality with impact on the right to life is **rare**. The severity of this impact is **major**, with the salience of the project's potential impact on the right to life is **medium**.

11.4.2.3 Standard of living

The right to an adequate standard of living is an overarching right that provides every person the right to a standard of living adequate for the health and wellbeing of themselves and their family, including adequate food, water, sanitation, clothing and housing (OHCHR 2018).

The right to adequate food requires that food must be available from natural resources or for sale, accessible, affordable and satisfy dietary needs (OHCHR and FAO 2010). The right to water requires everyone has access to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use (WHO 2003).The OHCHR (2014) stipulates that the right to adequate housing incorporates (among other things) security of tenure; services such as drinking water, sanitation and energy; enough space, and protection from the elements. Access to safe drinking water is necessary to sustain life and health and is a fundamental dignity of all people.

Livelihoods are not explicitly named under the right to an adequate standard of living, although are integral to its realisation. In particular, for rightsholders living in rural and remote communities, livelihoods are the primary means through which food, housing, and other essentials are secured. In this HRIA, 'livelihood' refers to the range of strategies people adopt to pursue an adequate standard of living, such as cash cropping and subsistence gardening, collecting bush resources, and earning income from formal and informal work.

Human rights context and potential impacts

Livelihoods, food and water security, housing and wellbeing for communities within the study area are closely linked to the natural environment. Section 9.4.2 provides a detailed description of natural resource use within the study area. Garden and bushland areas are the primary source of food for households in the TSF and infrastructure corridor communities, with garden crops the main source of food for households. The cultivation and collection of cash crops, such as betel nut, rubber, balsa wood, eagle wood and coconut, for sale at local markets supports household income, and contributes to food security, while forested areas support the provision of bush resources, including collection of wild foods, medicinal plants, construction materials and firewood. Freshwater and riverine ecosystems, including the Ok Tedi, Ok Birim, Ok Yep and other smaller tributaries, provide freshwater for drinking and domestic use and aquatic food resources.

Construction of the TSF development area will result in the clearing of approximately 1,500 ha of forested land used by TSF communities including Kungembit, Karandimok, Birimkamba and Ambaga for livelihood activities such as gardening, sago production, hunting, cash cropping, and collection of bush resources. The TSF development area and areas surrounding the TSF also include rivers, creeks and springs that are also used by communities as sources of drinking water, for fishing and to support gardening activities. Construction of the infrastructure corridor will directly impact up to 480 ha of land, including forested areas, river corridors and alluvial floodplains.

The project has potential to impact on the rights of community members to adequate food, water, housing and livelihoods. Construction and operation of the project will impact on land and water resources used by communities to support these rights. Potential impacts will mainly be associated with the loss of, or disturbance to, land and water within the TSF site and infrastructure corridor. Impacts may also result from increased demand for land from in-migration of people into project communities due to potential economic opportunities of the project.

Following construction of the TSF, improvements to the riverine environment due to the reduction in tailings disposal into the Ok Tedi will have positive impacts for rightsholders in relation to the right to an adequate standard of living. Changes to livelihoods through new jobs, business opportunities, and higher cash incomes will support opportunities to enhance the rights of community rightsholders to an adequate standard of living.

Food security

Adequate food for rightsholders is achieved through access to a range of sources, including subsistence gardening, fishing, and collecting resources from bushland and watercourses. Food from trade stores is also an important source of food for households in some communities, particularly in communities such as Tabubil and Ningerum. The level of vulnerability to changes in food security therefore reflects a household's access to land and water sources to provide for food through subsistence sources, along with their access to cash incomes, which are often limited.

The project has the potential to cause reduced food security and therefore affect the right to adequate food due to:

- Loss or reduced access to land that produces staple foods and traditional resources (e.g., gardens, sago and hunting areas).
- Changes in aquatic ecology and waterway health near the TSF affecting fishing and sago making.
- Higher prices for food, goods, and materials, reducing the affordability of basic food items for vulnerable households.
- Increased pressure on subsistence food resources due to PIIM in local and regional communities.

Water security

Rightsholders rely on dug wells that provide access to groundwater, surface water from springs, and major rivers and their tributaries, and rainwater tanks for drinking and domestic water use. Potential impacts of the project on the water security of community rightsholders will mainly be associated with the:

- Loss or disruption to surface and groundwater sources (e.g., creeks, wells, springs) within the TSF development area.
- Changes in the water quality of surface and groundwater sources (e.g., creeks, rivers) near the TSF.
- Changes in the quality of groundwater sources (e.g., wells, springs) near the TSF.
- Changes in water quality of surface water resources near the infrastructure corridor.

The project has the potential to enhance the right to water for some riverine communities through improved water quality and reduced sedimentation within the Ok Tedi associated with stopping riverine tailings disposal.

Housing

Houses in TSF and infrastructure communities comprise permanent housing, that is dwellings constructed from finished materials such as metal and wood; semi-permanent housing constructed by a mix of finished and bush materials such as thatched walls with metal roof; and traditional housing constructed from bush materials such as thatch and palm leaf. The project's potential impact on the right to adequate housing are primarily driven by PIIM. Specifically, PIIM has the potential to increase population in communities across the study area, particularly Birimkamba, Ningerum, Alice Pit, Ok Ma, and Seven Kona, leading to increased demand on land and materials for housing, and overcrowding in some households.

Livelihoods

Livelihoods are foundational to supporting an adequate standard of living. The primary livelihood activity for households in the TSF and infrastructure corridor is subsistence gardening, with marketing and the sale of produce, casual labour, formal employment, and ASM also important livelihood activities. ASM is particularly important for households in communities close to the Ok Tedi. Once constructed, the project will reduce the amount of sand and silt being discharged into the Ok Tedi and transported to the lower Ok Tedi due to most of the tailings being placed in the TSF.

The project has the potential to enhance livelihoods by improving access to business and employment opportunities for people, particularly during construction. Rightsholders may experience reduced livelihoods due to:

- Loss or disrupted access to areas within the TSF site used to grow or collect cash crops, gardening, materials sold at market and bush resources.
- Disruption to ASM activities within the Ok Tedi due to project activities near to gravel extraction sites, and changes to riverine tailings disposal and sediment transport.

Mitigation and management

Measures to avoid, mitigate, or manage the potential impacts on this right are outlined in the social impact assessment in Table 11.9 and Table 11.10. These include compensation for land loss and livelihood restoration programs, measures to manage potential impacts related to PIIM into project communities, engagement with potentially affected people regarding the timing and duration of construction activities and potential disruptions, refinement of the project footprint, where possible, and sourcing food and essential supplies for the workforce from broader supply chains to minimise pressure on local prices.

Residual assessment of human rights impacts

The following assesses potential impacts on the right to an adequate standard of living for community rightsholders. Where the likelihood and severity of potential impacts on the various rights is different for communities in the study area, these are addressed separately.

Food security

Loss or disrupted access to land and waterways

Loss of, or disturbance to land and waterways within the TSF development area used for growing garden food for consumption, hunting, fishing, and collection of bush resources for food is **likely** to **cause** a decline in food security for rightsholders in TSF communities. This will most likely impact rightsholders of villages closest to the TSF site, such as Kungembit and Birimkamba, and particularly clans that have large proportions of their land directly affected. Following the implementation of management measures, there is potential for noticeable impacts on the right to adequate food for a notable proportion of rightsholders. Restoration of these rights is likely to be achievable with the implementation of good practices, with the severity of the impact **moderate**. Consequently, the residual salience of the potential impact on the right to adequate food for rightsholders within the TSF communities is **high**.

For rightsholders in the infrastructure corridor communities, the area of land used for growing and gathering food resources will be minimised where possible, through the siting and design of the tailings pipeline and pipeline access road. As such, the potential for the project to **cause** a decline in food security for directly affected rightsholders is **unlikely**. Should potential impacts occur, these are expected to have a minor impact on a discrete proportion of rightsholders. Consequently, the severity of the impact will be **minor** and the residual salience of impacts on right to food for rightsholders in the infrastructure corridor communities is **low**.

Changes to aquatic ecology and waterway health

The project will divert streams away from the TSF, which may negatively impact aquatic biodiversity and ecological values, which may affect fishing sites along the Ok Yep (Section 11.1).The construction and operation of the TSF will adversely affect water quality and stream habitat in the Ok Yep and smaller drainages downstream of the TSF, through increased sediment load and TSF seepage. The intensity and extent of sedimentation are expected to be greatest during construction, with some reduction during the operational phase. These changes will affect the abundance and diversity of aquatic resources in the Ok Yep used by rightsholders for food consumption particularly in Ambaga. Changes in water quality of waterways may also affect the health of sago stands or water used for sago processing.

Potential impacts on water quality and stream habitat in the Ok Yep will mainly affect rightsholders in Ambaga whose land covers areas along the Ok Yep south of the TSF site, with potential for minor changes in food security **caused** by the project. With the implementation of management measures, the likelihood of potential impacts on food security is **unlikely** assuming there are alternative and accessible fishing locations in the unimpacted west branch of the Ok Yep, and remediation likely to restore the right to adequate food for affected rightsholders. Consequently, the severity of impact is **minor** and the residual salience is **low**.

Construction of the bridge over the Ok Birim may temporarily disrupt access to areas used by the Karandimok community for fishing. Potential impacts on food security **caused** by the project will be **rare**, given the temporary nature of construction works within the Ok Birim. With the implementation of management measures, impacts on food security will be minimal and affect discrete proportions of rightsholders only. Consequently, the severity of potential impact on food security is **minor**, and the residual salience is **very low**.

Decreased affordability of food items

Trade stores are a food source for households in TSF and infrastructure corridor communities (see Chapter 9). Potential increase in household costs due to the project are discussed in Section 11.1.3.2.

Increased individual and household incomes, population growth from PIIM, and loss of access to natural resources due to construction of the TSF development area and infrastructure corridor, will increase demand for store-bought food in the study area. Construction of the ITCS Road separate to the project will provide improved access for households to markets in Indonesia, which were reported by community members to be more affordable compared to markets in Ningerum. However, experience of other projects in PNG and feedback from rightsholders for this assessment suggests increased demand for store-bought food will lead to an increase in the cost of food in local markets and stores in Ningerum, Yetetkun PLBN, Tabubil, and other communities within the study area, reducing food affordability for some rightsholders. This has potential to impact on the right to adequate food for households that do not receive project-related payments, and individuals of vulnerable groups, such as elderly, people with disability, and women, who may be less able to benefit from project-related employment.

Following the implementation of management measures, the potential for impacts on community rightsholders rights to adequate food due to increased food costs is **unlikely**. The severity of this impact on right to adequate food for vulnerable groups will be **moderate**, and the residual salience is **low**.

Increased pressure on subsistence food resources

Demand for land and natural resources to support population growth from PIIM will directly impact on land already used for subsistence food and bush resources within the study area. This has potential for noticeable reductions in food security for rightsholders in communities such as Birimkamba, Ningerum, Alice Pit, Ok Ma, and Seven Kona, which are anticipated to have the highest potential for PIIM. Following the implementation of management measures, the impact on right to adequate food for community rightsholders is **possible**, particularly for households who rely mainly on gardens and bush resources for their food. The severity of the impact will be **moderate**, with the residual salience of this impact **directly linked** to the project is **medium**.

Water security

Water security in the study area is influenced by the availability, quality and reliability of community water sources, including wells, creeks, rivers and springs. TSF communities commonly rely on dug wells and surface water sources, including the Ok Yep, for drinking, cooking, washing and other domestic uses, while infrastructure corridor communities use creeks, rivers, wells and springs for these uses.

Construction and operation of the TSF and infrastructure corridor have the potential to affect both surface water and groundwater resources (see Section 11.1.3.4).

Changes in water sources used by TSF communities

Construction of the TSF will require extensive clearing within the Ok Yep headwaters, resulting in the permanent loss of spring-fed creeks, small watercourses and associated aquatic habitats. Direct impacts on domestic water use have potential to impact on community water security and the right to water for community rightsholders, especially where alternative water sources are limited or less reliable during extended dry periods. The severity of potential impact on the right to water is **major**, with the scale of impact expected to be large, for notable proportions of rightsholders in communities closest to the TSF (e.g., Kungembit, Birimkamba and Ambaga). The restoration of the impacted rights is likely to be achievable with the implementation of

established good practices. Following the implementation of management measures, the likelihood for impacts **caused** by the project is **possible**, with the residual salience on the right to water **high**.

Construction activities are also expected to increase sediment mobilisation and total suspended solids (TSS) in receiving waters, particularly the Ok Yep, with potential downstream effects on water quality. This will most likely affect the right to water for rightsholders in Ambaga, where they rely on the Ok Yep during dry periods. The severity of potential impact on the right to water from changes to surface water quality in the Ok Yep caused by the project will be **moderate**. This has potential for a noticeable impact on discrete proportions of rightsholders, and restoration likely to be achievable with the implementation of established good practices. With the implementation of management measures, the likelihood for potential impacts on the right to water for community rightsholders is **possible**, with the residual salience **medium**.

During operations, TSF seepage may contribute to elevated concentrations of dissolved salts and metals in groundwater and connected surface water systems. *C*hanges to groundwater sources used by communities have potential to impact on the right to water for rightsholders. Groundwater model predictions indicate that there will be limited interaction of contaminants from seepage with the shallow groundwater system that the local community water supplies use and that changes will be restricted to the immediate vicinity of the TSF. Further, modelling predicts no change to levels or groundwater quality at nearby villages such as Ambaga, Kungembit, Birimkamba and Karandimok or their community water sources (see Section 11.1.3.4). Following the implementation of management measures, potential impacts on the right to water for rightsholders in communities closest to the project are **unlikely** and the severity of potential impacts is **minor**. The residual salience of potential impacts on the right to water from changes to groundwater sources is **low**.

Changes in surface water sources used by infrastructure corridor communities

Construction of the access road, pipeline and bridge crossings may result in localised sedimentation, temporary restriction of access to water sources, and potential localised deterioration in water quality in the Ok Ma and other nearby waterways. During operations, runoff from the road may also affect some water sources in highly localised areas. The corridor has been aligned to avoid key water sources where possible, although some rightsholders may still experience reduced access or reduced acceptability of water sources close to the project footprint, impacting on their right to water. With the implementation of management measures, the severity of potential impacts on the right to water for community rightsholders is **minor**, with the likelihood of potential impacts **rare**. As such, the residual salience of impacts is **very low**.

Housing

Loss or disruption to land within the TSF development area and infrastructure corridor has potential to impact on available bush resources for house construction, additionally increased demand for housing due to population growth from PIIM may result in overcrowding and affect the right to adequate housing for some rightsholders. Approximately 30% of dwellings in Kungembit and nearly 40% in Birimkamba are traditional houses that are constructed from bush materials such as thatch and palm leaf. For Ambaga and Karandimok, traditional houses comprise about 20% and 60% of dwellings respectively. With the implementation of management measures, such as compensation for the loss of bush resources and implementation of livelihood programs, and PIIM management potential impacts on the right to adequate housing caused by the project are **possible**. The severity of the potential impact will be **moderate**, with potential for noticeable impacts on discrete proportions of rights holders, and restoration of rights likely to be achievable with the implementation of good practices. Consequently, the residual salience of is **medium**.

Livelihoods

Loss or disrupted access to land

Construction of the TSF development area and infrastructure corridor will impact on natural resources that support livelihoods for households, including areas for:

- Growing cash crops such as betel nut, eagle wood, rubber, coconut and balsa, and garden food for consumption and to sell at markets.
- Collection of resources to support activities such as house construction, canoe making, firewood, and medicinal plants.

Potential impacts on land used for livelihood activities is presented in Section 11.1.3.2. The review of satellite imagery showed that land used for growing cash crops is generally located away from the TSF footprint closer to Ambaga, although identified areas will be directly impacted by the perimeter road between Kungembit and Ambaga and the surface water diversions near Kungembit. The review of satellite imagery and engagement with communities also identified garden areas with the TSF development area that are used by households in Kungembit, Ambaga and Birimkamba to grow food for household consumption and sale at markets. It is also likely that there will be other areas of land in the TSF footprint used for growing cash crops and garden produce for sale at markets that were not identified during consultation or able to be identified through satellite imagery. Bush resources are collected from forested areas to provide food, medicinal plants, building materials and materials for household use. Consultation identified one area used by Karandimok for the collection of bush resources, although it is expected that these resources are collected from forested areas across the TSF by all clans that have access to these areas.

Loss of land within the TSF development area that supports livelihood activities has potential for a large impact on the right to an adequate standard of living, for a notable proportion of rightsholders in villages such as Kungembit, Birimkamba, Ambaga and Karandimok. The restoration of the rights will be achievable through the implementation of established good practices, including compensation and livelihood restoration programs and the severity of the impact is therefore **major**. Following the implementation of management measures, potential impacts on livelihoods and the right to an adequate standard of living, caused by the project will be **possible**, with the residual salience **high**.

Within the infrastructure corridor, the severity of potential impacts on livelihoods and the right to an adequate standard of living **caused** by the project will be **minor** following the implementation of measures such as avoiding areas used for cash cropping where possible, and implementing compensation and livelihood restoration programs. The likelihood of potential impacts is **possible**, with the residual salience **low**.

Disruption or decline in ASM in the Ok Tedi

Construction activities within the Ok Tedi, including construction of the bridge at Tabubil and gravel extraction near Birimkamba have potential to disrupt access to sites actively used for ASM activities. This has potential to temporarily reduce cash incomes for some individuals and households in project communities near to the Ok Tedi (see Section 11.1.3.2). This may **cause** impacts on livelihoods and the right to an adequate standard of living for a notable number of rightsholders who rely on income earnt from ASM activities to support household expenses such as food and school fees. Following the implementation of management measures, the severity of the impact will be **minor**, with the scale of impact minor and restoration of affected rights readily achievable. The likelihood of potential impacts on an adequate standard of living for rightsholders is **possible**, with the residual salience **low**.

The importance of ASM to households within the study area means that any impact on ASM activities will affect a notable proportion of rightsholders across the study area. Advice from OTML suggests that most gold in the Ok Tedi that is targeted by ASM is from historic and current waste rock disposal, and historical accumulation of tailings. Further, the levels of gold in the tailings currently discharged into the Ok Tedi are understood to be very low due to the relatively low head grade and high levels of gold recovery in the

processing plant (Section 11.1.3.2). Consequently, the scale of impact from the essential cessation of tailings input to the river system will be marginal, and the severity of potential impacts on the right to an adequate standard of living **minor**. The likelihood of potential impacts on livelihoods and the right to an adequate standard of living for rightsholders **caused** by the project is **unlikely**, with the residual salience **low**.

11.4.2.4 Cultural rights

Construction and operation of the project have potential to impact on the right to take part in cultural life and the right of Indigenous Peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions.

The right to participate in cultural life recognises an individual's ability to participate in, and contribute to, ongoing expressions of their culture including customary and spiritual practices, language, traditional knowledge and arts (UN 2009). This right is interrelated with the rights of Indigenous Peoples to preserve, protect and develop their cultural heritage, traditional knowledge systems, and cultural expressions. '*Indigenous peoples' cultures include tangible and intangible manifestations of their ways of life, achievements and creativity'* such as manifestations in language, spirituality, traditional knowledge, customs, rituals, methods of production, morals, value systems, and activities such as hunting, fishing, trapping and gathering (UN 2012a).

Human rights and potential impacts

The cultural heritage values in the TSF development area and infrastructure corridor are diverse and include sacred and mythical areas associated with ancestral beings, traditional settlement sites, ancient clan boundaries, burial grounds, waterway route or tracks, and resource-use zones such as gardens, sago groves, and fishing, hunting sites (see Section 11.1.3.1). Community identity across the TSF and infrastructure corridor communities relating to cultural traditions and practices remains strong. Cultural traditions and practices continue to be upheld and exercised, although feedback from rightsholders reported a loss or decline in some local traditions and cultural practices due to factors such as the influence of the church, education providing new perspectives and ways of doing things, population growth and marriage, the introduction of the cash economy and modern lifestyles, and younger generations not upholding practices.

Construction and operation of the project has potential to impact on the cultural rights of Indigenous Peoples' due to:

- The loss of, damage or disruption to tangible and intangible cultural heritage values within the TSF development area and infrastructure corridor.
- The potential for a shift from the subsistence to cash economy.

Mitigation and management

Measures to avoid, mitigate, or manage the potential impacts on this right are outlined in the social impact assessment (Table 11.4) and include implementation of the CHMP (Attachment 2), consultation with affected landowners and communities, support for programs that preserve cultural traditions, design of infrastructure to avoid cultural sites of high significance where possible, and implementation of measures to manage potential PIIM.

Residual assessment of human rights impacts

Construction activities for the TSF development area will result in the permanent loss, damage or disturbance to cultural heritage values, with construction activities for the infrastructure corridor also having potential to result in the loss, damage or disturbance of heritage values of customary landowners (see sections 11.1.3.1 and 11.2.2.1). These values are integral to the historical, social, and spiritual identity of the Yonggom and

Ningerum peoples of the TSF development area and infrastructure corridor respectively, and their loss may adversely affect cultural continuity, customary practices, and the relationship of affected communities to their land.

The TSF development area and infrastructure corridor include cultural heritage values of moderate to high significance to communities. Loss of, or disruption or disturbance to these values have potential to impact on rights to take part in cultural life and of Indigenous peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions.

For TSF communities, potential impacts on these rights from the loss, or disruption or disturbance to tangible and intangible cultural heritage values is **almost certain**. This will have a noticeable impact on a notable proportion of rightsholders within the TSF communities. The severity of impact on cultural rights is **moderate**. Consequently, the residual salience of impact on rights of community rightsholders in the TSF communities to take part in cultural life and of Indigenous Peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions, **caused** by the project is **high**.

Within the infrastructure corridor, the design will seek to avoid potential impacts on cultural values of high significance where possible. However, potential impact on the rights to take part in cultural life and of Indigenous Peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions from the loss or disruption to heritage values **caused** by the project is **possible**. Given the smaller footprint and linear nature of the corridor, the implementation of management measures, including avoiding cultural values of high significance, where possible, will mean that impacts on cultural rights are expected to be minor, and affect discrete proportions of rightsholders only. Consequently, the severity of potential impacts on the rights to take part in cultural life and of Indigenous Peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions will be **minor** and the residual salience **low**.

Social and economic changes within the TSF and infrastructure corridor communities such as increased incomes, participation in employment and population growth from PIIM, will **contribute** to the loss, or decline of cultural practices and traditions currently occurring and further affect the communities' ability to sustain their cultural identity and traditions. Following the implementation of management measures, potential impacts on the rights to take part in cultural life and of Indigenous peoples to maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions, are **likely**. The severity of the impact is **moderate**, with the potential for noticeable impacts on the cultural identity and traditions of a notable number of people across the study. Consequently, the residual salience of impact is **high**.

11.4.2.5 Consultation, engagement and consent

Human rights relating to consultation, engagement and consent potentially impacted by the project include the rights of Indigenous Peoples including the right to participation and self-determination, the right to information and participation, and access to remedy.

UNDRIP affirms the rights of Indigenous People to self-determination, including the freedom to pursue cultural, economic and social development (OHCHR 2007). UNDRIP also affirm the rights of Indigenous Peoples to maintain and strengthen their relationship with their lands, territories, resources and cultural heritage, including their rights to participate in decision-making, protect cultural and spiritual sites, and have states consult with them in good faith through their own institutions to obtain FPIC before adopting and implementing measures that may affect them (OHCHR 2007). These rights are particularly important in regard to land access requirements for project development, and in particular resettlement should it be required. The IFC PS5 and IFC PS7 establishes the requirements for FPIC relating to project development on Indigenous Peoples' lands subject to traditional ownership or customary use, where resettlement is required, or where significant impacts would occur to critical cultural heritage under IFC PS7.

The right to participate in public affairs and access information is essential for individuals and communities to take part in decisions that affect their livelihoods, including development and environmental concerns (UNHR 2018). For Indigenous Peoples, UNDRIP affirms the right to participate in decision-making through their own representatives and to be consulted in good faith in ways that allow them to understand and engage with matters affecting them. Where information is not accessible or participation is limited, rightsholders may not be able to meaningfully influence decisions that affect their lives, livelihoods and communities.

The right to effective remedy is a fundamental concept within the UNGPs, which aims to protect affected people from business-related human rights abuse. Remedy can include apologies, restitution, rehabilitation, financial or non-financial compensation, punitive sanctions, prevent of harm through injunctions or guarantees of non-repetition. A grievance mechanism is a process through which business-related human rights abuse grievances can be raised and remedy sought. Grievance mechanisms should be accessible, transparent and capable of addressing gender-specific issues, such as sexual violence or discrimination (UN 2011).

Human rights context and potential impacts

Rights of Indigenous Peoples including the right to participation and self-determination

PNG explicitly recognises customary landowners and their rights over land and natural resources, and has developed a system that requires the identification of landowners and their consent prior to use of their land. Land ownership studies are required to be included in the proposal for development, which forms part of the application for a mining tenure (Chamber of Mines and Petroleum 2013). In practice, identifying the correct customary owners can be complicated by disputes over customary land tenure, overlapping clan claims, and uncertainty regarding land boundaries (Oliver and Fingleton 2014). By way of example, OTML's 2024 Annual Review reports customary land tenure disputes in relation to existing land access unrelated to the project (OTML 2024f). This can affect whether all relevant rightsholders are properly identified for compensation, consultation and FPIC processes.

OTML has conducted several rounds of engagement with potentially affected communities of the project (see Chapter 5 and Section 11.1.1.5) and has established clan usage agreements for the conduct of studies to support the feasibility assessment and environmental permitting (OTML 2025h). Detailed mapping of clan boundaries for the project is underway and will be used to inform landowner identification for the legislative processes for land access under the Mining Act 1992 and OTML's ongoing land access and consent processes.

Following landowner identification, the Mining Act 1992 incorporates a process for engaging with landowners and negotiating agreements for the use of their land. These processes support FPIC for Indigenous Peoples in PNG. In addition to meeting legislative requirements for the project's land access, OTML will also meet the requirements of the IFC PS and Equator Principles including achieving FPIC prior to use of land for the project.

Potential impacts on Indigenous Peoples' rights to participation and self-determination may occur where community engagement processes and formal negotiation processes do not properly achieve FPIC for all relevant Indigenous rightsholders prior to construction (e.g., information provided does not allow impacts to be fully understood).

Right to participation and information

OTML currently conducts formal and informal engagement activities with a wide range of stakeholders, including landowners, affected communities, provincial and national government agencies, employees, contractors, suppliers, and other interest groups, to share information and updates on OTML's operations, seek feedback, and respond to stakeholder issues and complaints.

Community engagement by OTML about the project commenced through the recent CMCA review process and has continued through the preparation of the ESIA. To date, community and stakeholder engagement for the ESIA has focused on sharing information and raising awareness about the project and the ESIA, and gathering information on existing conditions and community perceptions about potential impacts. A pre-ESIA roadshow was also conducted to share information and gather community feedback on issues, impacts and management measures prior to completion of the ESIA. The project will require ongoing engagement with Indigenous communities across the project lifecycle, including on matters affecting land use, livelihoods, the environment and community interests.

Engagement for the ESIA included separate discussions with women to gather feedback on existing social conditions and issues about the project important to women. Feedback from engagement with women indicated that their involvement in discussions about the project have been limited. Specifically, feedback from most communities suggested that information about the project was provided through men who had participated in discussions with OTML rather than through the direct involvement of women in the meetings. This was mainly attributed to cultural traditions that limit women's participation in decision making. Further, women's understanding about the project and its potential impacts was limited. Engagement for the ESIA, particularly the pre-ESIA roadshow, included community presentations attended by men and women about the project, its impacts and measures for managing identified impacts.

Given the cultural context, the project may have an impact on the rights to information and participation for vulnerable groups, particularly where engagement processes are not able to provide for adequate participation of women and other vulnerable groups in community discussions and decision making.

Access to remedy

Formal police presence in the study area is generally limited to urban centres such as Ningerum, Tabubil and Kiunga, with most villages relying on traditional governance mechanisms, such as village and clan leaders to maintain peace, and resolve law and order issues. The capacity of traditional governance functions to manage law and order and provide remedy was reported positively by community members in TSF villages. However, in larger communities, with greater population movement, the capacity of traditional governance functions to provide remedy is reported to be diminished, as social control is weaker and disputes are more difficult to manage.

OTML's *Community Level Stakeholder Complaint and Grievance Mechanism* (CGM) Operating Procedure Guideline (DRMS-IMS001-2021) establishes the processes for receiving and responding to concerns and complaints of affected communities. The IMS Standard 1.10 Internal Communications and Awareness (OTML 2018b) establish OTML's system for managing concerns and complaints. Monthly reports from the Complaints and Grievance Management System (e.g., OTML 2025f) are used to track complaint categories and outcomes, and demonstrate disclosure of grievance-related information to affected communities; the Annual Reviews report publicly on overall number of grievances and resolution of grievances.

The CGM applies to community level stakeholder complaints and grievances and has been designed to meet the requirements of the ICMM, the UNGPs, and IFC.

The project may impact on the right to access to remedy through:

- Failure to manage community grievances effectively, due to limited awareness, understanding and access and use of the CGM.
- Reduced access to existing community remedy mechanisms (e.g., police) where PIIM increases demand for these services.

In addition to these specific rights, the effectiveness of the CGM impacts the effectiveness of management measures for a variety of other rights.

Mitigation and management

OTML is aligning the project to international standards in addition to meeting legislative requirements, including requirements of IFC PS5 and IFC PS7.

Measures for managing potential impacts relating to rightsholders access to effective remedy are provided in Section 11.1.3.1, particularly in relation to management of PIIM. The following measures are proposed to be implemented by OTML to manage potential impacts on the rights of Indigenous Peoples including the right to participation and self-determination, the right to information and participation, and access to remedy. Key measures include:

- Provide ongoing implementation of the project's Stakeholder Engagement Plan, to provide for informed consultation and participation (ICP) with specific strategies to engage women, youth, and other vulnerable groups (MM240).
- Establish a network of Village Liaison Officers (VLOs) in the study area that includes female representatives to support engagement for the project (MM241).
- Implement FPIC processes where triggered under international standards for the project, in accordance with the Stakeholder Engagement Plan, Resettlement Process Operating Procedure (Lands IMS402-2025) (OTML 2025e), CR Land Management Standard (CR-STD001) (MM242).
- Provide strategies for the inclusion of women and youth into the decision-making and negotiation process for land access and discussions relating to project benefits (MM243).
- Collaboration with government to strengthen community remedy mechanisms.
- Engage with affected communities in the review and update of the CGM to make sure it is adequate and accessible.
- Conduct community awareness and education of the CGM, supported by ongoing review of its accessibility and effectiveness.
- Monitor and report on grievances, with separate reporting for grievances related to human rights impacts.
- Conduct ongoing human rights due diligence processes.

Residual assessment of human rights impacts

Rights of Indigenous Peoples including the right to participation and self-determination

Challenges with engagement may result in some affected rightsholders having an incomplete understanding of the project and its potential impacts to make an informed decision or to consent to the project. Engagement undertaken for the ESIA (see Chapter 5) has indicated broad initial support for the project, a high-level awareness of some of the potential impacts and concerns relating to some impacts, a general desire by affected communities to receive compensation. However, ESIA engagement has also highlighted concerns regarding women's representation in agreement processes, and awareness of the permitting and approval process.

The management measures proposed will develop processes to develop community awareness and understanding of the project's potential impacts, and grant consent for the project to affect their land, natural resources and cultural heritage. Consequently, the potential that community engagement processes do not achieve FPIC and as a result **cause** an impact on Indigenous Peoples' rights to participation and self-determination is **unlikely**. The severity of the impact caused by the project is expected to be **moderate,** as the residual impact is expected to be limited to a small number of rightsholders in a noticeable. Consequently, the residual salience of the potential impact to the rights of Indigenous Peoples related to engagement processes not achieving FPIC and the right to participation and self-determination is **low**.

Right to participation and information

The right to participation and information may be affected by language barriers, dispersed settlements, limited communications infrastructure, and logistical constraints on regular in-village engagement. These challenges may reduce the extent to which Indigenous rightsholders are able to access information and participate meaningfully in decision-making over the life of the project. However, the engagement processes established for the project are designed to improve access to information and support ongoing consultation. Consequently, it is **unlikely** the project will cause an impact on Indigenous Peoples' rights to participation and information. The severity of this impact on this right for communities in the study area is **minor**. Consequently, the salience of the potential impact on Indigenous People's rights to participation and information is **low**.

In addition to the community-level challenges identified above, vulnerable rightsholders such as women, youth, older people and people with disabilities may face greater barriers to accessing information and participating meaningfully in decision-making. These barriers may be compounded by lower levels of literacy, gendered social norms that limit women's participation in public engagement processes, and a preference among some women for smaller or women-only spaces to raise concerns.

Mitigation and management measures are expected to improve access to information and strengthen meaningful participation by women, youth and other vulnerable groups, reducing the likelihood of their exclusion from decision-making and engagement processes. However, given the cultural context it is **possible** the project will **contribute** to an impact on the right to participation and information. The severity of this impact on this right for affected rightsholders is **moderate,** resulting in a residual salience of **medium**.

Access to remedy

The project will generate community grievances across the study area through its interactions with communities, including impacts to livelihoods, access, and day-to-day community relations. It will rely on the CGM as the primary mechanism for receiving and responding to complaints and concerns.

The proposed mitigation and management measures for the project include use of the established grievance procedures, complaint tracking systems, VLO support, and communication channels. With these measures the severity of the impact in terms of how many people are affected, along with the seriousness of these complaints is **minor**. Grievances can generally be addressed through established complaint processes and local remedy, although delays or dissatisfaction with outcomes may still occur. It is **possible** that the project will **cause** an impact on people's right to access remedy. Consequently, the salience of the potential impact on the right to access remedy is **low**.

The project may increase population movement into local and regional communities through PIIM, which may place additional pressure on existing community remedy mechanisms, including police and other formal and informal law and order systems. Given the limited capacity of these services across the study area, it is **possible** that the project will be **directly linked** to reduced access to existing community remedy mechanisms, particularly where PIIM is concentrated. Following the implementation of management measures, including measures to manage PIIM and working with local and provincial governments to support community remedy mechanisms, the severity of the potential impact is **moderate,** resulting in an overall salience on the right to effective remedy being **medium**.

11.4.2.6 Community conflict and exploitation

Community conflict from the project has potential to impact on the right to life, liberty and security of person; and rights of women and children, including the right to protection from trafficking and exploitation from prostitution. The right to life, liberty and security of a person means that people have the inherent right to live and that their lives should not be endangered or ended prematurely by the actions of others, either intentionally or accidentally (OHCHR 2019). The rights of women and children include the right to protection from sexual exploitation and abuse, and violence (e.g., sexual, psychological and gender-based violence).

In this assessment, these rights are considered in relation to the existing social context in the study area, including reported concerns about alcohol and drug use, theft and the prevalence of family and sexual violence in PNG. The assessment also considers the extent to which the project may increase the risk of exploitation, violence or abuse through changes in population, income, employment, compensation and other project benefits.

Human rights context and potential impacts

Rightsholders across the TSF and infrastructure corridor communities generally reported feeling safe within their villages and noted that while serious law and order issues occur these are not common. However, drug and alcohol related violence, including family and sexual violence, are existing issues in larger communities such as Alice Pit, Ningerum, and Seven Kona, with increased access to money from ASM seen as the primary contributor. Stakeholder consultation for this assessment also noted fear of SARV as a concern for community members from TSF communities and in Alice Pit, particularly amongst women (see Section 11.1.3.1).

Although women generally report feeling safe in their communities, rates of family and sexual violence are exceptionally high in PNG, and represent a significant risk to the human rights of children and women (Human Rights Watch 2024; UNICEF 2024). Concerns about safety, particularly for women and girls, due to the influx of male workers into the study area were raised during community consultation.

Social and economic changes resulting from the construction and operation of the project may increase levels of crime, conflict and community conflict within project communities, leading to potential impacts on the safety and security of community members. Where project-related conditions increase disposable incomes, population movement, and demand for transactional sex, these rights are important for protecting women and girls from coercion and abuse. This has potential to impact on the right to life, liberty and security of person; and rights of women and children, including the right to protection from trafficking and exploitation of prostitution due to:

- Increased rates of drug and alcohol-related anti-social behaviour, crime and violence, including family and sexual violence against women and children and SARV, due to increased disposable incomes and PIIM.
- Increased incidences of community conflict relating to the distribution of land compensation and lease payments.
- Increased risk to women and girls to be subject to sexual exploitation and abuse, due to increased disposable incomes, and in-migration of predominantly males into project communities.

Mitigation and management

Measures to avoid, mitigate, or manage the potential impacts on this right are outlined in the social impact assessment (see Table 11.7). These include the development and implementation of measures for managing potential PIIM, implementation of worker Code of Conduct and community development initiatives that support community safety, and collaboration with government and stakeholders to strengthen community remedy mechanisms, and implementation of education programs regarding SARV.

Residual assessment of human rights impacts

Increased anti-social behaviour, crime and violence, including family and sexual violence

Population changes in project communities due to PIIM and influx of project workers, and increased disposable incomes, particularly for young men, from employment and project benefits, may contribute to a rise in drug and alcohol related crime, violence, and anti-social behaviour, including family and sexual violence.

Consultation for this assessment identified drug and alcohol related violence, including family and sexual violence, and SARV as existing issues for people across the study area. SARV in PNG is often related to disputes over land, marriage, resources, and political or business rivalries, and is often fuelled by feelings of jealousy and perceived inequality (UNFPA 2025). Social and economic changes related to in-migration, and distribution of compensation and other project benefits have potential to increase the incidence of SARV.

Increases in drug and alcohol related violence, including family and sexual violence, and SARV have potential to impact on the right to life, liberty and security of person, and the rights of women and children. Potential impacts are most likely to occur in communities such as Alice Pit, Ningerum, and Seven Kona, given existing populations and potential for PIIM into these settlements. Further, drug trafficking was raised during engagement as an existing problem in communities such as Alice Pit and Ningerum, in part due to their locations as key transit points between regional centres and the Indonesian border, and limited police presence to manage these issues.

In-migration into project communities, and increased disposable incomes, particularly for males, in combination with ready availability of drugs and alcohol, has potential to escalate levels of crime and violence, including family and sexual violence against women and girls. The severity of potential impacts on the right to life, liberty and security of person, and the rights of women and children, is **major** with potential to materially impair the rights of a large proportion of rightsholders, including large proportions of a vulnerable group. These impacts relate to significant and existing underlying issues relating to violence that are challenging to manage and are confounded by limited formal governance capacity. Restoration of potential impacts are likely to be difficult, complex and lengthy and involve multiple parties. Following the implementation of management measures, the potential for impacts on rightsholders **directly linked** to the project are **likely**, and the residual significance on the right to life, liberty and security of person, and the rights of women and children is **high**.

Community conflict relating to the distribution of project benefits

The distribution of project compensation and benefits has potential to cause community tension and disputes if these are distributed unequally amongst project communities and groups, or where people perceive the distribution of project benefits and compensation is not evenly shared. This is consistent with experiences from other projects in PNG, which have seen community conflict due to perceptions around uneven distribution of compensation and project opportunities particularly where benefits are based on land ownership, such as the TSF communities. This could **contribute** to conflict within and between communities, including violence towards individuals, with potential impact on rights to life, liberty and security of person.

Conflict and violence relating to project benefits and compensation have potential for a noticeable impact on the right to life, liberty, and security of persons. Potential impacts are expected to affect discrete proportions of rightsholders, with the severity of impact on rights to life, liberty and security of person **moderate**. Following the implementation of mitigation measures, the potential for conflict to escalate to levels that would impact on rights to life, liberty and security of person is **unlikely**, with the residual salience **low**.

Sexual exploitation and abuse

Based on similar construction and resource projects in PNG and elsewhere, direct and indirect employment for the project is likely to see an increase in males across the study area, particularly in areas near to the TSF, construction worksites for the infrastructure corridor, and at worker accommodation facilities at Alice Pit, Ningerum and Tabubil. More males, coupled with higher disposable incomes, has potential to lead to an increase in the exploitation and abuse of women and girls, leading to gender-based violence, demand for commercial sex, and enticement to transactional sex for women and girls. Although sex work is illegal in PNG, it remains present, and there is evidence that economic pressure and population movement can increase vulnerability to exploitation, including for children (USDOS 2025).

An increase in gender-based violence, demand for commercial sex, and enticement to transactional sex has potential to impact on a significant proportion of women and girls within the study area. This is most likely to impact on women and girls in communities such as Birimkamba, Ningerum, Alice Pit, Ok Ma, and Seven

Kona, which are anticipated to have the highest potential for PIIM and will be the location of work activities and facilities for the project. Realisation of the rights of women and children, including the right to protection from trafficking and exploitation of prostitution will be noticeably impaired by a potential increase in sexual exploitation and abuse **directly linked** to the project. The impact is moderately remediable, as some forms of harm may be addressed through reporting, support services and enforcement mechanisms, although effective remedy may be limited in practice where vulnerable people are reluctant to report or access assistance. Consequently, the severity of the impact is expected to be **moderate**. Following the implementation of management measures, the likelihood of potential impacts on the rights of women and children to protection from sexual exploitation and abuse, and violence are **possible**. The residual salience of potential impacts on the rights of women and children, including the right to protection from trafficking and exploitation of prostitution is **medium**.

11.4.2.7 Interaction with public and private security forces

Project-related interactions between community members and public and private security forces have potential to impact on the right to life, liberty, and security of the person, right to freedom from torture, and freedom from arbitrary arrest or detention. The right to liberty and security of person protects people is recognised in various instruments. It is a fundamental right that includes the right to be able to live freely from unlawful killing, arbitrary arrest or detention, torture or cruel, inhuman, or degrading treatment, assault, domestic violence, and other forms of abuse.

These protections are particularly relevant to project developments where interactions between public security forces, or private security personnel, and local rightsholders can create risks of intimidation, excessive force, unlawful detention, or other coercive conduct. The Voluntary Principles on Security and Human Rights (VPSHR) were created to help companies, governments, and civil society address security and human rights challenges in high-risk environments, and are intended to support security practices that respect human rights.

Human rights and potential impacts

Law and order services are limited in the TSF and infrastructure corridor communities. There are no police stations in the villages, with police stations at Ningerum, Kiunga and Tabubil. In July 2025, the Ningerum police station had one permanent police officer, with support for policing provided by around 20 auxiliary police personnel of which most were volunteers. OTML has established a Memorandum of Understanding (MoU) with the Royal Papua New Guinea Constabulary (RPNGC) Special Services Division (Mobile Squads) to support operations for the Ok Tedi Mine.

The MoU (RPNGC 2026) captures expectations that security personnel assigned by RPNGC '*will act in a manner that respects human rights, in compliance with all applicable domestic laws relating to human rights and also consistent with the principles in the Universal Declaration of Human Rights, Fundamental Principles and Rights at Work of the 1998 ILO Declaration, UN Code of Conduct for Law Enforcement Officials and UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials*'. The MoU also provides that personnel will receive appropriate training prior to providing services on OTML sites that includes respect for human rights. The latest round of training on human rights was conducted in 2025 and involved police officers and OTML Asset Protection Department security personnel. Interactions between OTML and the RPNGC are coordinated through OTML's Asset Protection Team. The PNG Defence Force sometimes responds to incidents in the study area where RPNGC capacity is insufficient.

The use of excessive force by the RPNGC in other parts of PNG is well documented (Dinnen 2020). Specific to the study area, there have been reports of excessive force by the RPNGC against community members (Post Courier 2026). These are contrasted with concerns about increasing levels of violence in the broader region, raised as a general concern by stakeholders during consultation.

OTML manages security internally through its Asset Protection Team, supported by contracted unarmed security guards and the use of security checkpoints, screening, surveillance, and access control measures in its operational areas.

The project has the potential to increase public and private security concerns, including through increased community conflict and anti-social behaviour (see Section 11.4.2.6). These concerns may manifest in:

- Increased negative interactions between police and affected community members, including intimidation, harassment, or excessive use of force.
- Increased rates of abuse, physical assault, gender-based violence and harassment, and mistreatment of community members by the project's private security providers.

Mitigation and management

The key mitigation and management measures relating to protecting human rights in relation to interactions between the local communities and both public security forces and OTML's security personnel are the MoU with the RPNGC and OTML's commitment to the VPSHR. OTML also prioritises its role in supporting the development of the region and maintaining a positive relationship with the community.

Measures to avoid, mitigate, or manage the potential impacts on this right include

- Maintain a MoU with the RPNGC, which includes respect for human rights, including human rights safeguards and training.
- Implement a whistleblower policy.
- Align OTML security operations with the VPSHR and conduct regular assessments to measure compliance with the VPSHR, including confirming human rights training is undertaken.
- Provide private security forces engaged on the project, induction training on VPSHR, conflict resolution and other human rights risks identified through monitoring of grievances raised.
- Conduct community awareness-raising and education of OTML's Community Grievance Mechanism.
- Conduct ongoing monitoring of grievances raised relating to interactions between RPNGC officers and communities.
- Conduct ongoing monitoring of grievances raised relating to interactions between private security providers and communities.

Residual assessment of human rights impacts

Increased rates of negative interactions between police and affected communities

Increased interaction between project communities and the police has potential to lead to an increase in abuse, physical assault, violence, and mistreatment of community members impacting on rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention.

Proposed management measures include monitoring compliance with the MoU and monitoring grievance mechanisms to detect and respond to alleged incidents between public security forces and community members. However, following the implementation of management measures, it is **possible** that potential impacts on the rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention for community rightsholders occur. This may be due to actions of public security forces such as excessive use of force and intimidation or harassment of community members, or uncontrolled interaction between community members and public security forces.

The severity of potential impacts on the rights of community rightsholders from interactions with public security forces is **moderate**, due to restoration of the impacted rights likely to be complex and difficult to implement. Consequently, the residual salience of potential impacts on rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention **directly linked** to the project is **medium**.

Increased rates of negative interactions between private security forces and affected communities

Increased interaction between project communities and project security guards may lead to an increase in abuse, physical assault, violence, and mistreatment of community members impacting on rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention.

Proposed measures include ongoing monitoring of compliance with the VPSHR, implementation of human rights training for project personnel, monitoring grievance mechanisms to detect and respond to alleged incidents involving community members, and inclusion of human rights clauses in contracts with private security providers. Following the implementation of management measures, it is **possible** that potential impacts on the rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention for community rightsholders **directly linked** to the project occur due to actions of private security guards. The severity of potential impacts is **minor**, with the restoration of rights likely to be achievable with the implementation of established good practices. Consequently, the residual salience on the rights to life, liberty, and security of the person, freedom from torture, and freedom from arbitrary arrest or detention is **low**.

11.4.2.8 Workers' rights

The potential impacts within this section have been assessed with reference to key workers' rights, including the rights to just and favourable conditions of work; non-discrimination; freedom from child labour; freedom from slavery, servitude, forced or compulsory labour; right to freedom of association; and right to effective remedy. These rights are summarised as follows:

- The right to just and favourable conditions of work incorporates the right to safe and healthy working conditions, fair wages, an adequate standard of living through decent remuneration, equal opportunity for promotion to an appropriate higher level, and rest, leisure, reasonable limitation of working hours, and periodic holidays with pay (UN 1966; UN 1948; ILO 1951).
- The right to non-discrimination in a work context recognises that everyone has the right to equal pay for equal work; requires all individuals to be treated equally and fairly; requires employers to prevent discriminatory practices in recruitment, promotion, and across their supply chains; and to take all appropriate actions to eliminate discrimination against women (UN 1948; UN 1976; UN 1979; ILO 1951; ILO 1958).
- The right to freedom from child labour recognises that every child should have equal rights to their childhood, their potential and their dignity, and should not be subject to work that is harmful to their physical and mental development (ILO 1973). Child labour includes work that is mentally, physically, socially, or morally harmful or that interferes with their schooling (ILO 2024). Industries subject to minimum age admissions include mining and quarrying; construction; and transport. A particular focus of the right is protection from the worst forms of child labour, which is labour that exposes children to physical danger and/or psychological trauma, such as slavery, child prostitution and pornography, drug trafficking and hazardous work (ILO 1999).
- The right to freedom from slavery, servitude, forced labour or compulsory labour requires that a person be free from work or service that is compelled under the threat of penalty and which the person has not offered to perform voluntarily (ILO 1930, UN 1976, UN 1948). It includes protection of vulnerable groups such as migrant workers, customary landowners, children, and women.
- The right to freedom of association and protection of the right to collective bargaining ensures workers the right to form and join trade unions and to bargain collectively with their employers (ILO 1948; ILO 149).
- The right to effective remedy is integral to the UNGPs and emphasises the need for effective grievance mechanisms for those affected by business-related human rights abuses (UN 2011).

Potential impacts on workers' rights apply to direct employees, contractors and subcontractors and suppliers operating within the study area. Potential issues associated with the broader supply chain have not been assessed. The potential impacts to workers' rights would mainly be associated with recruitment practices, worker contracts and conditions, and worksite conditions, including within worker accommodation facilities.

Human rights context and potential impacts

Worker's rights are regulated through the following legislation in PNG:

- *Constitution of the Independent State of Papua New Guinea 1975* which provides for freedom from forced or compulsory labour.
- *Criminal Code Amendment of 2013* which criminalises trafficking in persons and use of forced labour and similar practices.
- *Employment Act 1978* which applies to formal employment and addresses work hours, minimum age of work and gender discrimination.
- *Industrial Safety, Health and Welfare Act 1961* and the *Mining (Safety) Act 1977* which regulate protection of workers' health and safety including accident reporting and investigation.

The realisation and enjoyment of workers' rights in PNG has limitations due to both the level of protection afforded by the legislation and the level of regulation and enforcement of those protections that are in the legislation. This is particularly so in the following areas of relevance to this assessment:

- Enforcement of minimum wage, overtime, and occupational, safety and health legislation and investigation of worker complaints due to lack of enforcement capacity and corruption (USDOS 2024a).
- Non-discrimination of women: the *Employment Act 1978* prohibits women from undertaking certain types of work such as heavy labour, and from working certain hours such as night shifts unless they hold certain positions. There is also an absence of sexual harassment laws and women frequently experience sexual harassment and discrimination at work (USDOS 2022).
- Enforcement of child labour laws due to funding and resource challenges. As a result, child labour is common across PNG, particularly in the agricultural, informal mining and service sectors involving hazardous labour activities (USDL 2023). Age verification is also difficult due to only around 15% of children in Papua New Guinea having their birth registered (USDL 2024).
- Limited protections of child labour laws. The *Employment Act 1978* sets the minimum age for engaging in hazardous work at 16 years which is below the international standard of 18 years. Additionally, the Act does not define hazardous occupations or activities prohibited for children. The ILO reported that in 2021, 19% of the country's labour force fell within the category of child labour, including instances of prostitution and forced labour (ILO 2021). Papua New Guinea also does not have laws that prohibit using, procuring, or offering a child for illicit activities, including for the production and trafficking of drugs and laws do not sufficiently protect children from commercial sexual exploitation because the use of a child in pornography is not criminally prohibited.
- Non-discrimination based on family or social ties: in PNG, nepotism in recruitment and promotion is common, especially within one's *wantok* (social group) and this practice is not prohibited by law.
- While workers in the formal sector have the right to unionise, bargain collectively and strike, the government has the power to intervene in labour disputes (e.g., preventing union action through arbitration before strikes could take place) (USDOS 2022).

As detailed in Section 11.1.3.2 people in the project area live mainly a subsistence-based lifestyle with the majority of employment in the informal sector including selling of produce and other goods. ASM is a key source of income for many households in communities along the Ok Tedi. OTML and its contractors and business partners are key employers in the formal sector, there are also government roles such as health workers, teachers and police. During engagement for this assessment women reported that they lacked the level of education required to participate in formal employment.

OTML has existing policy and management systems that address many aspects of workers' rights; these generally align to PNG legislation and the ILO fundamental rights and include OTML's internal standards and procedures for managing worker health and safety and contractors.

The project is expected to create direct and indirect employment opportunities during construction and operation, including jobs with OTML, local contractors, and suppliers (see Section 11.1.3.2). Construction will require about 300 workers, and operations about 150 workers over the project life, with priority given to workers from project communities, the North Fly District and Western Province. The workforce will be mainly male, but the project also offers opportunities for women, especially if training, recruitment support, and skills development are provided.

Recruitment practices of OTML, contractors and suppliers have the potential to impact workers' rights, including the rights to just and favourable conditions of work; non-discrimination; freedom from child labour; freedom from slavery, servitude, forced or compulsory labour; right to freedom of association; and right to effective remedy. Given OTML's existing management framework relating to its employees and contractors, the third-party and supplier operations that are not directly controlled by OTML are more likely to have potential for impacts to workers' rights, particularly those that may involve use of vulnerable groups such as youth, migrant workers, and women.

Mitigation and management

Potential impacts on workers' rights will be primarily managed through OTML's existing internal standards and procedures relating to employment, work conditions and worker health and safety including:

- OTML's existing safety plan, safety management system based on ISO 45001 and the OTML Contractor Management Standard. The system is a prequalifying requirement prior to formal engagement of contractors (OTML 2024f).
- Contractor Selection and Management procedures, which requires contractors and suppliers to complete a pre-qualification assessment covering risk assessment, occupational health and safety, environmental management, quality management, and safety, health, environment, and community plans.
- Register of approved contractors and suppliers.
- Contractor Management Plans.
- Incident management and investigation processes to report, investigate, and address incidents and near misses, with corrective actions to prevent recurrent. The system includes emergency response, risk classification, and workforce rehabilitation and return to work, and is reviewed through audits and annual analysis of incidents and near misses.

Key additional measures to avoid, mitigate or manage the potential impacts on workers' rights specific to the project include:

- Develop incident response and emergency medical response plans to cover the project area and planned activities during both construction and operation.
- Develop a worker grievance mechanism that aligns with the UNGPs and require that contractors also provide a UNGP-aligned grievance mechanism for their employees.
- Provide appropriate grievance tracking, trend analysis, and escalation thresholds to identify systemic issues relating to workers' including specific tracking of any aspects related to workers' rights.
- Implement induction training and ongoing refresher training on non-discrimination, code of conduct, awareness and prevention of sexual harassment, worker grievance mechanism, whistleblower protections and workers' rights including awareness of servitude and debt-bondage.
- Implement strategies to build awareness and job-readiness in the local community for construction opportunities and adopt transparent approaches to recruitment for both direct employees contractors.

- Include clauses in contracts with suppliers and contractors prohibiting the use of child labour, and that require verification of workers' age.
- Undertake supplier human rights due diligence assessments including of child labour in the supply chain.
- Implement workforce scheduling for the construction and operation phase that provides for reasonable work hours and rest periods.
- Provide contract clauses in contracts with suppliers and contractors to specify reasonable work hours and rest periods aligned with legislation.
- Provide transparent wage payments in line with legislation and IFC PS2, with periodic reviews of payroll practices.
- Implement victim support and protection plans for instances of workplace harassment, discrimination or abuse.
- Conduct periodic assessments of contractors and suppliers of workforce rights and protections.
- Implement whistleblower policy and reporting mechanism accessible to workers.
- Conduct regular occupational health and safety inspections of workplaces, including contractors and suppliers.

Residual assessment of human rights impacts

The following assesses potential impacts on workers' rights, following the implementation of the mitigation and management measures. The assessment recognises that OTML has a stronger level of control and influence on its own workforce than its contractors and secondary contractors and suppliers.

Right to just and favourable conditions of work

OTML has a strong focus on workplace health and safety management. In 2023 and 2024, OTML recorded a total recordable injury frequency rate of 0.47 and 0.40 respectively, which was substantially lower than 2023 average reported by members of the International Council for Mining and Metals of 2.59 (ICMM 2024). Based on this, the residual risks to worker health and safety have been identified to apply primarily to contractors and subcontractors and suppliers.

The project workforce will comprise OTML employees and employees of contractors and subcontractors, particularly during the construction phase. Both the construction and operation phases of the project present inherent hazards that, if not properly managed, could pose health and safety risks to the employees of contractors and subcontractors, including the potential for injury, disability or fatality contributed to by the project.

With the implementation of the mitigation and measures the residual likelihood for a serious work-related injury or fatality to occur on the project in the contractor, or subcontractor workforce will be possible. The scope of the potential impact is limited as any incident is likely to impact a small number of individuals. However, the potential scale of harm (i.e., death or long-term disability) and the irremediability of the impact results in a severity of **moderate**. Consequently, the salience of the potential impact on the right to just and favourable conditions that is contributed to by the project is **medium**.

Right to rest, leisure and reasonable working hours

The right to rest, leisure, and reasonable working hours recognises that human dignity and wellbeing depend on protection from exploitation through excessive work. Workers' rights include daily and weekly rest periods, paid annual leave and limits on working hours and overtime.

The project's schedule and contracting arrangements have potential to create situations where workers' rights to adequate rest, leisure and reasonable working hours are adversely impacted for contractors and suppliers. OTML's employment contracts align with legislative requirements including the *Employment Act 1978* which

provides for limitations of work hours per day and week and provisions for annual and public holiday leave. Major contractors to the project are likely to also align with legislative requirements; however, OTML's subcontractors and suppliers may not have the same level of provisions in worker contracts. Additionally, project timeline pressure may create situations were double shifts and extended overtime is incentivised to meet contract expectations. It is **possible** that the right to rest, leisure and reasonable work hours for workers of contractors and suppliers to the project occurs. The severity of this impact is **minor** and likely to be readily remediable and affect discrete proportions of the workforce. Consequently, the salience of the potential impact that is *contributed* to by the project is **low**.

Reduced access to employment opportunities for workers at any stage of recruitment, hiring, pay, promotion, or dismissal due to discrimination based on sex, nepotism, or religion

Discrimination through employment considers two distinct but related impact pathways. Firstly, it is **possible** that the project may be **directly linked** to incidences of discrimination in access to employment opportunities by suppliers and contractors. Secondly, for workers employed directly employed on the project, it is **possible** that the project may **cause** incidences of discriminatory practices in recruitment and employment decisions. Across both pathways, discrimination may occur during recruitment, hiring, remuneration, promotion, or dismissal, including on the basis of sex, nepotism, or religion. Such impacts may disproportionately affect vulnerable or marginalised rights-holders, particularly women.

With the implementation of the mitigation and measures including worker grievance mechanisms, contractor management, training, regular review and tracking of grievance mechanisms and results the residual severity is expected to be **moderate** for supplier and contractor-related impacts and **minor** for direct project employment impacts. Consequently, the salience of the potential impact on the right to non-discrimination that is **contributed** to by the project for supplier and contractor-related impacts to rightsholders particularly vulnerable rights holders is **medium** and the salience of the potential impact on the right to non-discrimination that is caused by the project for direct OTML employee related impacts to rightsholders is **low**.

Harassment or abuse of women in the workplace by employees, suppliers and contractors

Traditional attitudes and cultural norms in PNG mean women often do not enjoy the same level of respect and protections as men. This culture can extend to the workplace, particularly where there are perceptions that women's role should remain solely to conducting domestic duties and child rearing and there is limited education and influences to counter these attitudes or protections and limited reporting or intervention for women when issues arise. With the implementation of the mitigation and management measures it is **unlikely** that women's right to safe and healthy work conditions and non-discrimination due to harassment or abuse of women in the workplace caused by OTML employees will occur. It is, however, **possible** that this may still occur among some contractors and suppliers. The severity of the potential impact is **moderate** in both scenarios, considering it will affect notable proportions of rightsholders, including a vulnerable group and that access to remedy will be available through the worker grievance mechanism. Consequently, the residual salience is **low** for the OTML workforce and **medium** for the contractor and supplier workforce.

Right to strike, collectively bargain, or unionise

OTML's contracts allow for the right to join unions and collectively bargain up to certain levels. There are limitations in contracts on workers' ability to strike which are in accordance with the PNG legislation. The provisions for workers of contractors and suppliers that may be used on the project are not known. It is **possible** that the project will be **directly linked** to contractors and/or subcontractors restricting workers the access to strike, collectively bargain, or unionise. With the implementation of mitigation and management measures it is likely that the main contractors used will make provisions for these rights and that a smaller number of contractors and suppliers may not. The potential impact to the rights of contractors and suppliers to strike, collectively bargain and unionise is of **minor** severity and the salience of the impact is **low**.

Freedom from child labour, including freedom from the worst forms of child labour

With mitigation and management measures in place including supplier screening, audits for child labour in the supply chain, and implementation of existing OTML policies and standards, it is **unlikely** that the project will be **directly linked** to the employment of people under the age of 18 years in hazardous work through contractors, subcontractors or suppliers. The severity of impact on the rights of children would be **moderate**, with potential for this to involve serious harm to a small number of minors. The residual salience of the impact to the rights of children is **low**.

Right not to be submitted to slavery, servitude, forced labour or compulsory labour

The project, particularly during the construction phase, will create direct and indirect employment opportunities with OTML and its business partners, contractors and suppliers. In-migrant labourers can become dependent on landowner companies for employment and general welfare, resulting in increased vulnerability to servitude or bonded labour. Experience elsewhere in PNG has demonstrated potential human rights impacts relating to forced or bonded labour among Papua New Guinean workers and migrants in the construction, mining and logging sectors; these issues are particularly associated with contractors from China, Malaysia and the Philippines (USDOS 2024b; BHRRC 2024).

Mitigation and management measures including OTML's Contractor Selection and Management requirements that require that its supply chain and subcontractors have a zero-tolerance approach to modern slavery and supplier human rights due diligence, are expected to reduce the likelihood of such impacts occurring. However, it is **possible** that forced labour could occur among Papua New Guinean workers and migrant workers employed by contractors and subcontractors to the project. The risk is likely to be greatest during construction, when demand for workers, contractors, and subcontractors is highest. Vulnerable workers, including those employed in lower tiers of the supply chain, may be most exposed to this impact. Forced labour conditions could include withholding of wages, debt bondage, lack of valid work permits, or absence of clear employment contracts. Access to remedy may be challenge due to workers' vulnerability and the limited capacity of labour inspection systems. As a result, the severity of the potential impact is **moderate**, and the residual salience of the potential impact is **medium**.