Panguna Mine Legacy Impact Assessment

Phase 1 Assessment Report
Chapter 12 – Human Rights Impact Assessment

Panguna Legacy Assessment Company Limited

Reference: 754-MELEN305719_R03

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12. INTRODUCTION

This chapter presents the human rights impact assessment for Phase 1. This is presented in nine sections:

- Section 12.1 Approach to this Human Rights Impact Assessment explains the approach to the human rights impact assessment and how it aligns with the United Nations' Guiding Principles on Business and Human Rights (UNGPs) (2011) and accepted human rights impact assessment methodology drawing on the phases outlined in the Danish Institute for Human Rights' Human Rights Impact Assessment Guidance and Toolbox.
- Section 12.2 Method gives an overview of the method for assessing the salience of identified human rights impacts.
- Section 12.3 Rightsholders and duty bearers describes the rightsholders identified as having adverse impacts to human rights and identifies the duty bearers.
- Section 12.4 Impacted human rights – an overview presents a summary of the human rights that have been assessed, including the source of the human rights, key concepts about how environmental impacts of the Panguna Mine affect human rights, and an overview of the current capacity of the state to protect these rights.
- Sections 12.5 to 12.8 assess the human rights impacts directly connected to the environmental impacts for each domain:
    - Section 12.5 Mine Domain covers the Mine Domain, and whether impacts affect people in Panguna Town, Moroni, In-Pit, Dapera, Pirurari, Onove, Guava and surrounding hamlets.
    - Section 12.6 River System Domain covers the River System Domain, and whether impacts affect people in Ioro 2, Baiaruai, Tengkona, Barako, Enamira, Tempiri, Gold Miners (UT), Jaba Pump Station, Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Derevai, Momau, Kirivia, Pem'ana, Kataul, Kobalu, Kuneka, Namunsa, Polamato, Wasikeuluma, Mokerokeroai, Moratona, Maile, and Moirue, and surrounding hamlets.
    - Section 12.7 Delta Domain covers the Delta Domain, and whether impacts affect people in Marau, Matoga, and surrounding hamlets.
    - Section 12.8 Port and Town Domain covers the Port and Town Domain, and whether impacts affect people in the Rorovana 1, 2 and 3, Loloho, Anewa Bay, Tunuru Mission, Sipusipu, Bikora, Pisinara, Pakia, Parakake, and surrounding hamlets.
- Section 12.9 Summary presents a summary of the human rights impact assessment.

12.1 APPROACH TO THIS HUMAN RIGHTS IMPACT ASSESSMENT

This human rights impact assessment has been conducted as a core component of the Legacy Impact Assessment. The whole assessment has been undertaken in a manner that respects human rights and is consistent with applicable international standards (see Chapter 3). The scope of this human rights impact assessment was established as part of the Primary Contractor Scope of Work developed by the Parties for the overall Legacy Impact Assessment.

This section outlines how the approach to this human rights impact assessment aligns with the UNGPs (UN 2011) and accepted human rights impact assessment methodology drawing on the phases (termed 'stages' for the purpose of this document to avoid confusion with the Legacy Impact Assessment phases) outlined in the Danish Institute's Human Rights Impact Assessment Guidance and Toolbox (Gotzmann et al., 2020). Not all stages of a typical human rights impact assessment process are within the scope of Phase 1 of the Legacy Impact Assessment.

12.1.1 Human rights impact assessment stage 1: Planning and scoping

The planning and scoping for the Legacy Impact Assessment including the human rights impact assessment had two main stages: establishing the overall scope of work; and detailed planning and scoping for Phase 1.

12.1.1.1 Establishing the overall scope of work and the governance structure

The Legacy Impact Assessment process has been established in response to and in the context of the Complaint (see Section 1.2) that was lodged by HRLC with the Australian National Contact Point (AusNCP) on behalf of 162 residents of villages in Bougainville. The Complaint draws on data obtained by HRLC between September 2019 and September 2021 during site visits to 38 villages near the Panguna Mine whereby 60 in-depth interviews were undertaken with residents. This was supplemented with further information in September 2022. Data obtained by the Catholic Diocese of Bougainville between 2017 and 2019, which included 300 interviews of mine-affected residents, was also used to inform the Complaint.

The parties to the Complaint, Rio Tinto Limited, and HRLC representing the complainants, developed the Primary Contractor Scope of Work for the Panguna Mine Legacy Impact Assessment (Rio Tinto and HRLC, 2022). This outlined the overall objective of the Legacy Impact Assessment, which is to:

Identify and assess the actual and potential environmental impacts caused by the Panguna Mine since the cessation of mining in 1989 and the social and human rights impacts that are directly connected to these environmental impacts and to develop recommendations for what needs to be remedied to address or mitigate these impacts.

The scope of work also establishes the study area and objectives for Phase 1 and 2 of the Legacy Impact Assessment. The focus of this report is Phase 1, the objectives of which are to (Rio Tinto and HRLC, 2022):

- Assess the acute actual and potential impacts posed to local communities and their environment by unstable infrastructure (open pit, waste rock repositories, tailings deposition area and levees) and erosion of mineral waste into the Jaba-Kawerong rivers and consequent mineral waste transport, deposition, and related flooding downstream.
- Assess water quality (via initial sampling), access and supply to determine issues with access to safe drinking water and sanitation for impacted communities.
- Characterise the social environment, including identifying affected and potentially affected communities and determining the location, size, and composition of potentially affected communities, as well as their water sources, livelihood activities, and other land use.
- Identify what impacts need to be mitigated or remedied based on the impact assessment; and recommend the types of analysis needed to determine options to mitigate or remediate the impacts.

The scope of work refers to applicable standards for the Legacy Impact Assessment process, which include the following:

- *ABG regulatory requirements.*
- *PNG regulatory requirements where applicable to Bougainville.*
- *Applicable international standards and best practice for environmental, social and human rights impact assessments, and specifically in accordance with the:*
    - The UN Guiding Principles on Business and Human Rights (UNGPs).
    - The OECD Guidelines for Multinational Enterprises.
    - International Finance Corporation (IFC) Performance Standards.
    - Other internationally recognised human rights standards including the Voluntary Principles on Security and Human Rights (VPSHR).

It also requires that the Primary Contractor *"acknowledge and respect human rights in accordance with the Universal Declaration of Human Rights and acknowledge and respect Indigenous peoples' rights and connection to lands and waters, consistent with the UN Declaration on the Rights of Indigenous Peoples."*

The parties to the Complaint established the governance structure for the Legacy Impact Assessment, described in Chapter 1 Introduction. Key elements of this include:

- **Panguna Legacy Assessment Company (PLAC),** a company established to fund the Legacy Impact Assessment. PLAC is funded by the Autonomous Bougainville Government (ABG), BCL and Rio Tinto Limited and is managed by three directors who are independent of the funding parties.
- **Oversight Committee,** a joint committee of stakeholders formed to oversee the Legacy Impact Assessment. This Oversight Committee was established by the Autonomous Bougainville Government (ABG) and the parties to the AusNCP process (Rio Tinto Limited, HRLC and the community members the HRLC represents). An Independent Facilitator chairs the Oversight Committee, which includes representatives from the Independent State of Papua New Guinea, BCL, and other landowners and community representatives. The Oversight Committee is entrusted with endorsing documents and actions to progress the Impact Assessment, for example:
  - Primary Contractor scope and tender process.
  - Endorse lists and options for Technical Sub-Committee and Secretariat selection.
  - Oversee Impact Assessment and pass information back to key stakeholders.
  - Review process reports and advise on gaps and concerns.
  - Approve key messages for release.
- **Technical Sub-Committee**, whose role is to provide support to the Oversight Committee on technical aspects of the assessment and to peer review the work of the primary contractor. The Technical Sub-Committee comprises five independent technical experts in human health, social and communities, human rights, environmental, geomorphology and geotechnical.
- **Independent Facilitator**, who is independent from ABG, the Papua New Guinean Government, Rio Tinto Limited and the Complainants, and whose role is to manage the Secretariat and chair the Oversight Committee.
- **Secretariat**, is an organisation supporting the Oversight Committee, Technical Sub-Committee, Independent Facilitator and Complaints Mechanism. The Secretariat provides independent culturally sensitive advice and recommendations, management, community engagement and logistical support. The Secretariat manages the independent Primary Contractor (Tetra Tech Coffey) and the Complaints Mechanism.
- **Primary Contractor**, following a tender process, Tetra Tech Coffey was selected as the Primary Contractor to prepare Phase 1 of the Legacy Impact Assessment in October 2022. Tetra Tech Coffey is contracted to the Panguna Legacy Assessment Company Limited.

12.1.1.2 Detailed planning and scoping for Phase 1 of the Legacy Impact Assessment

Following appointment as Primary Contractor, Tetra Tech Coffey conducted further planning and scoping for the Legacy Impact Assessment. This process was conducted in accordance with the scope of work and the execution framework that is set out in the scope of work (see Chapter 3). This planning and scoping stage involved:

- Establishment of a technical team of in-house and subconsultant personnel which included technical specialists in their respective fields, Bougainvilleans and Papua New Guineans.
- Establishment of an independent peer review panel of specialists in their respective fields to provide technical assurance and feedback throughout the impact assessment process.

- Desktop research and preparation of a preliminary conceptual site model that identifies the material environmental, social and human rights aspects to be investigated.
- Site reconnaissance visits to develop an understanding of the study area and meet key stakeholders.
- Two of the key technical investigations that informed the human rights impact assessment were the human health risk assessment (Appendix G) and the social and human rights characterisation (Appendix H). The social and human rights investigation were developed to collect indicators that are related to the potential social and human rights impacts that were identified during the scoping phase.
- Development of a stakeholder engagement plan (see Chapter 4) in consultation with the Secretariat to support meaningful, rights-respecting engagement of relevant stakeholder groups including rightsholders in Phase 1. The Oversight Committee had input to this through the Secretariat and provided valuable advice throughout Phase 1.

12.1.2 Human rights impact assessment stage 2: Data collection and baseline development

The Legacy Impact Assessment is an integrated assessment process involving investigation of environmental, social and human rights aspects. As a legacy impact assessment process, it is based on establishing a thorough characterisation of current conditions, rather than a pre-development baseline.

The social, health and human rights data were collected using quantitative and qualitative techniques in accordance with the detailed investigation plans. Engagement with rightsholders across the study area occurred as part of the field investigations. Two field campaigns were conducted for the social, health and human rights investigations. The field investigations were undertaken by social researchers from Tetra Tech Coffey with support from Bougainvillean enumerators employed by Tetra Tech Coffey and community facilitators employed by the Secretariat.

Further detail on the data collection and characterisation development is outlined in Chapter 6.

12.1.3 Human rights impact assessment stage 3: Analysing impacts

This human rights impact assessment is the final step in the integrated Legacy Impact Assessment process. The human rights impact assessment aligns with the UNGPs, with some important scope limitations:

- It is an assessment solely focused on the human rights impacts that are ‘directly connected’ (Box 12-1) to the environmental impacts of the Panguna Mine since the cessation of mining in 1989.
- It assesses the legacy impacts of the Panguna Mine and does not extend to a broader evaluation of a business enterprise. As such it does not consider the scope of impacts referred to in the UNGPs of impacts that are: ‘directly linked’, ‘caused by’, or ‘contributed to’ by a business enterprise.

The severity of human rights impacts is assessed with consideration of scope, scale and remediability and is in line with the UNGPs as described in Section 12.2. This allows for impacts to be addressed in order of the severity, noting that all human rights impact should be addressed (UN 2011).

The UNGPs (2011) language relating to the association of impacts (i.e., caused, contributed and directly linked) to a business enterprise as part of a human rights impact assessment process has not been adopted for this Legacy Impact Assessment. This is because in the context of this assessment there is no business enterprise that the human rights impact assessment is considering.

In this Legacy Impact Assessment, the term 'directly connected' refers to actual, potential and possible human rights impacts resulting straight (without intervening or intermediatory factors) from environmental impacts caused by the mine since the cessation of mining in 1989.

Box 12-1 Directly connected definition

12.1.4 Human rights impact assessment stage 4: Impact mitigation and management

The scope of Phase 1 of the Legacy Impact Assessment is to identify and analyse impacts and make recommendations as to what impacts require remedy or further investigation to address areas of uncertainty. The recommendations are outlined in Chapter 13.

Recommendations relating to impact mitigation and management are outside the scope of this report. The Oversight Committee and the Parties to the Complaint will consider the outcomes of this report along with feedback from rightsholders and relevant stakeholders in determining the next steps of the process.

12.1.5 Human rights impact assessment stage 5: Reporting and evaluation

Stakeholder engagement on the Legacy Impact Assessment has been a key focus as outlined in Chapter 4.

The draft results of Phase 1 of the Legacy Impact Assessment were presented to community rightsholders and other key stakeholders following the Oversight Committee's endorsement of the Draft Phase 1 Assessment Report (see Section 4.3.2.5). The engagement process involved a series of community presentations from 7 to 12 October 2024, in five locations accessible to people from each of the study area domains as identified by the Secretariat. The results were presented in Tok Pisin by the Tetra Tech Coffey team and focussed on the key impacts assessed for each domain. Feedback from rightsholders that attended the presentations was obtained through an open question and answer session at each presentation and through completion of feedback forms. The sessions were well attended, with attendee numbers ranging from approximately 100 to 400 people at each location.

Following completion of the final Phase 1 Assessment Report and receipt of approval from the Oversight Committee, a Phase 1 Impact Assessment summary report and summary brochure suitable for distribution to communities in Bougainville will be released. The summary report and summary brochure will be translated into Tok Pisin. During this stage, stakeholder engagement will focus on informing community members and other interested stakeholders on the availability of the summary brochure and where to access the document. This information will be disseminated through social media posts, as well as media releases.

Subsequent reporting and evaluation stages to Phase 1 have not yet been determined by the Parties to the Complaint.

12.2 METHOD

The human rights impact assessment method has been designed to achieve principles associated with participation, non-discrimination and equality, and transparency and accountability as described in the Social and Human Rights Characterisation (Chapter 6). Effective characterisation of the social and human rights environment provides the foundation for assessing actual and potential social and human rights impacts that are directly connected to the environmental impacts of the Panguna Mine since mining ceased in 1989.

The assessment of human rights is the final step in the integrated impact assessment process. The outcomes of both the environmental (Chapter 10) and social (Chapter 11) impact assessments were examined in this assessment to determine what human rights impacts are directly connected to actual or potential environmental impacts caused by the mine since 1989. The results of the environmental and social impact assessments assist in identifying the scale, scope and remediability of an impact. However, the human rights impact assessment does not adopt the significance ratings of these assessments, as the human rights impact assessment is concerned with impacts to human rights, rather than social and environmental impacts.

Where appropriate, the assessment has considered the availability, accessibility, acceptability, and quality of a resource (e.g., water) within the local context, to aid assessment of how the environmental impacts have in turn impacted and/or have the potential to impact on human rights.

Consistent with the approach in the social impact assessment (Chapter 11) a separate approach to presenting the risks to the right to health associated with mine-related contamination has been taken as described in Section 12.2.1.

The UNGPs (UN, 2011) guidance of assessing human rights impacts based on their severity was adopted. The severity was established through an assessment of an impact's scale, scope, and remediability (Section 12.2.2). The likelihood of impact was also assessed for each of the actual, potential and possible impacts that were identified (Section 12.2.3). Finally, the severity and likelihood of actual, potential and possible impacts were combined to produce a salience rating, assisting in the identification of the salient human rights impacts (Section 12.2.4).

Impacts to vulnerable rightsholders have been considered throughout the assessment as outlined in Section 12.2.5.

Given the preliminary nature of Phase 1, a number of uncertainties exist related to the human rights impact assessment. The approach to determining the level of uncertainty is outlined in Section12.2.6.

12.2.1 Actual, potential, and possible human rights impacts and possible risks to the right to health

This assessment considers actual, potential and possible human rights impacts and possible risks to the right to health that are directly connected to actual and potential environmental impacts of the Panguna Mine since 1989.

12.2.1.1 Actual impacts

An actual human rights impact is defined as an adverse impact to a human right that is directly connected to an actual environmental impact that has occurred, or persisted, since mining ceased in 1989 (i.e., an historic impact) or is currently occurring.

12.2.1.2 Potential impacts

A potential human rights impact is an adverse impact to a human right that is directly connected to an environmental impact that may occur in the future (e.g., pit wall failure) but has not yet done so.

12.2.1.3 Possible impacts

A possible human rights impact is a credible impact to a human right that could be directly connected to an actual environmental impact but there is insufficient information to determine if there is an actual impact or not. Given the preliminary nature of Phase 1 there are several impacts that have a high level of uncertainty and are classified as possible impacts.

12.2.1.4 Possible risks to the right to health

There is a separate categorisation for possible human health risks related to potential contaminant exposure that may impact on the right to health. This is consistent with the approach taken for the human health risks identified in the social impact assessment (Chapter 11), which in turn were based on the human health risk assessment (Chapter 6). The human health risk assessment is based on a Tier 1 screening assessment, which indicates whether a possible health risk related to potential contaminant exposure is evident or not and where further investigations are needed. A Tier 1 screening assessment is not able to determine if there is an actual or potential impact to human health. Exposure to contaminated food, water, or soil can pose a health risk but it does not mean that someone will develop a health condition. Consequently, and aligning with the approach in the social impact assessment (Section 11.1.1), human health (and risks to the right to human health) is presented based on the results of the human health risk assessment. It is not possible to assess the salience of these risks, as there is insufficient information to understand the severity (scale, scope of remediability) and likelihood of possible risks to the right to health.

12.2.2 Severity of human rights impacts

The severity of an impact is assessed based on:

- Scale: the gravity or seriousness of the impact.
- Scope: the area of affect and the population within it (to the extent known).
- Remediability: the ability to restore the human rights that have been impacted.

Table 12.1 shows the criteria used to define each of these components of severity for each human rights impact. The assessment of each component is used to develop an overall severity rating. Some guidance has placed greater emphasis on remediability in determining a severity approach (e.g., ICMM, 2023). For this assessment, the scale of the impact is weighted above that of remediability and the number of people affected because:

- Focusing on the scale of impacts places a greater emphasis on the consequences and seriousness of the impacts. This also draws on consultation and engagement with affected rightsholders.
- Phase 1 of the Legacy Impact Assessment aims to identify what needs to be remedied, but not how to remedy impacts. This human rights impact assessment provides an assessment of remediability reflecting the complexity of the drivers for some impacts and the general ability to restore the human right(s) that have been impacted, rather than delving into a detailed assessment of remediability.

Although the scale has been weighted, there is generally a strong relationship between scale and remediability: very serious impacts are often difficult or impossible to remediate. For example, an impact that causes death is rated as severe for both the scale of the impact and the remediability.

Table 12.1 Severity criteria

Level	Description		
	Scale *(the gravity of the impact on human rights)*	**Scope*** *(the area of affect and the population within it)*	**Remediability** *(the ability to restore the human rights that have been impacted)*
Severe	• Adverse health consequences that lead to an extreme reduction in quality of life or will cause death. • Impact to environmental attribute identified as essential to livelihoods, health, safety, or culture in the environmental, social and human health impact assessments. • Impact to environmental, cultural, economic, natural, and social infrastructure/assets that have been identified as very highly valuable by identified groups or subject matter experts in the environmental, social and human health impact assessments.	• The impact affects people across multiple domains. • Affects most people across the study area, and affects people across multiple domains (>50% of the study area population or over 15,720 people).	• It is not possible to restore the human rights that have been impacted.
Major	• Impact to environmental attribute identified as to contribute materially to livelihoods, health, safety, or culture in the environmental, social and human health impact assessments. • Impact to cultural, economic, natural, and social infrastructure/assets that have been identified as highly valued by identified groups or subject matter experts in the environmental, social and human health impact assessments.	• The impact is widespread across a domain. • Affects large proportion of people across a domain and beyond this area (>10% to <50% of the study area population, or between 3,151 and 15,720 people).	• Restoration of the human rights that have been impacted is likely to be difficult, complex, lengthy and/or an incomplete restoration.
Moderate	• Impact to environmental attribute identified as to contribute in a notable way to livelihoods, health, safety, or culture in the environmental, social and human health impact assessments. • Impact to cultural, economic, natural, and social infrastructure/assets that have been identified as valued by identified groups or subject matter experts in the environmental, social and human health impact assessments.	• Affects almost all people in a village or the majority of multiple villages. • Affects a notable proportion of people within a domain, but the effect is not experienced by the majority of a domain. (>1% to <10% of the study area population, or between 311 and 3,150 people).	• Restoration of the human rights that have been impacted is achievable with implementation of established good practices. • Restoration of the right is likely to be almost complete with no material difference expected.
Minor	• Impact to environmental attribute identified that contributes in a small way to livelihoods, health, safety, or culture in the environmental, social and human health impact assessments. • Impact to cultural, economic, natural, and social infrastructure/assets that have been identified to have some value by identified groups or subject matter experts in the environmental, social and human health impact assessments.	• Affects the majority of a village or parts of multiple villages or hamlets. • Affects discrete proportions of a domain (<0.2% to 1% of the study area population, or between 50 and 310 people).	• Restoration of the human rights that have been impacted is readily achievable with the implementation of standard practices. • Complete restoration of the right is likely.

Level	Description		
	Scale *(the gravity of the impact on human rights)*	**Scope*** *(the area of affect and the population within it)*	**Remediability** *(the ability to restore the human rights that have been impacted)*
Minimal	• Adverse health consequences that would lead to a limited reduction in quality of life or longevity. • Impact to environmental attribute identified that have limited contribution to livelihoods, health, safety, or culture in the environmental, social and human health impact assessments. • Impact to cultural, economic, natural, and social infrastructure/assets that have been identified as having limited value as identified by groups or subject matter experts in the environmental, social and human health impact assessments.	• Affects scattered residents, a hamlet, or a non-residential area that is regularly used by people. • Affects a small number of individuals (<0.2% of the study area population or less than 50 persons).	• Restoration of the human rights that have been impacted is readily achievable with simple, established practices.

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

* Based on estimated percentage of affected people in the Phase 1 Study Area, excluding Arawa, which is outside the scope of Phase 1.

12.2.3 Likelihood of human rights impacts

The criteria used to assess the likelihood of human rights impacts occurring is shown in Table 12.2.

Table 12.2 Likelihood criteria

Likelihood	Description
Almost certain/actual impact	The impact has occurred, is occurring, or is expected to occur and has frequently occurred before in similar circumstances[1].
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.
Remote	The impact is rare or practically impossible; it may occur in exceptional circumstances. The impact has very rarely if ever occurred.

1. Similar circumstances refer to environments or projects that have a similar setting or nature to Panguna (e.g., other mining operations in high rainfall environments or other projects in Papua New Guinea). Similarly, conclusions made regarding the condition and nature of impacts that similar locations may experience across the study area are drawn from the environmental and social impact assessment results.

For this human rights impact assessment, specific categories of human rights impacts have been defined (see Section 12.2.1), i.e., actual, potential and possible human rights impacts. These descriptors do not equate to the likelihood criteria category apart from the term ‘actual impact’ which is classified as almost certain on the likelihood scale. Potential impacts[1] and possible impacts have been assigned likelihood criteria based on the understanding of each respective potential and possible impact identified.

12.2.4 Salience of human rights impacts

The salience rating for each human right impact was determined by combining the severity and likelihood criteria (Table 12.3). The assessment matrix places a greater weight on the severity of an impact over the likelihood of it occurring (UN 2011; Gotzmann, Vanclay, and Seier 2016; ICMM 2023).

The purpose of the salience rating is to prioritise what impacts need to be remedied. This does not mean that impacts with a lower salience rating should not be addressed, as all human rights impacts should be addressed.

[1] Riverine and other hazards potentially relating to actual environmental impacts have been reported by the HRLC and communities to have resulted in past fatalities. However, it is beyond the scope of Phase 1 to investigate the number, nature and causes of past fatalities and whether these are related to the environmental impacts of the Panguna Mine. For this reason, impacts to the right to life are assessed as potential.

Table 12.3 Salience rating

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

12.2.5 Assessing human rights impacts on vulnerable rightsholders

Groups that are more vulnerable to the identified impacts are assessed separately, and the assessment of either the severity or likelihood of an impact is used to identify where:

- A group is more likely to experience an impact, or
- The scale or remediability of an impact is different for the identified group.

Where the impact on vulnerable groups would be the same as that experienced by the community as a whole, the assessment of vulnerable groups is not presented separately.

The assessment of rightsholders affected by a particular impact has been based on the outcomes of population modelling undertaken for Social Characterisation (Chapter 6). This incorporates geospatial analysis of structures identified on high-resolution aerial imagery and average household size identified in the sub-domains. Small area population estimates have a high degree of uncertainty, and are used to provide an indication of the possible population at risk for assessment purposes.

12.2.6 Uncertainty

An uncertainty ranking has been provided for each impact rating. The ranking considers the level of information used to assess the impact (including information used to understand the environmental impacts that the human rights impact relates to and the social and human rights data) and the generally high level of uncertainty regarding the remediability of identified human rights impacts. The key drivers for uncertainty in the human rights impact assessment are the same as those for the social impact assessment and are described in Section 11.7.

The level of uncertainty associated with each of the human rights impacts assessed has been assigned as high, medium or low:

- High – additional relevant information is needed to adequately assess the impact.
- Medium – there is some information available but additional information is required to assess the impact.
- Low – there is adequate information and evidence to assess the impact.

The uncertainty rating does not affect the assessment of salience. Where impacts have been identified and there is a high degree of uncertainty, additional investigations have been identified in Chapter 13.

12.3 RIGHTSHOLDERS AND DUTY BEARERS

12.3.1 Rightsholders

The potentially affected rightsholders in this Legacy Impact Assessment are primarily those living within the study area. In addition, the 'customary groups' rightsholders include people who have customary rights and connections to land within the study area but are not currently living there. The different categories of identified rightsholders that are relevant to this assessment are as follows:

- Communities, which includes people living within the towns, villages, hamlets and isolated residences in each domain as follows:
  - **Mine Domain**: Panguna Town, Moroni, In-Pit, Dapera, Pirurari, Onove, Guava and surrounding hamlets.
  - **River System Domain**: Ioro 2, Baiaruai, Tengkona, Enamira, Barako, Tempiri, Gold Miners (UT), Jaba Pump Station, Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Derevai, Momau, Kirivia, Pem'ana, Kataul, Kobalu, Kuneka, Namunsa, Polamato, Wasikeuluma, Mokerokeroai, Moratona, Maile, and Moirue, and surrounding hamlets.
  - **Delta Domain**: Marau, Matoga, and surrounding hamlets.
  - **Port and Town Domain**: Rorovana 1, 2 and 3, Loloho, Anewa Bay, Tunuru Mission, Sipusipu, Bikora, Pisinara, Pakia, Parakake, and surrounding hamlets.
- Women.
- Children.
- Physically vulnerable groups, such as young children, the elderly and persons with a disability.
- ASM workers.
- Loloho Port workers.
- Customary groups (including people no longer living in the study area).
- In-migrants and leaseholders.

12.3.2 Duty bearers

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 and are required to respect, protect and fulfil the human rights of individuals within their territory (UN 2011). This includes ensuring that laws, policies, and practices align with human rights standards.

Business enterprises are also duty bearers and responsible for respecting human rights wherever they operate (UN 2011). This human rights impact assessment is not conducted based on a particular business enterprise's operations. It is focussed on actual and potential human rights impacts that are directly connected to environmental impacts of the Panguna Mine that have persisted or occurred since 1989 and does not identify business enterprises as duty bearers.

12.4 IMPACTED HUMAN RIGHTS – AN OVERVIEW

The UNGPs (UN 2011) specify that a human rights impact assessment should consider at a minimum those rights expressed in the International Bill of Human Rights[2] and the fundamental rights set out in the International Labour Organization's Declaration on Fundamental Principles and Rights at Work[3]. The practice of human rights impact assessment has since expanded to incorporate the rights established within:

- The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (UN 2007).
- The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (UN 1993).
- The Convention of the Rights of the Child (CRC) (UN 1989).
- ILO 169, the Indigenous and Tribal Peoples Convention (ILO 1989), the primary binding international convention concerning Indigenous Peoples.

This human rights impact assessment only assesses human rights impacts directly connected to an environmental impact of the Panguna Mine since mining ceased in 1989. In particular, as there is no operating mine or business entity, the fundamental labour conventions set out by the ILO are out of scope.

Figure 12.1 summarises the connection between environmental, social and human rights impacts, and identifies:

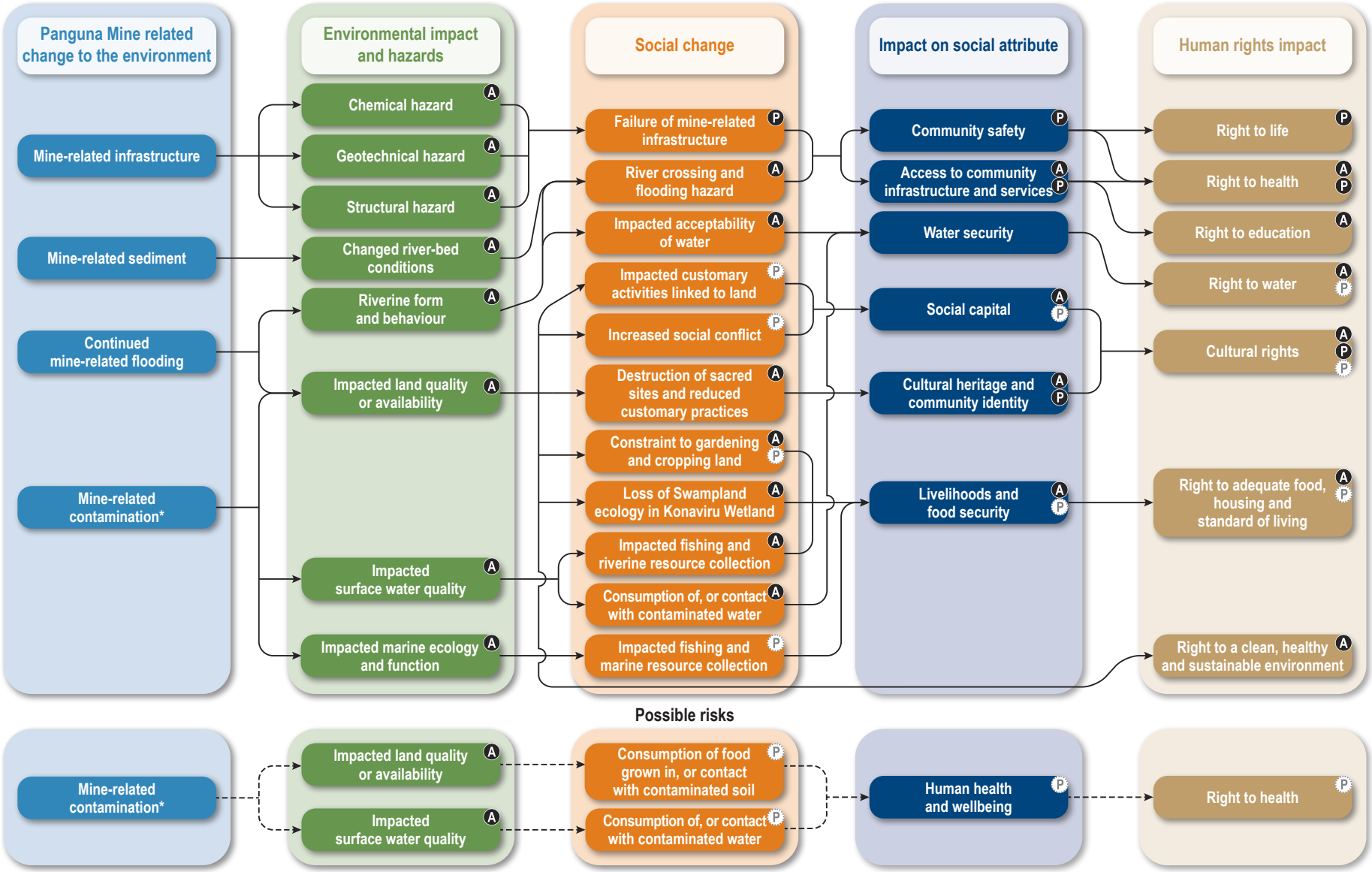
- The Panguna Mine related change to the environment, drawn from the environmental impact assessment (Chapter 10), the Structural Hazard assessment (Section 5.4) or Geotechnical Hazard assessment (Section 5.1.3).
- The environmental impact that has occurred or has the potential to occur as a result of these changes.
- The social change that has or has the potential to occur as a result of the environmental impact.
- The actual, potential or possible impact on the social attribute that contributes to social wellbeing.
- The actual, potential or possible human rights impact.

Based on this analysis, the environmental impacts of the Panguna Mine since 1989 have had or may affect the following human rights:

- Right to life
- Right to health
- Right to adequate food, housing, and standard of living
- Right to water
- Right to education
- Cultural rights
- Right to a clean, healthy and sustainable environment.

The rights of specific groups such as women and children are discussed as relevant for each of the human rights above. Indigenous rights intersect with all of the above human rights and this assessment recognises that Bougainvilleans are the Indigenous people of Bougainville.

[2] The International Bill of Human Rights consists of the *Universal Declaration of Human Rights* (UNDHR) (United Nations, 1948), the *International Covenant on Economic, Social and Cultural Rights* (ICESCR) (United Nations 1976b), and the *International Covenant on Civil and Political Rights* (ICCPR) (United Nations 1976a).
[3] The eight fundamental conventions include: ILO Convention 87, also known as the *Freedom of Association and Protection of the Right to Organise Convention* (ILO 1948), ILO Convention 29, also known as the *Forced Labour Convention* (ILO 1957), ILO Convention 138, also known as the *Minimum Age Convention* (ILO 1973), ILO Convention 182, also known as the *Worst Forms of Child Labour Convention* (ILO 1999), ILO Convention 100, also known as the *Equal Remuneration Convention* (ILO 1951), ILO Convention 111, also known as the *Discrimination (Employment and Occupation) Convention* (ILO 1958).



NOTE
*Mine-related contamination includes mineralised and non-mineralised contamination

SOURCE
Tetra Tech Coffey, 2024

LEGEND

- (A) Actual impacts
- (P) Potential impacts
- (P) Possible impacts / risks

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.1

Connections between environmental impacts, social impacts and human rights impacts

TETRA TECH COFFEY

DATE: 01.11.24 PROJECT: 754-MELEN305719 FILE: 305719_R03_F12.01_GRA

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This section provides an overview of these human rights impacts through:

- Identifying the source of human rights from international human rights instruments.
- Summarising key concepts about how environmental impacts affect human rights.
- An overview of the current capacity of the state to protect these rights. This contextual information is relied on in later parts of the assessment, as these broader factors contribute to human rights risk (Equator Principles Association 2020).

PNG has ratified many human rights treaties (e.g., CEDAW, IESCR, CERD) and provides human rights recognition and protection through its regulatory framework. This human rights impact assessment focuses on the capacity to protect the rights from the perspective of rightsholders in the study area and does not articulate the various legislative and regulatory provisions encompassing these rights aspects. In general terms, the PNG regulatory framework for the protection of rights in PNG is relatively robust. However, the on-ground capacity to protect the rights and allow enjoyment of the rights is very limited.

12.4.1 Right to life

The right to life is a fundamental right, which is 'a prerequisite for the enjoyment of all other rights and the content of which can be informed by other human rights' (OHCHR 2019). The right to life 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.

12.4.1.1 Relevant international human rights instruments

The protection of the right to life is recognised in:

- **UD article 3:** the right to life is recognised as a fundamental human right
- **CP article 6:** as the inherent right to life for every human being
- **CRC article 6:** as a child's inherent right to life
- **UNDRIP article 7:** Indigenous individuals have the rights to life.

12.4.1.2 How environmental impacts can affect the right

The right to life entitles rightsholders to a life free from acts and hazards that may result in their unnatural or premature death. This includes conditions that may give rise to direct threats to life that have been identified in this assessment, such as:

- Hazards related to mine-related infrastructure and chemicals that remain in the environment.
- Hazards relating to riverine conditions, particularly for people who have to cross rivers on foot.
- Potential hazards associated with the failure of large-scale mine infrastructure (e.g., roads, levee, the open pit wall).

Chemical hazards can have both acute and chronic effects. Acute effects, like explosions, are sudden and severe. Similarly, exposure to some chemicals may result in skin blistering, or even fatality if inhaled. These acute effects are addressed within the community safety and hazards category. Chronic health effects from mine-related chemicals and other contaminants are assessed within the right to health (Section 12.4.2).

12.4.1.3 Current context regarding protection of the right

The state has a responsibility to protect the right to life (OHCHR 2019). Specifically:

- Protect by safeguarding the right to life from violations, for example, through laws and regulations.

- To advance the right to life, states should develop appropriate supportive services, such as health care emergency health services, and emergency response services (e.g., firefighter, ambulance services, and police forces).

As noted in the Social Characterisation (Chapter 6) there is limited capacity to respond to emergency situations caused by a hazard event in the study area, reflecting broader constraints in service capacity in Bougainville and Papua New Guinea. There are no formal emergency response services in the study area: there is no fire brigade, and the Arawa Hospital does not have an ambulance. Typically, community members act as 'first responders', sometimes aided by health and police services, depending on access and staff availability. However, health and police services are also constrained by staff and equipment shortages. In essence, there is limited capacity to protect or advance the right to life from hazards in the study area.

12.4.1.4 The right to life and interrelated rights

The right to life is fundamental to the enjoyment of other human rights including but not limited to the right to health; adequate food, housing and standard of living; and a clean and healthy environment. Extreme violations of other human rights can result in violations of the right to life: examples of this include death from the lack of clean drinking water, or from lack of adequate food. The right to life is impacted where the right to health is not protected, especially for vulnerable groups such as pregnant women, children, elderly and people living with disabilities (OHCHR 2019).

12.4.2 Right to health

Enjoyment of the highest standards of physical and mental health means that people can attain the best possible health available to them. This means not just treating and preventing disease or illness, but encompasses access to food, water, a healthy environment and also considers gender equality in health treatment. Women are recognised to have additional rights in the context of their sexual and reproductive health rights.

Rights bearers are entitled to protection of their health including equal and timely access to basic health services and medicines, treatment and control of diseases and health related education. For women, this also means rights to maternal health services (CESCR 2000). The right to health does not guarantee that a person is healthy (CESCR 2000).

12.4.2.1 Relevant international human rights instruments

The right to health is detailed in:

- **UD article 25 (1)**: as part of a standard of living adequate for health and wellbeing.
- **IESC article 12**: described as enjoyment of the highest attainable standard of physical and mental health.
- **CEDAW article 12, 14:** as access to healthcare free from discrimination and access to healthcare for rural women.
- **CRC article 24 (2):** as the enjoyment of the highest attainable standard of health.
- **UNDRIP article 24 (2):** as the enjoyment of the highest attainable standard of physical and mental health.
- **CRPD article 25:** recognises the right to the enjoyment of the highest attainable standard of health available to people with disabilities, ensuring that services are of the same standard for people living disabilities.
- **CERD article 5:** as the enjoyment of public health services free from discrimination on the basis of race.

12.4.2.2 How environmental impacts can affect the right

This assessment considers environmental impacts that prevent people from attaining the highest standard of health available to them, through changes in access to healthcare associated with actual and potential mine-related hazards, such as flooding, or potential large-scale geotechnical failures of mine infrastructure. Exposure to mine-related mineralised and non-mineralised contamination in water, soil, or transferred through soil to food present a potential risk to human health.

As detailed in Section 12.2.1, the human health risk assessment collected samples of water, soil, and food and analysed these to identify where there was an exceedance of contaminants that can pose a health risk. The information collected at this stage is not sufficient to understand whether there has been an impact to the right to health. Rather, these results indicate where there is a risk to the right to health in the environment directly connected to the Panguna Mine, and where further investigations would better understand this. These have been presented separately.

12.4.2.3 Current context regarding protection of the right

States are obligated to protect and fulfil the right to health. Protecting is done by safeguarding through laws and regulations. States fulfil the right to health by providing health-related services, such as health centres and hospitals, and also addressing broader matters that contribute to health, such as providing access to clean water.

States have an obligation to move towards fulfilling the right to health despite the limitations of the local context, using the resources available to them to provide services as possible (OHCHR and WHO 2008).

There are limited health facilities in the study area: one hospital level facility in Arawa, and two health centres: Panguna Town and Moratona. Distance was reported as a barrier to accessing health services across the domains. Travel time to a health facility was reported at between half an hour to three hours, increasing for those travelling from further west in the study area. When people are able to access these services, the quality of service may be limited. Health services lack resources and staff and are not well equipped to provide suitable services.

12.4.2.4 The right to health and interrelated rights

The right to health depends on and contributes to protecting and fulfilling other fundamental human rights. These include but are not limited to the right to: water; adequate food, housing and a standard of living; education; and a clean and healthy environment. A healthy person can participate in and enjoy other human rights, such as the right to an education. If a person is not physically healthy, it impedes their enjoyment of other rights. The right to health depends on the right to a clean, healthy and sustainable environment, where degradation of the natural environment can have adverse outcomes for human health (UNDP 2023). This is demonstrated in the violation of the right to water, where consumption of unclean water has adverse health risks for human health, risking the violation of the right to health and life (OHCHR and WHO 2008).

12.4.3 Right to adequate food, housing and standard of living

The right to an adequate standard of living is a fundamental right expressing the basic needs and services that contribute to human wellbeing. It includes the right to food, clothing, and housing, as well as other fundamental human rights that contribute to the overall standard of living, including water and sanitation. Two components of this right are addressed in this assessment: the right to food; and the right to an adequate standard of living and continuous improvement of living conditions.

The right to food is an inclusive right, incorporating physical and economic access to adequate food or the means for its procurement. More specifically, the right to food entails that food must be (OHCHR 2010c):

- Available from natural resources or for sale in markets and shops.
- Accessible both physically and economically. Economic access is primarily defined in terms of affordability.
- Adequate, in that food must satisfy dietary needs.

The right to an adequate standard of living implies that people have a right to develop and pursue the means to maintain and improve their living conditions. In many contexts, this is achieved through the related right to work, or the right to social security. In this context, the term livelihood is more appropriate, which includes a range of strategies that are adopted to pursue an adequate standard of living, which includes but is not limited to agricultural pursuits, such as cash cropping and subsistence gardening, collection of bush resources, and employment in the formal and informal sector.

12.4.3.1 Relevant international human rights instruments

The right to adequate food, housing and standard of living is detailed in:

- **UD article 25:** Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.
- **IESC article 11:** as the right to an adequate standard of living and continuous improvement of living conditions.
- **CEDAW article 14:** as part of enjoyment of adequate living conditions for rural women in elimination of discrimination against women.
- **CRC article 27:** recognises the right of every child to a standard of living adequate for their physical, mental, spiritual, moral and social development.
- **UNDRIP article 21 (1):** as the right to improvement of housing, health, sanitation, and social security contributing Indigenous people's economic and social conditions.

The right to adequate food is also detailed in:

- **CEDAW article 12:** as part of nutrition during pregnancy and lactation.
- **CRC article 24 (c):** the right to food to combat disease and malnutrition is recognised as part of a child's enjoyment of the highest attainable standard of health.
- **UNDRIP article 29 (1)** as the right to conservation and production capacity of lands or territories and resources.

12.4.3.2 How environmental impacts can affect the right

This assessment considers environmental impacts that may adversely affect the right to adequate food, housing, and standard of living, through:

- Mine-related contamination affecting the productivity of soil.
- Changes in flooding regimes affecting the availability and access of land for gardening or cash cropping, which supports rightsholders' standard of living.
- Changes in riverine behaviour affecting areas that are used for bush collection.

12.4.3.3 Current context regarding protection of the right

States are responsible for protecting and fulfilling the right to adequate food, housing and standard of living. Protecting is done by safeguarding through laws and regulations. Fulfilling the right means creating supportive conditions for adequate food, housing and standard of living. In the case of adequate food, this means supporting and strengthening their people's capacity to obtain food, and in the case where they cannot provide food for themselves, the state provides food, an example of which may be in a natural disaster event.

The responsibility of the state regarding the right to adequate food is primarily concerned with providing an enabling environment for people to produce or procure food. In this context, most food is grown locally by each household or sourced from local markets.

Communities across the study area rely on productive land to grow food to eat and grow surplus to sell to make an income. As described in the Social Characterisation Report (Appendix H), food security is an issue across the study area, with between 40% and 67% of household survey respondents expressing concern about having enough food to eat in the 12 months prior to field investigations in 2023.

Similarly, and as noted above, people in the study area improve their standard of living through a range of strategies, including, but not limited to, cash cropping and subsistence gardening, collection of bush resources, ASM, and employment in the formal and informal sector.

12.4.3.4 The right to adequate food, housing and standard of living and interrelated rights

The right to adequate food, housing and standard of living is related to several other rights including but not limited to the right to health, water and the right to life. The right to food is integral to the right to health: inadequate nutrition results in malnutrition for people who do not have access to adequate food sources. Where families cannot get sufficient food, the right to education may be at risk where children must forgo school to work to support family incomes. Access to adequate housing with appropriate basic facilities including safe water and sanitation is integral to health outcomes. This can be detrimental to the rights of women, who generally bear greater domestic responsibilities in many contexts (OHCHR 2010a).

12.4.4 Right to water

Water is indispensable to human health and life. Everyone has the right to access a sufficient amount of water for personal and domestic uses, including for drinking and preparing food, washing clothes and other household items. The right to water entails access to sufficient, safe drinking water that is free from microbes and parasites and chemical substances that may pose a threat to a person's health. Water must also be acceptable aesthetically, in terms of colour, odour and taste. Water and sanitation facilities must also be accessible, which is generally having a facility in walking distance of people's home (OHCHR 2010b).

12.4.4.1 Relevant international human rights instruments

The right to water is recognised in:

- **UD article 25 (1)**: as part of a standard of living adequate for health and wellbeing.
- **IESC article 11** addresses the right to an adequate standard of living. While the right to water is not explicit in the IESC, the Committee on Economic, Social and Cultural Rights has since stated that the right to water is a part of the right to an adequate standard of living (OHCHR, 2010b).
- **CP article 6:** as part of the inherent right to life and to not be arbitrarily deprived of life.
- **CEDAW article 14 (2):** access to adequate water supply is recognised as integral to adequate living conditions for rural women in eliminating discrimination against women.

- **CRC articles 24 and 27 (3):** access to water is understood as integral to the enjoyment of the highest attainable standard of health and adequate standard of living.
- **UNDRIP articles 21, 25 and 32 (2):** water is protected as part of Indigenous people's health and in the traditional relationships with water bodies.
- **CRPD article 28:** adequate standard of living including access to clean water services.

12.4.4.2 How environmental impacts can affect the right

This assessment considers mine-related environmental impacts such as mine-related contamination or flooding that impact access to water, or the quality of water sources.

12.4.4.3 Current context regarding protection of the right

The state is responsible for protecting and fulfilling the right to water through taking measures that realise and promote the right to water for their people. This includes, to the extent allowed by their resources, extending water and sanitation services to all people, providing water and sanitation education, and protecting water sources (OHCHR, 2010b).

As described in the Social Characterisation (Chapter 6), aside from Arawa, the state has limited involvement in water provision. Communities rely on a number of drinking water sources depending on their geographic location, and the sources differ depending on the season. Although some communities have piped water, this water is piped from nearby sources, such as springs, streams or communal tanks. This is consistent with drinking water sources reported for Bougainville with the most common identified as water tanks (32%), river water (20%), creek water (14%) and spring water (11%) (GoPNG and ABG 2021). In many instances, communities have worked together to purchase and develop piped systems to their home. In addition, some water infrastructure (e.g., rainwater tanks) have been established with the assistance of aid programs. Similarly, sanitation facilities are limited, and unimproved sanitation conditions dominate. Contextually, the state has limited capacity to provide water and sanitation services, and testing of communal and natural resources is limited.

12.4.4.4 The right to water and interrelated rights

The right to water is a precondition for other interrelated human rights. The most extreme example of this is the need for adequate drinking water to prevent death from dehydration, protecting the right to life. The lack of adequate water also has repercussions for the right to adequate food, for use in cooking, and the right to health, where people become unwell from consuming unclean water. The right to education is also impacted by the right to water in contexts where school facilities do not have sufficient water supply for drinking or sanitation for children to attend school. It is integral to gender equality in contexts where women and children are responsible for collecting water (OHCHR 2010b).

12.4.5 Right to education

The right to education recognises education as a fundamental right for human development and in realising other human rights. The right to education is recognised as fundamental in safeguarding women and children from exploitation and in combating inequality and poverty. It requires positive action on the part of states to develop systems that enable the right to education. Access to free primary education is considered compulsory. States should work towards access to secondary and higher education, preferencing free education but making it available on merit (OHCHR, 1999a).

12.4.5.1 Relevant international human rights instruments

The right to education is recognised in:

- **UD article 26:** stating the right of everyone to an education.
- **IESC article 13:** describing the right of everyone to education in human development and the right to free and compulsory primary education and available and accessible secondary and higher education.
- **CEDAW article 10**: for equal rights for women in accessing and having the same opportunities for education.
- **CRC article 28**: as the right of the child to education.
- **UNDRIP article 13**: as the right of all individuals, particularly children, to have the right to all levels of education without discrimination and for people to have access to an education in their own culture and language.
- **CRPD article 24:** recognising the right of people with disabilities to education.
- **CERD article 5:** as the right to education free from discrimination on the basis of race.

12.4.5.2 How environmental impacts can affect the right

This assessment considers environmental impacts that prevent people from attaining the highest standard of education available to them, such as through changes in access to education associated with actual and potential mine-related hazards, such as flooding, or potential large-scale geotechnical failures of mine infrastructure.

12.4.5.3 Current context regarding protection of the right

The state has the responsibility to protect and fulfil the right to education by providing accessible, affordable, and quality education services.

Elementary and primary schools used by households in the study area are in Rorovana 2, Arawa, Panguna, Dapera, Oune, Ioro 2, Jaba Pump Station, Kuneka, and Koiare (Chapter 3). Children in other communities are required to travel between one and two hours on average to access primary school. Like Bougainville and Papua New Guinea more generally, schools in the study area are often under resourced and lack basic facilities (Goro 2023).

There are two secondary schools that service the study area, which are located in Arawa and Bana.

12.4.5.4 The right to education and interrelated rights

The right to education is a right in of itself but is also regarded as a precursor to other rights. Essentially, education empowers people to understand and enjoy other human rights. Lack of education, for example, can mean that rightsholders do not have the information necessary to protect their health rights. Education is also critical concerning the rights of Indigenous peoples to protect their cultural rights. As mentioned above, the right to water is critical to the right to education, as water and sanitation facilities are critical for children's health when attending school.

The right to education is considered integral to understanding other rights and protecting vulnerable people including women and children in contexts of poverty and exploitation (OHCHR, 1999b).

12.4.6 Cultural rights

Cultural rights recognise and protect human experience and expression through language, art, customs, religion and beliefs. The right to cultural participation recognises the importance of individuals and groups identifying and relating to people of their own culture without fear of persecution or discrimination. Cultural rights also recognise the importance of land, territories and other natural resources for Indigenous people in practising their culture.

12.4.6.1 Relevant international human rights instruments

Cultural rights are recognised in:

- **UD article 27 (1):** recognised as free participation in cultural life of the community.
- **CP article 1 (1)**: as part of the right of self-determination to pursue economic, social and cultural development and **article 27**: enjoy culture in community with other members of their group. Specifically, as an ethnic, religious or linguistic minority group.
- **CEDAW:** articulating the rights for women to be free from discrimination, expressed explicitly in **article 13 (c):** as the right to eliminate discrimination for women's participation in cultural life.
- **CRC articles 29, 30 and 31**: as part of a child's right to identity and participation in cultural life.
- **UNDRIP:** cultural and customary rights are at the core of rights for Indigenous peoples, and are interwoven in the provisions of UNDRIP to protect the right to participate in cultural life. Those most relevant in the context of the Legacy Impact Assessment are:
    - Article 11: to practice and revitalise cultural traditions and customs including maintain and protecting sites, and to access effective state redress for cultural property taken without free, prior and informed consent.
    - Article 12: to practice, develop and teach traditions, customs and ceremonies and have access to religious and cultural sites.
    - Article 26: the right to the lands, territories and resources that they have traditionally owned and to develop and control them.
- **CRPD article 30:** to not be discriminated in participating in cultural life on the basis of disabilities.
- **CERD article 5:** as the right to participate in cultural life free from discrimination on the basis of race.
- **ILO 169 article 14:** The rights of Indigenous peoples to their traditional lands, territories and resources. Indigenous peoples have the right to ownership of their ancestral lands, the right recognises that adequate procedures should be established to resolve land claims by Indigenous peoples.

12.4.6.2 How environmental impacts can affect the right

Cultural rights relate to a broad range of issues. For this assessment, the focus is on cultural rights that may be affected by changes in the environment, including land and water. As detailed in the Social Characterisation (Chapter 6), land is central to Bougainvillean culture, and customary practices are strongly linked to land. Similarly, traditional subsistence practices, including gardening, fishing, and hunting, have strong customary components.

Changes to these may affect:

- The rights of individuals and groups to participate, or not to participate, in the cultural life of their choice and to conduct their own cultural practices (OHCHR no date).
- The right of access to, and enjoyment of, cultural heritage (OHCHR 2011).

- The rights of Indigenous peoples to their traditional lands, territories and resources. Indigenous peoples have the right to ownership of their ancestral lands, the right recognises that adequate procedures should be established to resolve land claims by Indigenous peoples (ILO 1989).

12.4.6.3 Current context regarding protection of the right

The state has a responsibility to protect and fulfil this right. Specifically:

- Protect cultural heritage and safeguarding historical sites and cultural practices, for example through enacting laws that protect cultural heritage.
- Fulfil the right to cultural participation through supporting and empowering people to participate in cultural activities, education, and expression.
- Enacting laws and providing for land titling for Indigenous peoples.

Papua New Guineans, and Bougainvilleans, have maintained a range of cultural practices, and their culture, language, and cultural practices and the 'majority' culture. The Papua New Guinea National Museum and Art Gallery oversees archaeological research and cultural heritage management in the country, with a few exceptions such as World Heritage. There is a disparity in the funding and resources dedicated to this work and the PNG National Museum is noted to be under-resourced (Denham 2013).

Customary ownership of land is recognised by PNG law, and approximately 97% of the total land area in PNG is held under customary law (Yala 2019). Despite this, the on the ground capacity of people to secure title is challenging, from a range of factors including long delays in the execution of contracts, and lengthy land registration processes (Na, 2022).

12.4.6.4 Cultural rights and interrelated rights

Cultural rights are relevant in considering the historic and ongoing violations of human rights of Indigenous peoples and are integral to the freedom to enjoy all human rights. Cultural rights recognise an individual's ability to participate in and contribute to expressions of their culture including but not limited to customary and spiritual practices, language, knowledge and arts (UN, 2010). Cultural rights are interrelated with other human rights including but not limited to the right to health, education and right to clean and healthy environment. In the context of Indigenous peoples, land is integral to customary and spiritual practices. Degradation of the environment can violate both the right to a clean, healthy and sustainable environment and cultural rights. An example is the destruction of traditional lands and territories that may be used to carry out customary practices. When these are degraded, the practices tied to them can be lost (UNDP, 2023).

12.4.7 Right to a clean, healthy and sustainable environment

The right to a clean, healthy and sustainable environment recognises that human rights and the environment are interdependent, and that a clean, healthy, and sustainable environment is necessary for the enjoyment of a range of other human rights, including the right to life, health, and adequate food, housing and a standard of living (OHCHR 2023). While there is not a universally agreed definition, the OHCHR (2023) states that the right to a clean and health environment generally includes:

- A safe climate
- Clean air
- Healthy ecosystems and biodiversity
- Safe and sufficient water
- Healthy and sustainable food
- Nontoxic environment

- Access to information on environmental matters
- Public participation
- Access to effective remedies.

12.4.7.1 Relevant international human rights instruments

The right to a clean, healthy and sustainable environment is detailed in:

- **IESC article 12:** as the improvement of all aspects of environmental and industrial hygiene contributing to the highest attainable standard of physical and mental health.
- **CRC article 24 (2):** considering the risks of environmental pollution as part of the right of the child to enjoyment of the highest attainable standard of health.
- **UNDRIP articles 29 and 32:** as the right to conservation and protection of the environment, lands and resources and state provision of effective mechanisms and redress to mitigate adverse environmental impact.

12.4.7.2 How environmental impacts can affect the right

This right recognises environmental health as integral to human health and wellbeing and is interdependent with other rights including the right to water and the right to health. In the context of this assessment, the right to a clean, healthy and sustainable environment considers mine-related impacts to the environment which in turn have an adverse impact on human rights.

12.4.7.3 Current context regarding protection of the right

As with other rights, although there may be regulatory, policy and legislative protections for rights, there is limited capacity to identify, analyse, and communicate the current state of the environment and whether this has been affected by the Panguna Mine since mining ceased in 1989.

12.4.7.4 The right to a clean, healthy and sustainable environment and interrelated rights

The right to a clean, healthy and sustainable environment acknowledges the interrelated nature of human rights in sustaining human and ecological life. It is closely related to rights including but not limited to the rights to water, adequate food, housing and a standard of living, health, cultural rights, and life. Safe and sufficient water is generally included in this right, for example, protecting water sources from pollution and degradation protects the environment. Cultural rights are also relevant in that protecting the traditional lands, resources and territories that are integral to the customs of Indigenous people is important for their survival. The right to a clean, healthy and sustainable environment also acknowledges vulnerable groups and their rights in facing environmental degradation including women, children, Indigenous peoples, the elderly and people with disabilities (UNDP 2023).

12.4.8 Summary

This assessment identifies where the environmental impacts of the Panguna Mine since 1989 have or may affect the above identified rights in each domain in the study area. Based on the outcomes of the environmental and social impact assessment (Chapter 10 and Chapter 11), the Panguna Mine has or may affect the right to life, the right to health, the right to an adequate food, housing and standard of living, the righty to education, cultural rights, and the right to a clean, healthy and sustainable environment. The severity and scope of these impacts differ, depending on the extent and nature of the environmental impacts of the Panguna Mine.

In the sections that follow, human rights impacts are identified for each domain. Each section identifies the affected rights, describes the impact on the rightsholder, and assesses the severity and scope of the impact to determine the salience of the impact. The rights of specific groups such as women and children are discussed as relevant for each of the human rights above. Indigenous rights intersect with all of the above human rights and this assessment recognises that Bougainvilleans are the Indigenous people of Bougainville.

The vulnerable groups are only separated out from the community rightsholders where there is a different assessment outcome. Sometimes this means that the human right impact is described more than once in the first column to allow presentation of the different impacts to rightsholder groups.

12.5 MINE DOMAIN

This section identifies and assesses the actual, potential and possible human rights impacts in the Mine Domain that are directly connected to the environmental impacts caused by the Panguna Mine since 1989. This assessment considers the outcomes of the environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) undertaken for the Mine Domain.

The rightsholders relevant to this assessment in the Mine Domain are:

- Communities, including Panguna Town, Moroni, Dapera, In-pit community, Pirurari, Onove, Guava, Baiaruai, Ioro 2, and Keirobi.
- Women.
- Children.
- Physically vulnerable groups, such as the elderly and persons with a disability.
- ASM workers.

Table 12.4 summarises the human rights impacts assessed for this domain, including the connected environmental and social impacts or hazards. Figure 12.2 shows these.

The following sections detail the assessment of these human rights impacts, and is structured based on the affected right, with a focus on which rightsholders are affected and where they are impacted. Figure 12.3 shows a spatial summary of the affected rights.

12.5.1 Right to life

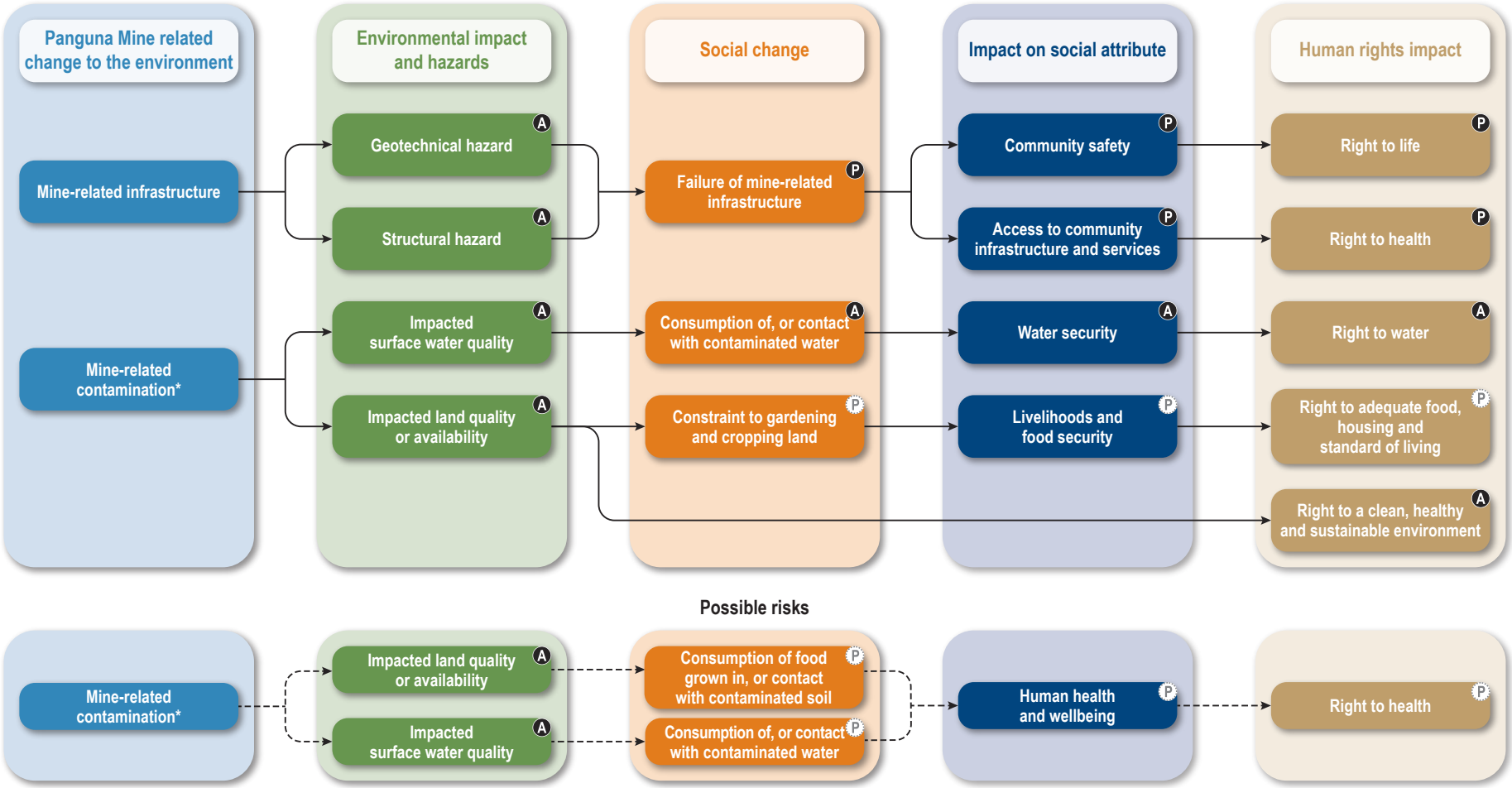
The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified five areas of geotechnical hazard and 10 structural hazards in the Mine Domain (see Figure 11.6 in Section 11.3.1). Exposure to these mine-related hazards may impact the right to life of community rightsholders. Vulnerable groups such as women, children and those who are physically vulnerable were assessed to have the same impact as community rightsholders. An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in the Mine Domain raised concerns relating to the right to life, for example:

> Panguna is not a safe place anymore. When you venture into the big bush, you will think it's only just a big bush, but you will find scrap metal and pieces of iron that can cut you. I already described the garden, but the bush too is not safe. There are many different things that the company has left behind that you will find in the bush that can harm you.

Table 12.4 Environmental and social impact connections with human rights impacts – Mine Domain

Environmental impact or other hazard	Social impact/risk	Human rights impacts	Relevant rights holders
Geotechnical land stability hazards associated with legacy mine infrastructure.	Potential impact on community safety due to geotechnical hazard events.	Potential impact on the **right to life** from exposure to geotechnical hazard events that may result in fatalities.	Community; physically vulnerable groups; women; children; ASM workers
	Potential impact on access to community infrastructure and services due to geotechnical hazard events.	Potential impact on **right to health** from constrained access to community infrastructure and services due to issues associated with mine-related geotechnical hazard events.	Community; women; physically vulnerable groups; children
Structural hazards associated with legacy mine infrastructure.	Potential impact on community safety due to structural failure of mine-related infrastructure.	Potential impact on the **right to life** from exposure to structural hazards that may result in fatalities.	Community; physically vulnerable groups; ASM workers
Impacted land quality due to mineralised and non-mineralised contamination.	Possible impact on livelihoods and food security due to mineralised and non-mineralised contamination on land and soil quality.	Possible impact on **right to adequate food, housing and standard of living** due to contaminants.	Community, women; physically vulnerable persons, ASM workers
	Possible risk to human health and wellbeing due to exposure to mineralised and non-mineralised contaminants in soil and food.	Possible risk to the **right to health** from exposure to mine-related contaminants in soil and food.	Community; women; children; physically vulnerable persons, ASM workers
Impacted surface water quality in the Kawerong River due to runoff from the waste rock dump.	Possible risk to human health and wellbeing due to exposure to mineralised contamination in water.	Possible risk to the **right to health** from exposure to mine-related contaminants in water.	Community; women; children, ASM workers
Mineralised contamination in waste rock impacting surface water quality.	Actual impact to water security due to impacted water quality.	Actual impact on the **right to water** due to mine-related contaminants	Community; women; physically vulnerable persons
Mineralised and non-mineralised contamination in the Mine Domain.	Actual mine-related contamination to land and water quality.	Actual impacts on **right to a clean, healthy and sustainable environment** from exposure to mine related environmental impacts.	Community



NOTE
*Mine-related contamination includes mineralised and non-mineralised contamination

SOURCE
Tetra Tech Coffey, 2024

LEGEND

- (A) Actual impacts
- (P) Potential impacts
- (P) Possible impacts / risks

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.2

Connections between environmental impacts, social impacts and human rights impacts in the Mine Domain

TETRA TECH COFFEY

DATE: 01.11.24 PROJECT: 754-MELEN305719 FILE: 305719_R03_F12.02_GRA

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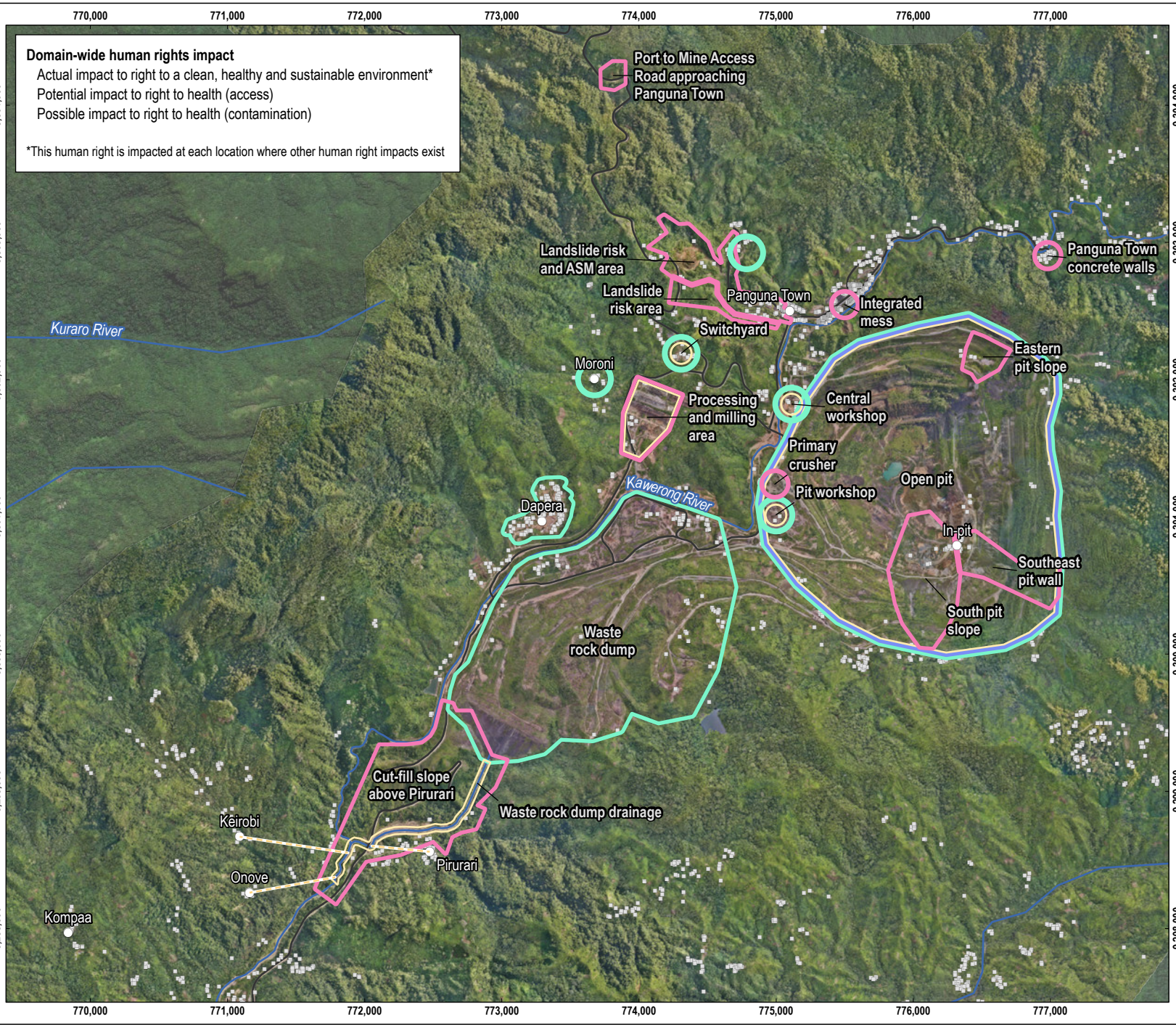

LEGEND

Village

Main dwelling structure

Road

Watercourse

Human rights impact

Actual impact to right to water

Potential impact to right to life

Possible impact to right to adequate food, housing and standard of living

Possible risk to right to health

Conservatively included community

Possible risk to right to health

Impact extents are approximate and circles shown are symbolic only. These areas should be used be used as a guide only.

SOURCE
Impacts, households, villages, roads and watercourses from Tetra Tech Coffey.
Imagery from Woolpert (2023) and Pleiades (2020).

0 0.5 1 km

SCALE **1:40,000**
PAGE SIZE: **A4**
PROJECTION: **WGS 1984 UTM Zone 56S**

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.3

Summary of impacted human rights – Mine Domain

TETRA TECH COFFEY

DATE: **31.10.24** PROJECT: **754-MELEN305719** FILE: **305719_R03_F12.03_GIS**

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SAVED BY: JASON.ORAM 31.10.24 5:32 PM

12.5.1.1 Community rightsholders

Geotechnical hazards

Four areas in the Mine Domain have been identified as presenting an extreme or high geotechnical hazard risk to communities. Geotechnical failure (e.g., landslides) associated with these structures have the potential to impact the right to life for individuals in the following areas:

- **Cut-fill slope above Pirurari**: slope failure has the potential to result in serious injury or fatality for people in Pirurari and surrounds and people travelling along Pirurari Road. This area is actively used by communities, including residences as well as gardening, water collection and ASM. Based on population modelling undertaken for the Social Characterisation (Chapter 6), slope failure would affect an estimated residential population of 90 in 19 dwellings.
- **Port to Mine Access Road:** three areas are at risk of failure, and the runout extent of a landslide may affect:
    - The northwestern and central part of Panguna Town, extending to the Port to Mine Access Road. Failure would affect a modelled population of 340 living in 64 dwellings in this area. This area includes places that people congregate (e.g., trade stores, market places). Consequently, a landslide could harm a greater number of people than the residential population and affect a range of social, economic, and natural resources.
    - An area bordering the western extent of Panguna Town extending 1 km to the west. Failure of the road is modelled to affect a population of 10 in three dwellings, along with other resources and facilities that have high social use (e.g., gardens, water sources).
    - An area located 2.8 km north-northwest of Panguna Town. Failure of the road will affect road users.

The potential area of failure of the cut-fill slope above Pirurari, and the runout areas of landslides in the two locations on the Port to Mine Access Road above Panguna Town includes residential areas, along with areas nominated for resource use. Based on this, along with the results of the geotechnical assessment, the likelihood of a fatality for these three areas is likely.

The likelihood of a failure of the Port to Mine Access Road 2.8 km north of the Panguna Town causing a fatality is related to people using the road at this location at the time of failure. Consequently, the likelihood of this event adversely affecting the right to life is **possible**.

These events all have the potential to result in fatalities for people in the area at the time of a geotechnical failure. Consequently, their scale and remediability are the same, and rated as follows:

- **Scale:** The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Table 12.5 defines the scope for each geotechnical risk based on the currently identified runout and the subsequent severity and salience rating for each event.

Table 12.5 Scope of potential geotechnical risk that may affect right to life and subsequent severity and salience ratings – Mine Domain

Event	Scope	Severity	Salience
Cut-fill slope above Pirurari	The scope of the potential impact is **minor**. Based on population modelling slope failure would affect an estimated residential population of 90 in 19 dwellings.	Severe	**Very high**
Port to Mine Access Road – northwest of Panguna Town	The scope of the potential impact is **moderate.** Modelling estimated a population of 340 in 64 dwellings in this area. This is an urban area and includes areas of resource and economic use (e.g., gardening, trade stores, markets).	Severe	**Very high**
Port to Mine Access Road – 1 km to west of Panguna Town.	The scope of the potential impact is **minimal.** Modelling estimated a population of 10 living in three dwellings in this area. The area is an urban area, and includes areas of resource use (e.g., gardening, water sources).	Major	**High**
Port to Mine Access Road – 2.8 km north-northwest of Panguna Town.	The scope of the potential impact is **minimal.** The extent of a landslide would likely cross and extend past the Port to Mine Access Road, and may result in injury, or fatalities for any road users if they were passing at the time of failure.	Major	**High**

Other factors not related to the Panguna Mine that contribute to the geotechnical hazards in the Mine Domain include environmental hazards (earthquakes) and ASM activities. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

All potential impacts to the right to life from geotechnical hazard events have a **medium** degree of uncertainty, based on limitations detailed in the Geotechnical Assessment (Appendix C) and those identified relating to social data. A summary of these is provided in Section 11.7.

Structural hazards

Four mine-related structures in the Mine Domain may fail in the event of an earthquake: the integrated mess, the Panguna Town concrete walls, and the primary and secondary crushers. These structures have the potential to impact the right to life for individuals in communities in Panguna Town:

- **Integrated mess:** The use of this building is unknown; the area surrounding this structure is relatively densely populated, with dwellings between 30 and 40 m away.
- **Panguna Town concrete walls:** This structure is used as a place of worship and dwellings have been established in the surrounding area.
- **Primary crusher:** The area surrounding this structure is reported to not typically be used as a thoroughfare; there are people living in buildings around 100 m west of the structure.
- **Secondary crusher:** Community use of the structures is transient, both in terms of residence and other activities; there are people living in buildings around 60 m east of the structure.

Given the high use of the area surrounding the integrated mess and the Panguna Town concrete walls, and the results of the structural assessment, the likelihood of a fatality occurring from structural failure is **likely**. The severity of the potential impact is **major**, based on:

- **Scale:** The scale of the potential impact is severe, as it may result in death or an extreme reduction of quality of life through serious injury.
- **Scope:** The scope of the potential impact is minimal. People living and travelling through these areas are at risk. A failure of either structure would affect a small number of people.

- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from the integrated mess and the Panguna Town concrete walls structural hazards for community rightsholders in Panguna Town is **high.**

Given the limited use of the area surrounding the primary and secondary crushers, the likelihood of a fatality occurring from structural failure is **possible**. The severity of the potential impact is **major**, based on:

- **Scale:** The scale of the potential impact is severe, as it may result in death or an extreme reduction of quality of life through serious injury.
- **Scope:** The scope of the potential impact is minimal. People traveling through this area are at risk. Given the limited use of these areas, if failure occurred and people were present in the immediate area of impact it has been assumed a small number of individuals would be affected.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from the primary and secondary crushers structural hazards for community rightsholders in Panguna Town is **high.**

Other factors not related to the Panguna Mine that contribute to the structural hazards in the Mine Domain include environmental hazards (strong winds, earthquakes) and behaviours of people interacting with infrastructure, such as salvaging, and undermining of building foundations. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Structural Assessment (Appendix F) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.1.2 ASM workers rightsholders

Geotechnical hazards

Four areas in the Mine Domain have been identified as presenting an extreme or high geotechnical hazard to ASM workers:

- **Panguna Mine open pit eastern slope:** localised slope collapse and slope failure have the potential to result in serious injury or fatality for people undertaking ASM within the open pit. Field investigations observed ASM camps at this location. Modelling estimated a population of 10 living in two dwellings in this area.
- **Panguna Mine open pit southeastern slope:** rock fall and debris flow have the potential to result in serious injury or fatality for people undertaking ASM within this location in the open pit. Field investigations observed ASM camps. Modelling estimated a population of 30 living in eight dwellings in this area.
- **Panguna Mine open pit southern slope:** rock fall and failure of the southern slope have the potential to result in serious injury or fatality for people undertaking ASM within the open pit. Field investigations indicate that several ASM camps exist within the open pit. Modelling estimated a population of 60 living in 13 dwellings in this area.
- **Port to Mine Access Road:** an area of road around 1 km to the northwest of Panguna Town has an extreme geohazard risk due to ASM activity in the area. Notable ASM activity was observed during field investigations, including the development of tunnels under the road. Failure would affect any people undertaking ASM. The geotechnical assessment also identified that the tunnel being developed by artisanal miners would collapse.

As with other geotechnical hazards, areas that people are living in increase the likelihood that people will be present during a failure. Consequently, the likelihood of an impact to the right to life for ASM workers in the open pit, particularly those temporarily or permanently residing within the open pit, is **likely**.

The area of the Port to Mine Access Road 1 km northwest from Panguna Town is actively used for ASM. Given the high use of this area and the results of the geotechnical assessment, the likelihood of a fatality occurring from geotechnical failure is **possible**.

These events all have the potential to result in fatalities for people in the area at the time of a geotechnical failure. Consequently, their scale and remediability are the same, and rated as follows:

- **Scale:** The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Table 12.6 defines the scope for each geotechnical risk based on the currently identified risk areas and the subsequent severity and salience rating for each event. The populations in the open pit and those in the area around the Port to Mine Access Road are likely to fluctuate.

Table 12.6 Scope of potential geotechnical risk that may affect right to life and subsequent severity and salience ratings for ASM workers rightsholders – Mine Domain

Event	Scope	Severity	Salience
Panguna open pit – failure of eastern slope	The scope of the potential impact is **minimal.** People undertaking ASM in this area are at risk. Based on population modelling slope failure would affect an estimated residential population of 10 people in two dwellings.	Major	**High**
Panguna open pit – rock fall and debris flow on southeastern slope	The scope of the potential impact is **minimal.** People undertaking ASM in this area are at risk. Modelling estimated a population of 30 in eight dwellings in this area.	Major	**High**
Panguna open pit – failure of southern slope	The scope of the potential impact is **minor**. People undertaking ASM in these areas are at risk. Modelling estimated a population of 60 living in 13 dwellings in the area likely to be affected by slope failure.	Severe	**Very High**
Port to Mine Access Road – failure of ASM area 1 km northwest of Panguna Town	The scope of the potential impact is **moderate.** People undertaking ASM in these areas are at risk. Modelling estimated a population of 340 in 64 dwellings in this area.	Severe	**Very High**

Consequently, the salience of potential impacts to the right to life from geotechnical hazards for ASM workers rightsholders on the eastern and southeastern slopes of the open pit is **high** and for those on the southern slope of the open pit and in areas along the Port to Mine Access Road is **very high.**

Other factors not related to the Panguna Mine that contribute to the geotechnical hazards in the Mine Domain include environmental hazards (earthquakes) and behaviours of people interacting with infrastructure, such as under-mining and ASM activities. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Geotechnical Assessment (Appendix C) and those identified relating to social data. A summary of these is provided in Section 11.7.

Structural hazards

Six large structures are at risk of collapsing and impacting people undertaking ASM in the processing and milling area. Households reported that ASM is undertaken throughout the processing and milling area and consequently these structures are used regularly, either for ASM or as a thoroughfare. The area is not understood to be used residentially.

Failure of these structures has the potential to impact the right to life for ASM workers in the processing and milling area. Insufficient data exists to estimate the number of people involved in ASM at a given site. Based on field observations, the number would be less than 100 persons.

Given the high use of these areas, and the results of the structural assessment, the likelihood of a fatality occurring from structural failure is **possible**. The severity of the potential impact is **severe**, based on:

- **Scale:** The scale of the potential impact is severe, as it may result in death or an extreme reduction of quality of life through serious injury.
- **Scope:** The scope of the potential impact is minor. People undertaking ASM in these areas are at risk. Given the level of ASM in these areas, if failure occurred and people were present in the immediate area of impact it has been assumed a discrete proportion of the population would be affected.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from structural hazards for ASM workers rightsholders is **very high.**

Other factors not related to the Panguna Mine that contribute to the structural hazards in the Mine Domain include environmental hazards (strong winds, earthquakes) and behaviours of people interacting with infrastructure, such as salvaging, and undermining of building foundations. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Structural Assessment (Appendix F) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.2 Right to health

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related impacts that have the potential to affect the right to health for some people in the Mine Domain. This includes impacted access to healthcare due to geotechnical hazard events.

Impacts to right to health may affect community rightsholders, as well as specific vulnerable groups, including women, children and physically vulnerable people. An assessment of these impacts is provided in the following sections.

Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition. Section 12.5.7 identifies where a possible risk to the right to health from mine related contaminants exists.

12.5.2.1 Community rightsholders

Reduced access to healthcare due to geotechnical hazard events

Geotechnical hazard events identified in Section 12.5.1 have the potential to reduce access to healthcare for individuals from communities in the Mine Domain. Land instability events (e.g., landslides) along areas of the Port to Mine Access Road and Pirurari Road would mean that these routes would be un-usable until restored. Loss of road access due to landslide would result in communities west of the affected areas having to travel to Arawa via Buin (approximately 180 km) to access hospital level care until the road was restored. Health care is provided at the Moratona Health Centre, although this facility has limited capacity to respond to complex emergency events. Although temporary, a reduction in access to health care could have material effects on health for rightsholders, particularly during an emergency.

The total population catchment in the Mine Domain that could be affected by a failure affecting the Port to Mine Access Road is estimated to be around 7,000 people, while the Pirurari Road is estimated to be around 700 people. Not all people will need to access healthcare during the period when road access is disrupted. Data from NSO and the IFC (2019) indicates that in 2019, around 37% of Bougainvillean women and 36% of Bougainvillean men had visited a health facility in the past 12 months. Applying these proportions to the catchment, it is estimated around 2,600 persons would be affected if a failure affected the Port to Mine Access Road, and 260 if a failure affected the Pirurari Road.

Given the high use of these areas and the results of the geotechnical assessment, the likelihood of access to healthcare being affected by geotechnical failure is **likely**. The severity of the potential impact is **moderate**, based on:

- **Scale:** The scale of the potential impact is major and may result in a material reduction in health and wellbeing. This would continue until access is restored.
- **Scope:** The scope of the potential impact is moderate. Given the high use of these areas, if failure occurred, alternative access routes are substantial and may be prohibitive for an estimated 260 to 2,600 people in the Mine Domain.
- **Remediability:** The remediability of the potential impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of the potential impact to the right to health from geotechnical hazard events for community rightsholders in the Mine Domain is **medium.**

Other factors not related to the Panguna Mine that contribute to human health and wellbeing in this domain include challenges for service delivery faced by the Bougainvillean and Papua New Guinean health system more broadly, such as medicine, funding and staffing shortages.

This impact has a **high** degree of uncertainty, as detailed in Section 11.7.

12.5.2.2 Women, young children and physically vulnerable rightsholders

Reduced access to healthcare due to geotechnical hazards

As described above, failure of geotechnical hazards in areas of the Mine Domain, including along the Port to Mine Access Road and Pirurari Road, have the potential to affect access to healthcare. Individuals who are physically vulnerable, such as the elderly, young children, pregnant women and those with a disability, are more vulnerable to changes in access to healthcare than other community members.

As a result, the right to health for physically vulnerable individuals may be impacted differently than that of the general community.

Based on this, the likelihood of access to healthcare being affected by geotechnical failure is **likely**. The severity of the potential impact is **major**, based on:

- **Scale:** The scale of the potential impact is severe, as it may result in death or an extreme reduction of quality of life for physically vulnerable groups who cannot access health services.
- **Scope:** The scope of the potential impact is moderate. If failure occurred and there were no alternative access routes available, and it took an extended period to restore access, it is assumed a notable proportion of a vulnerable group (e.g., physically vulnerable) would be affected.
- **Remediability:** The remediability of the potential impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of potential impacts to the right to health for women and physically vulnerable rightsholders as a result of geotechnical hazards is **high.**

Other factors not related to the Panguna Mine that contribute to human health and wellbeing in this domain include challenges for service delivery faced by the Bougainvillean and Papua New Guinean health system more broadly, such as medicine, funding and staffing shortages.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Geotechnical Assessment (Appendix C) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.3 Right to adequate food, housing and standard of living

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified that land quality in areas of the Mine Domain had been impacted by contaminants entering the soil from mineralised and non-mineralised contamination.

Household food security and livelihood strategies, such as the sale of excess garden produce, in the study area rely on the availability and quality of productive land. Impacts on land quality may affect households' right to food, as well as their ability to generate livelihood and right to an adequate standard of living.

Impacts to right to adequate food, housing and standard of living may affect community rightsholders, and specifically women. An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in the Mine Domain raised the following concerns relating to the right to adequate food, housing and standard of living:

> The food has not produced like it used to previously. The quality of food is not the same. We used to have big taros before, not anymore. That's why we buy from others who come and sell.

Mine-related contamination of soil that exceeded the agricultural ecological screening criteria for arsenic, copper, lead, molybdenum and zinc was reported in areas of the Mine Domain. These exceedances included gardening soils (21 of 24 garden soils sampled had exceedances) and indicate that soil productivity may be impacted.

In general terms, the level of effect can differ depending on the soil, and the crop or plants being grown, among other factors (Mohanta, Pradhan and Behera 2023). The actual impact of the exceedances on the productivity of gardening land in the contaminated areas of the Mine Domain cannot be determined based on the available data. However, taking a precautionary approach it is assumed that these exceedances would place a constraint on the productivity of the gardening land and contribute to food security and livelihood issues that are experienced in this domain.

12.5.3.1 Community rightsholders

Impacted capacity to grow enough food to eat and earn income due to mineralised contamination

Dapera village was resettled onto an area made from waste rock during mining operations. A small hamlet of around 30 households has also been established on the main waste rock dump. Samples taken from waste rock exceeded agricultural ecological screening criteria for arsenic, copper, molybdenum, selenium and zinc. Similarly, agricultural ecological screening criteria exceedances were reported for arsenic, copper, lead, molybdenum and zinc in samples from gardens in Dapera.

Mineralised contamination that exceeds the agricultural ecological screening criteria may affect land productivity, and the capacity of people to grow food or crops in this land. As gardening is one of the primary sources of food for households in this domain, impacts on land productivity due to contamination may affect the right to food for households in Dapera, along with households established on the waste rock dump. Additionally, as some people earn money through selling excess garden produce, impacts on land productivity can impact their ability to generate income and support an adequate standard of living.

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the Mine Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact. Taking a precautionary approach, the likelihood of mineralised contamination impacting capacity to grow food and generate income is **likely**. The severity of this possible impact is moderate, based on:

- **Scale**: The scale of the possible impact is moderate, and may result in a notable impact on livelihoods, although this land is still being used for gardening.
- **Scope**: The scope of the possible impact is moderate. The effect on soil productivity is expected to occur in areas of the Mine Domain where waste rock has been placed and settlements have been established. This area includes households in Dapera (~90) and households established on the waste rock dump (~30), affecting a modelled estimated population of 590 people.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human right that has been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for community rightsholders in Dapera and households living on the main waste rock dump is **medium**.

Other factors not related to the environmental impacts of the Panguna Mine after 1989 that may affect a household's ability to generate income and food security include displacement from customary land, loss of land suitable for agriculture due to mine development and operation, ASM related contamination of land, natural mineralisation in soil that exceeds agricultural ecological screening criteria, other properties of soil, population increase and impact on land availability and the subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty given the limitations detailed in the Human Health Risk Assessment (Appendix G) and Water quality and Geochemical Assessment (Appendix A) and those identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to grow enough food enough food to eat and earn income due to non-mineralised contamination

In the Mine Domain, contaminants of concern were identified above agricultural ecological screening criteria in garden soil near the following mining-related infrastructure:

- **Pit and central workshops:** Arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, zinc, and PCBs exceedances were identified in nine samples. People are living in this area and have developed gardens across the site. Modelling identified 32 dwellings in this area, equating to an estimated 160 persons.
- **Moroni and the hamlet near the switchyard:** Arsenic, cadmium, copper, cobalt, zinc, and PCBs were identified in six samples. Residences have established across the switchyard area, including household gardens. Modelling identified 18 residences, equating to an estimated 70 persons.
- **Panguna Town:** Arsenic and copper were found in three samples from gardens in the western part of Panguna Town. It is assumed that the contamination is localised and only affects three household (20 persons).

These exceedances suggest that the productive capacity of land in these areas may be reduced. The sampling for Phase 1 was targeted and was not designed to determine the extent of contamination. Based on the way these contaminants typically disperse in the environment, contamination is expected to be localised around mine-related infrastructure.

As gardening is one of the primary sources of food for households, impacts to land productivity due to contamination may affect the right to adequate food for households. Additionally, as some people (between 29% and 60% of households) in the domain earn money through selling excess garden produce, impacts on land productivity can impact their ability to generate income and support an adequate standard of living.

Food security can affect vulnerable groups differently: for example, women may be more likely to restrict food intake in favour of their children (Schmidt, Fang and Maht, 2022). Elderly people were identified by communities in several instances as particularly vulnerable to food security issues. These groups are also more susceptible to long-term health effects from reduced food intake (see Chapter 6).

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the Mine Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact. Taking a precautionary approach, the likelihood of non-mineralised contamination impacting the right to adequate food, housing and standard of living is **possible**. The severity of this possible impact is moderate, based on:

- **Scale**: The scale of the possible impact is moderate, and may result in a notable impact on livelihoods, although this land is still being used for gardening and these areas are where active ASM occurs.
- **Scope**: The scope of the possible impact is minor. Contamination is expected to be localised and be limited to the pit and central workshops (estimated population of 160 persons), Moroni and the hamlet near the switchyard (estimated population of 70 persons), an area in the western part of Panguna Town (estimated population of 20 persons).
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact to the right to adequate food, housing and standard of living for community rightsholders living in areas near Panguna Town and Moroni is **medium**.

Other factors not related to the Panguna Mine that may affect a household's ability to generate income and food security include displacement from customary land, loss of land suitable for agriculture due to mine development and operation, ASM related contamination of land, natural mineralisation in soil that exceeds agricultural ecological screening criteria, population increase and impact on land availability and the

subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.3.2 ASM workers rightsholders

Impacted capacity to grow enough food enough food to eat and earn income due to mineralised contamination

Since mining ceased, people have established temporary and permanent residences with some areas used for gardening within and on the edges of the open pit.

Metals concentrations in waste rock were elevated above background soil with maximum concentrations of arsenic, copper, molybdenum, selenium and zinc exceeding agricultural ecological screening criteria. Similarly, agricultural ecological screening criteria exceedances were reported for arsenic, copper, and molybdenum in samples from gardens in the open pit. Mineralised contamination that exceeds the agricultural ecological screening criteria may affect land productivity, and the capacity of people to grow food or crops in this land.

As the ASM workers living in the open pit are primarily there to conduct ASM and this is their main form of income, this reduces the reliance on the land productivity for gardening to earn an income. Similarly, these households typically use income generated by ASM to buy food, from either trade stores or markets, rather than growing food themselves. In addition, many (not all) people involved in ASM are transient, and they may have access to land elsewhere. In general, ASM populations engaged as part of the field investigation noted that they are reliant on store and market food while in the area, but have gardens in their own village.

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the Mine Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact. The likelihood of this possible impact occurring is **possible**. The severity of this possible impact is **minor**, based on:

- **Scale**: The scale of the possible impact is minor and may result in a small impact on food security, although this land is still being used for gardening.
- **Scope**: The scope of the possible impact is minor. People living in the pit and its edges (~50 households) includes a modelled estimate of 210 people. However, this population may fluctuate and there is high uncertainty.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for ASM workers rightsholders in the open pit and its edges is **low**.

Other factors not related to the Panguna Mine that may affect a household's ability to generate income and food security include ASM related contamination of land, natural mineralisation in soil that exceeds agricultural ecological screening criteria, population increase and impact on land availability and the subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty given the limitations detailed in the Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.4 Right to water

Access to water is fundamental to people's productive capacity. The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mineralised contamination in drinking water sources in the In-pit community within the Mine Domain.

Impacts to the right to water may affect community rightsholders within the In-pit community. Vulnerable groups, such as women and those who are physically vulnerable, and ASM workers were assessed to have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in the Mine Domain raised the following concerns relating to the right to water:

> The water will not stay clean, rust will be formed because water within the boundary [Special Mining Lease] is not safe for consumption. When they [BCL] were in the exploration phase and the water in the ground became affected that is why the water is not safe for those who live here.

12.5.4.1 Community rightsholders

Reduced water security due to presence of mineralised contamination

Concentrations of molybdenum were above the adopted drinking water health screening criteria in three community identified drinking water sources identified by the In-pit community. These water sources were identified as being used for domestic (drinking, bathing) and ASM purposes by individuals living and working within the open pit.

The identified exceedances of molybdenum reduce the overall acceptability and quality of water sources available to households and individuals within the open pit. As no alternative water sources were identified by households living within the open pit, the right to water for households and individuals living here is impacted.

The likelihood that mineralised contamination in water sources is adversely affecting the right to water is **almost certain**. The severity of the actual impact is **minor**, based on:

- **Scale**: The scale of the actual impact is moderate, and may result in a notable impact on livelihoods, although this water is still being used for domestic and ASM purposes.
- **Scope:** The scope of the actual impact is minor. People regularly consuming this water are at risk, which is likely limited to individuals, including children, living in the open pit and undertaking ASM, modelled to be a population of 210.
- **Remediability**: The remediability of the actual impact is minimal. Restoration of the human rights that have been impacted is readily achievable with the implementation of simple, established practices.

Consequently, the salience of the actual impact to the right to water for community rightsholders from the In-pit community is **medium.**

Other factors not related to the Panguna Mine that may affect household's water security include ongoing industrial activities, such as ASM. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.5 Right to a clean, healthy and sustainable environment

Environmental conditions in the Mine Domain were significantly changed prior to 1989 during the construction and operation of the Panguna Mine. The environmental impact assessment (Chapter 10) identified a range of environmental impacts in the Mine Domain caused by the mine since mining ceased in 1989. This includes mineralised and non-mineralised contamination of soil and water in areas of the domain surrounding mine-related infrastructure. The mineralised contamination is limited to areas in the domain where waste rock from Panguna Mine was exposed, for example the open pit and Dapera. Non-mineralised contamination was identified in areas surrounding historic mine infrastructure and is consistent with the historic use of the area.

These environmental impacts will affect the right to a clean, healthy and sustainable environment for community rightsholders in the domain. Vulnerable groups identified in this domain, such as women, children and those who are physically vulnerable, and ASM workers were assessed to have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

12.5.5.1 Community rightsholders

Exposure to environmental impacts directly connected to the mine

As described above in the previous sections, a number of environmental impacts associated with mineralised and non-mineralised contamination were identified in seven areas in the Mine Domain:

- **Dapera:** mineralised contamination of soil associated with waste rock.
- **Processing and milling area:** non-mineralised contamination of soil consistent with the industrial use of the area during mining operations.
- **Pit and central workshops:** non-mineralised contamination of soil consistent with supporting different industrial processes during mining operations.
- **Switchyard:** non-mineralised contamination soil from transformer oils associated with its former use.
- **Kawerong River:** mineralised contamination of water in two locations downstream of the Kawerong Valley waste rock dump.
- **Open mine pit:** mineralised contamination of soil and water sources within the open mine pit associated with its use during mining operations.

These environmental impacts affect three of the substantive elements of the right to a clean, healthy and sustainable environment: right to a non-toxic environment; the right to healthy and sustainably produced food; and the right to safe and sufficient water.

Based on the number of sites and contaminants identified, the likelihood of environmental impacts directly connected to the mine adversely affecting the right to a clean, healthy and sustainable environment occurring is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The scale of the actual impact is moderate, and may result in a notable impact to livelihoods, health, safety, or culture.
- **Scope**: The scope of the actual impact is moderate. Given the number and location of sites identified, it is estimated that around 220 households, with a modelled population of around 1,000 people, may be affected.

- **Remediability**: There is insufficient information to understand the remediability of the actual impact on the human right. Taking a precautionary approach, it is assumed to be moderate, meaning restoration of the human right is achievable with implementation of established good practices.

Consequently, the salience of the actual impact to the right to a clean, healthy and sustainable environment for community rightsholders including people in and around Moroni, Dapera, Panguna Town, In-pit, Pirurari, Keirobi and Onove is **medium**.

Other factors not related to the Panguna Mine that may affect the environment in the Mine Domain include waste management practices and ongoing industrial activities, such as ASM (including likely use of mercury). This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **low** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.5.6 Summary of human rights impacts in the Mine Domain

Table 12.7 summarises the impacts to human rights that are directly connected to the environmental impacts of the Panguna Mine since 1989, and the relevant rightsholders or vulnerable groups in the Mine Domain

Actual, potential and possible human rights impacts have been identified in six broad areas: Panguna Town and surrounds, the processing and milling area, Moroni and the switchyard, Dapera and the waste rock dump, Panguna open pit and the Lower mine area. In these areas, overlapping human rights impacts have been identified.

A summary of human rights impacts in each area is as follows (see Figure 12.7).

Possible risks to the right to health from contaminants in the environment are described in Section 12.5.7.

12.5.6.1 Domain wide impacts

Environmental impacts directly connected to the Panguna Mine since 1989 may result the following human rights impacts for rightsholders across the Mine Domain for:

- **Potential impact to right to health:** Potential geotechnical failures identified along areas of the Port to Mine Access Road and Pirurari Road would mean that these routes would be unusable, until restored. The population in the Mine Domain that relies on these routes for access to advanced health care services is substantial equating to modelled estimate of 7,600 people. Although temporary, a reduction in access to health care could have material effects for health for **community rightsholders**, particularly during an emergency.

  Individuals who are physically vulnerable, such as the elderly, pregnant women and those with a disability, are more vulnerable to changes in access to healthcare than other community members.

12.5.6.2 Panguna Town and surrounds

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **community rightsholders** in Panguna Town, including (see Figure 12.7):

- **Potential impact to right to life:** Three areas along the Port to Mine Access Road approaching Panguna Town have an extreme or high landslide risk. Additionally, four structures in Panguna Town may fail in the event of an earthquake: the integrated mess, the Panguna Town concrete walls, and the primary and secondary crushers. If any of these events occurred, there is the potential for fatalities of people in the area at the time.

Table 12.7 Summary of human rights impacts in the Mine Domain

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to life						
Potential[2]	Exposure to geotechnical hazard events that may result in fatalities in the following areas, impacting on right to life:	**Community (including vulnerable groups):** People living or travelling through these areas are at risk.	Likely	Severe	Very high	Medium
	• Cut-fill slope above Pirurari. • A section of the Port to Mine Access Road above the northwestern extent of Panguna Town.					
	• A section of the Port to Mine Access Road approaching Panguna Town (1 km west from town).		Likely	Major	High	Medium
	• A section of the Port to Mine Access Road 2.8 km north-northwest of Panguna Town.		Possible	Major	High	Medium
	• Panguna open pit: • Eastern slope • Southeastern slope	**ASM workers:** People undertaking ASM in these areas are at risk.	Likely	Major	High	Medium
	• Panguna open pit – southern slope		Likely	Severe	Very high	Medium
	• A section of the Port to Mine Access Road approaching Panguna Town (1 km west from town).		Possible	Severe	Very high	Medium
Potential[2]	*Exposure to structural failure of the following mine-related structures that may result in fatalities, impacting on the right to life*	**Community (including vulnerable groups):** People living or travelling through these areas are at risk. These areas have a relatively high level of use.	Likely	Major	High	Medium
	• The integrated mess. • Panguna Town concrete walls.					

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
	• The primary crusher located south of Panguna Town. • The secondary crusher located southwest of Panguna Town.	**Community (including vulnerable groups):** People using or otherwise travelling through this area are at risk. Given the limited use of the areas, failure is assumed to affect a small number of people.	Possible	Major	High	Medium
	• The fine ore crushing plant. • The screening plant. • The fine ore stockpile. • The milling building. • The substation. • The milling area workshop and storage.	**ASM workers:** People undertaking ASM in or around these buildings are at risk. There is insufficient data to estimate the number of people involved in ASM at a given site.	Possible	Severe	Very high	Medium
Right to health						
Potential[2]	*Reduced access to healthcare due to geotechnical hazard events, impacting on the right to health* Geotechnical hazard events (see above) may affect the Port to Mine Access Road and the Pirurari Road (cut-fill slope). This may prevent or change access to healthcare, including hospital level care, for communities in this domain. This impact would continue until access is restored.	**Community:** Failure at either of these locations would adversely affect access to health care for up to 260 to 2,600 people in the Mine Domain who are dependent on this access route.	Likely	Moderate	Medium	High
		Women and physically vulnerable individuals: Individuals within this group are more vulnerable to changes in access to healthcare than other community members.	Likely	Major	High	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to adequate food, housing, and standard of living						
Possible	*The presence of non-mineralised contamination may impact the right to adequate food, housing and standard of living* Exceedances of the agricultural ecological screening criteria were reported in gardens at the: pit and central workshops, switchyard, and west of Panguna Town. Contamination of land used for gardening may reduce the quality and amount of food able to be grown, and can impact right to adequate food and standard of living.	Community: These exceedances suggest that the productive capacity of land in these areas may be reduced. This is estimated to affect a modelled population of 190 people. This equates to around 40 households.	Possible	Moderate	Medium	High
Possible	*The presence of mineralised contamination may impact the right to adequate food, housing and standard of living* Exceedances of the agricultural ecological screening criteria due to mineralised contamination were reported in Dapera and on the waste rock dump. Contamination of land used for gardening may reduce the quality and amount of food able to be grown, and can impact right to adequate food and standard of living.	Community: The effect on soil productivity is expected to occur in areas of the Mine Domain where waste rock has been placed and settlements have been established. This is assumed to affect an estimated 90 households in Dapera and 30 households on the waste rock dump.	Likely	Moderate	Medium	High
		ASM workers: Agricultural criteria exceedances in the open pit suggest that the productive capacity of this land may be reduced. It is estimated that a modelled population of 210 people may be affected.	Possible	Minor	Low	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to water						
Actual	*The presence of mineralised contamination may impact the right to water* Three water sources in the open pit exceeded drinking water health screening criteria. No alternative water sources are available to households living in the open pit, affecting right to clean water.	Community: People living and working in the open pit will be affected. This is estimated to be a modelled residential population of around 210 people.	Almost certain	Minor	Medium	Medium
Right to a clean, healthy and sustainable environment						
Actual	*Exposure to environmental impacts directly connected to the mine may impact individuals' right to a clean, healthy and sustainable environment* Mineralised and non-mineralised contamination from mine-related infrastructure has impacted land and water quality in seven areas of the domain.	Community: Contamination was identified in seven areas in the domain near mine-related infrastructure. On a precautionary basis, it is assumed that around 220 households, with a modelled population of 1,000 people, may access these areas.	Almost certain	Moderate	Medium	Low

1. Where impacts have the same salience, they are presented here jointly for ease of reading, but these are assessed separately.

- **Possible impact to right to adequate food, housing and standard of living:** Exceedances of the agricultural ecological screening criteria for metals and PCBs were identified in nine garden soil samples at the pit and central workshops and three garden soil samples in Panguna Town. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income. Based on the locations of these gardens, 35 households are likely affected.
- **Actual impact to right to a clean, healthy and sustainable environment:** Non-mineralised contamination from mine-related infrastructure has resulted in contaminated soil in areas of the pit and central workshops. This contamination may affect the receiving environment for 32 households, with a modelled population of 160 people.

A potential geotechnical failure (e.g., landslide) along the Port to Mine Access Road around 1 km from Panguna Town would be a potential impact on the right to life for **ASM workers rightsholders** in the area. Notable ASM activity was observed during field investigations, including the development of tunnels. The geotechnical assessment also identified that the tunnel being developed by artisanal miners would collapse.

12.5.6.3 Processing and milling area

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **ASM workers rightsholders** in the processing and milling area, including (see Figure 12.7):

- **Potential impact to right to life:** Six large structures are at risk of collapsing and impacting people undertaking ASM in the processing and milling area. If failure occurred, there is potential for fatalities of people in the area at the time. Insufficient data exists to estimate the number of people involved in ASM at a given site.
- **Actual impact to right to a clean, healthy and sustainable environment:** Non-mineralised contamination from mine-related infrastructure has resulted in contaminated soil in areas of the processing and milling area. This contamination may affect the receiving environment for ASM workers in this area.

12.5.6.4 Moroni and the switchyard

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **community rightsholders** in Moroni and the hamlet near the switchyard, including (see Figure 12.7):

- **Possible impact to the right to adequate food, housing and standard of living:** Land and soil quality in areas of Moroni and the hamlet near the switchyard is affected and has concentrations of metals and PCBs above agricultural ecological screening criteria. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income. Based on the locations of these gardens, a modelled population of 70 persons are estimated to be affected.
- **Actual impact to the right to a clean, healthy and sustainable environment:** Non-mineralised contamination from mine-related infrastructure has resulted in contaminated soil in areas of the switchyard. This contamination may affect the receiving environment for nine households, with a modelled population of around 40 people.

12.5.6.5 Dapera and people settled on the waste rock dump

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **community rightsholders** in Dapera and people settled on the waste rock dump, including (see Figure 12.7):

- **Possible impact to the right to adequate food, housing and standard of living:** Mineralised contamination was identified in areas of the Mine Domain where waste rock was placed and settlements have been established, including Dapera and the waste rock dump. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income. Based on the extent of mineralised contamination in this domain, a modelled population of 580 are likely affected.
- **Actual impact to the right to a clean, healthy and sustainable environment:** Mineralised contamination has resulted in contaminated in soils in areas of Dapera. This contamination may affect the receiving environment for 90 households in Dapera and 30 households established on the waste rock dump, with a modelled population of 580.

12.5.6.6 Open pit

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **ASM workers rightsholders** in the open pit, including (see Figure 12.7):

- **Potential impact to the right to life:** Rock fall, debris flow and failure of the eastern, southeastern and southern slope have the potential to result in serious injury or fatality for people undertaking ASM within the open pit. Field investigations indicate that several ASM camps exist within the open pit.
- **Actual impact to the right to water:** The identified exceedances of molybdenum reduce the overall acceptability and quality of water sources available to households and individuals within the open pit. As no alternative water sources were identified by households living within the open pit, the right to water for households and individuals living here is impacted.
- **Possible impact to the right to adequate food, housing and standard of living:** Exceedances of metals associated with mineralised contamination were identified in garden soil samples from the open pit. These exceedances may affect the productivity of land, and subsequently food security and ability to generate an income.
- **Actual impact to the right to a clean, healthy and sustainable environment:** As people are living in the open pit this right has been assessed; however, it would not normally be applied to an active ASM area. The open pit has mineralised soils and a water source that has an exceedance of one metal. This mineralised contamination may affect the receiving environment for an estimated 50 households with a modelled population of 210 people.

12.5.6.7 Lower mine sub-domain

Environmental impacts directly connected to the Panguna Mine since 1989 may result human rights impacts for **community rightsholders** in the Lower mine sub-domain, including (see Figure 12.7):

- **Potential impact to the right to life:** Slope failure of the cut-fill slope above Pirurari has the potential to result in serious injury or fatality for people in Pirurari and travelling along Pirurari Road. Based on population modelling slope failure would affect an estimated residential population of 90 people in 19 dwellings.
- **Actual impact to the right to a clean, healthy and sustainable environment:** Mineralised contamination from the Kawerong Valley waste rock dump has resulted in contaminated water in two areas of Kawerong River downstream. This contamination may affect the receiving environment for an estimated modelled residential population of around 130 people.

12.5.7 Possible risks to the right to health from contaminants in the environment

During the participatory photography process, and focus group discussions, individuals raised concerns relating to right to health, for example:

> Today people [are] having so many kinds of diseases which killed many lives than before, the change of diseases start from 1988.

There is a widely held concern in the study area that people's health has been affected by contamination from the Panguna Mine. Possible risks to the right to health occur through exposure to mine-related contaminants of concern in soil, food, drinking and recreational water (Plate 12.1).

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related contaminants that pose a possible risk to the right to health for some people in the Mine Domain. Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition.

These possible risks to right to health may affect community rightsholders, as well as specific vulnerable groups, including women, children and physically vulnerable people and ASM workers. A description of these possible risks is provided in the following sections.

The possible risks to the right to health from contaminants in the environment have a **high** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

Other factors not related to the Panguna Mine that contribute to human health and wellbeing in this domain include ongoing industrial activities, such as ASM (including likely exposure to mercury), and overall levels of nutrition. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

12.5.7.1 Community rightsholders

Exposure to contaminants of concern through direct contact with soil

Non-mineralised contamination of soils consistent with the historic uses during mining was identified in areas surrounding mine-related infrastructure in the Mine Domain. Concentrations of contaminants exceeded residential (direct contact) health criteria in two areas, and present a possible risk to the right to health for people that have regular direct contact with soil, such as skin contactor ingestion in the following areas:

- **Pit and central workshops (near Panguna Town):** exceedances of cadmium, iron, lead, antimony, molybdenum, nickel, zinc, PCBs and hydrocarbons were detected in soils. This area is used by the community for industrial activities, such as workshops, and people are living in this area and amongst the infrastructure. Modelling estimated 32 dwellings in this area, equating to an estimated 160 persons.
- **Switchyard:** PCBs were detected in soils in this location. There are around nine residences including household gardens, equating to an estimated 40 persons in the switchyard area.

"Karona [Kawerong] River was used for drinking, washing and looking for food like crabs and eels before the mining. Since 1989, this has been affected by the [Panguna] Mine"

Photo credit: Community participatory photography, 2023

Plate 12.1
Participatory photography photo and quote raising concerns about drinking water in Panguna Town

Exposure to contaminants of concern through soil and food

Exceedances of the agricultural human health screening criteria were identified for arsenic, cadmium, copper, lead and molybdenum in garden soils from Dapera, Moroni, Panguna Town, In-pit and Pirurari. However, where garden soil exceedances were found there was no corresponding exceedance of the same metal in co-located food samples at these locations. The lack of exceedances of the same metal measured in soil and co-located food suggests that the contaminant intake in plants and raised animals is inconclusive based on the available data.

Of the 61 food samples collected in the Mine Domain, 10 samples (16%) exceeded the adopted food standard screening criteria for at least one metal:

- **Moroni** – exceedances of cadmium in a vegetable (leafy greens), fruit (cocoa) and two tubers (cassava and taro).
- **Dapera** – exceedances of cadmium (duck meat), lead[4] (duck meat) and selenium (chicken and duck meat).
- **Panguna Town** – an exceedance of selenium in pork meat.
- **In-pit** – exceedances of arsenic and selenium in chicken meat.
- **Pirurari** – exceedances of arsenic and selenium in chicken meat.
- **Onove** – exceedances of copper and selenium in duck meat.

To evaluate contaminant intake from foods in the Mine Domain, the average concentrations of metals and metalloids in foods collected for the market basket survey across the study area were adopted, and food consumption data obtained from surrogate villages in PNG were used to estimate the contaminant intakes associated with diet.

Based on the contaminant dietary intake evaluation undertaken for the Human Health Risk Assessment (Appendix G), there is a **low risk** to the right to health of people aged over six due to mine-related contaminants in food in the Mine Domain. However, the calculated intakes of cadmium in foods for young children (<6 years) is a **possible risk** to the right to health for young children, shown on Figure 12.3 (see Section 12.5.7.4).

12.5.7.2 Women, young children and physically vulnerable rightsholders

Exposure to contaminants of concern through direct contact with soil

As described in Section 12.5.7.1, land used for gardening in the pit and central workshops and the switchyard has non-mineralised contamination that exceeds the residential (direct contact) health criteria. The contamination presents a **possible risk** to the right to health for people that have regular contact with the soil. As gardening is primarily undertaken by women, they may be exposed to these contaminants via direct contact more frequently than other community members. Additionally, women often garden with young children present and as young children have increased hand to mouth contact, they are more likely to ingest soils than adults.

Based on this, women's and young children's right to health in the Mine Domain may be impacted differently than that of the general community. Further work would improve understanding of the possible risk.

[4] The elevated concentrations of lead may be a result of a lead shot during collection of the food sample.

12.5.7.3 ASM workers rightsholders

Exposure to contaminants of concern through direct contact with soil

Soils in the processing and milling area have non-mineralised contamination that exceeds the residential (direct contact) health criteria for copper, iron, PCBs and lead. The contamination presents a **possible risk** to the right to health for ASM workers and their families who work in this area and may have regular direct contact with soils.

Exposure to mineralised contamination in surface waters

Mineralised contamination in two general waterbodies in the Mine Domain was identified as presenting a **possible risk** to the right to health for ASM workers:

- **Waste rock dump drainage and the Kawerong River (before Pirurari bridge):** Concentrations of copper and manganese exceeded adopted recreational/other use health screening criteria for water in a stretch of approximately 1 km along this waterway. Furthermore, the levels of copper detected in the water may pose an acute health risk if 200 mL or lesser amounts of water is incidentally ingested. This water source was not identified as a drinking water source; however, households reported undertaking ASM in the area, and children may swim in the water (the risk of which is assessed separately below).
- **Kawerong River (near Onove footbridge):** Exceedances of manganese were identified in water samples in this area and exceedances are expected to occur until Barako, around 3 km downstream in the River System Domain. This section of the river was not identified as a drinking water source; however, ASM is undertaken in this area.

Water in these areas present a possible risk to the right to health for ASM workers and other individuals who frequently use these water sources for recreation or other activities (bathing, washing). Contaminants in water in these areas may impact the right to health for ASM workers rightsholders likely from Pirurari, Keirobi and Onove.

Exposure to mineralised contamination in drinking water sources

Mineralised contamination of drinking water in the Mine Domain was found in three community identified drinking water sources used by the In-pit community who live in the pit to conduct ASM activities. All other community identified drinking water sources sampled in this Domain were below the adopted drinking water health screening criteria for mine-related contaminants.

The drinking water sources used by the In-pit community had concentrations of molybdenum above the adopted drinking water health screening criteria and pose a possible health risk exists for people who regularly consume this water. The molybdenum exceedances in these water sources is a **possible risk** to the right to health for individuals from the In-pit community.

12.5.7.4 Children rightsholders

Exposure to mineralised contamination in surface waters

As described above, concentrations of copper and manganese in the seepage from the Kawerong Valley waste rock dump (before Pirurari bridge) exceeded the recreational water health screening criteria. Furthermore, the levels of copper detected in the water may pose an acute health risk to children if 200 mL or lesser amounts of water is incidentally ingested.

This water source is accessible to children from Pirurari, 100 m south. Children may not view the water as a possible health risk and are more likely to recreationally swim in the water and incidentally ingest water.

Given the possible use of this water source, there is a **possible risk** to the right to health for individual children from Pirurari.

Exposure to contaminants of concern through soil and food

As described above, garden soils in the Mine Domain had exceedances of the agricultural human health screening criteria and 16% of the food samples collected within this domain exceeded the adopted food standard screening criteria for at least one metal (see Section 12.5.2.1).

Based on the contaminant intake evaluation undertaken for the Human Health Risk Assessment (Appendix G), a possible health risk may exist associated with cadmium intake in foods in young children (less than 6 years old) in the Mine Domain. Given the consumption data for children under 6 years is less robust than other age groups due to variable periods of breast feeding and introduction of solids, further investigations would provide greater understanding of this possible health risk.

This possible health risk may impact the right to health for some children in Moroni, Dapera, Panguna Town, In-pit, Pirurari and Onove and is shown as a domain wide impact on Figure 12.3.

12.6 RIVER SYSTEM DOMAIN

This section identifies and assesses the actual, potential and possible human rights impacts in the River System Domain that are directly connected to the environmental impacts caused by the mine since the cessation of mining in 1989. This assessment considers the outcomes of the environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) undertaken for the domain.

The rightsholders relevant to this assessment in the River System Domain are:

- Communities, including Ioro 2, Baiaruai, Enamira, Tengkona, Barako, Tempiri, Gold Miners (UT), Jaba Pump Station, Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Derevai, Momau, Kirivia, Pem'ana, Katauli, Kobalu, Kuneka, Namunsa, Polamato, Wasikeuluma, Mokerokeroai, Moratona, Maile, and Moirue, and surrounding hamlets.
- Women.
- ASM workers.
- Children.
- Physically vulnerable groups, such as young children, the elderly and persons with a disability.

Table 12.8 summarises the human rights impacts assessed for the River System Domain, including the connected environmental and social impacts or hazards. Figure 12.4 shows these.

The following sections detail the assessment of these human rights impacts, and is structured based on the affected right, with a focus on which rightsholders are affected and where they are impacted. Figure 12.5 shows a spatial summary of the affected rights.

12.6.1 Right to life

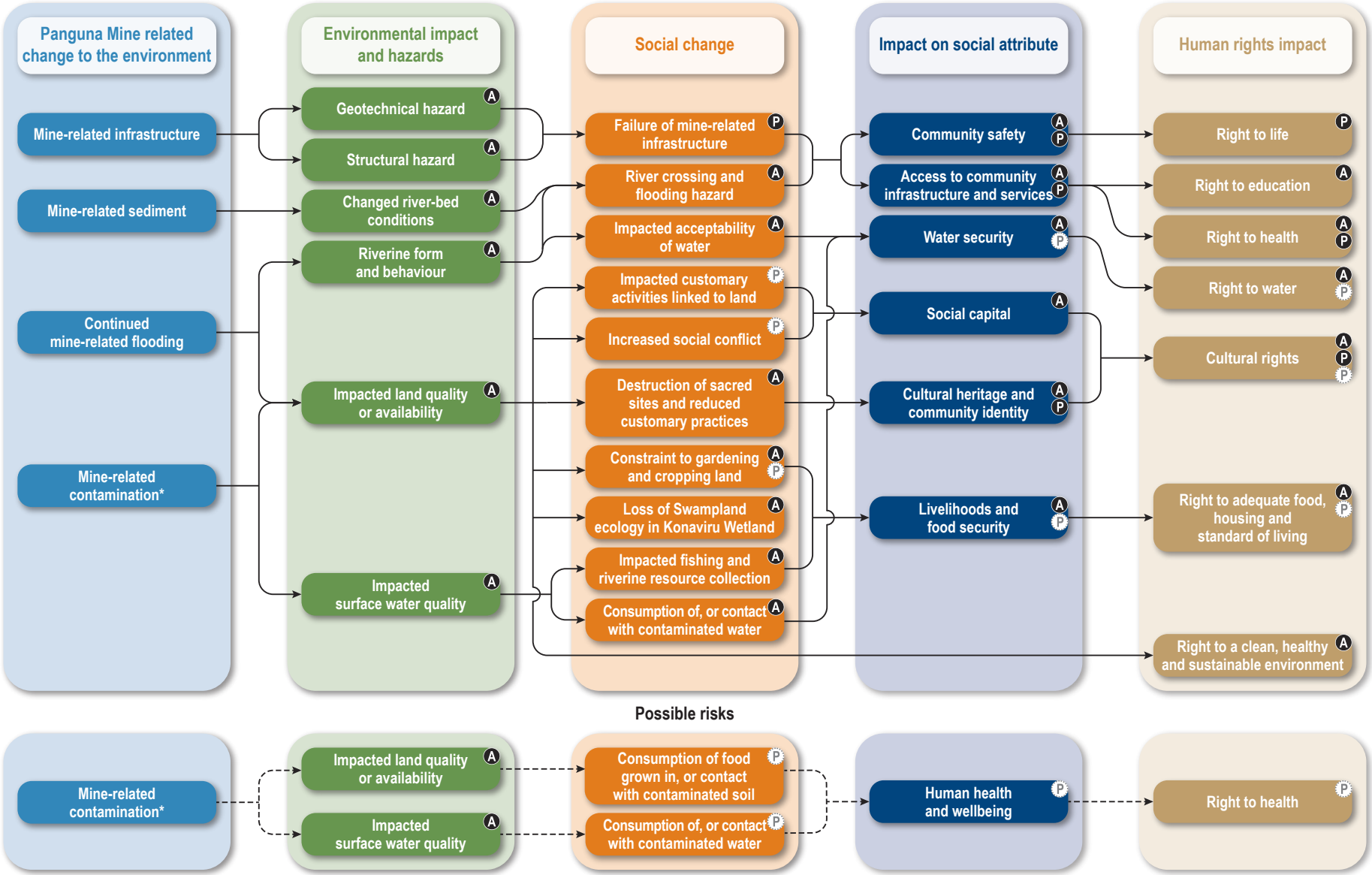
The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified three areas of geotechnical hazard, two structural hazards in the River System Domain, and hazards pertaining to river crossings (see Figure 11.7). Exposure to these mine-related hazards may impact the right to life of rightsholders in communities. Vulnerable groups such as children and those who are physically vulnerable were assessed to have the same impact as community rightsholders, except for river crossing hazards, which have been assessed separately.

An assessment of these impacts is provided in the following sections.

Table 12.8 Environmental and social impact connections with human rights impacts – River System Domain

Environmental impact or other hazard	Social impact/risk	Human rights	Relevant rights holders
Geotechnical land stability hazards associated with legacy mine infrastructure.	Potential impact on community safety due to geotechnical hazard events.	Potential impact on the **right to life** from exposure to geotechnical hazard events that may result in fatalities.	Community; physically vulnerable groups; ASM workers
Structural hazards associated with legacy mine infrastructure.	Potential impact on community safety due to structural failure of mine-related infrastructure.	Potential impact on the **right to life** from exposure to structural hazards that may result in fatalities.	Community; physically vulnerable groups
Impacted land quality due to mineralised and non-mineralised contamination.	Possible impact on livelihoods and food security due to mineralised contamination on land and soil quality.	Possible impact on **right to adequate food, housing and standard of living** due to contaminants.	Community
	Possible risk to human health and wellbeing due to exposure to mine-related contaminants in soil and food.	Possible risk to the **right to health** from exposure to mine-related contaminants in soil and food.	Community; physically vulnerable groups
Impacted surface water quality in the Kawerong-Jaba River system due to mineralised contamination.	Possible risk to human health and wellbeing due to exposure to mineralised contamination in surface water.	Possible risk to the **right to health** from exposure to mine-related contaminants in water.	Community; ASM workers
	Actual impact to water security due to exposure to mineralised contamination in surface water.	Actual impact on the **right to water** due to mine related impacts.	Community; physically vulnerable persons
	Actual impact on livelihoods and food security due to mineralised contamination in surface water	Actual impact on **right to adequate food, housing and standard of living** due to impacts to fishing.	Community
Changed flooding regime and river form due to tailings erosion, migration and sedimentation	Actual impact to community safety due to river crossing and flooding hazards.	Potential impact on the **right to life** due to hazardous river crossings and flooding that may result in fatalities	Community; physically vulnerable persons
	Actual impact to access to community infrastructure and services due to flooding hazards.	Actual impact on **right to health** from constrained access to community infrastructure and services due to flooding.	Community; physically vulnerable persons

Environmental impact or other hazard	Social impact/risk	Human rights	Relevant rights holders
	Actual impact to social capital due to reduced land availability and usability.	Actual impact on **cultural rights** from flooding and tailings deposition.	Community, customary groups
	Actual and potential impact to cultural heritage and community identity due to loss of cultural heritage sites.	Actual impact on **cultural rights** from flooding and tailings deposition.	Community, customary groups
	Actual impact to livelihoods and food security due to impacted land quality.	Actual impact on **right to adequate food, housing and standard of living** due to flooding.	Community
	Actual, potential and possible impacts to water security due to impacts to water acceptability.	Actual impact on the **right to water** due to flooding	Community; physically vulnerable persons
	Actual impact on access to community infrastructure and services	Actual impact to **right to education** from riverine behaviour	Children
Loss of Swampland vegetation in Konaviru Wetland	Possible impact to livelihoods and food security and due to loss of access to bush resources.	Possible impact on **right to adequate food, housing and standard of living** due to loss of resources.	Community
Mineralised and non-mineralised contamination in River System Domain	Mine-related contamination to land and water quality.	Actual impact on **right to a clean, healthy and sustainable environment** from exposure to mine related environmental impacts	Community



NOTE
*Mine-related contamination includes mineralised and non-mineralised contamination

SOURCE
Tetra Tech Coffey, 2024

LEGEND

- (A) Actual impacts
- (P) Potential impacts
- (P) Possible impacts / risks

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FIGURE 12.4

Connections between environmental impacts, social impacts and human rights impacts in the River System Domain

TETRA TECH COFFEY

DATE: 01.11.24 PROJECT: 754-MELEN305719 FILE: 305719_R03_F12.04_GRA

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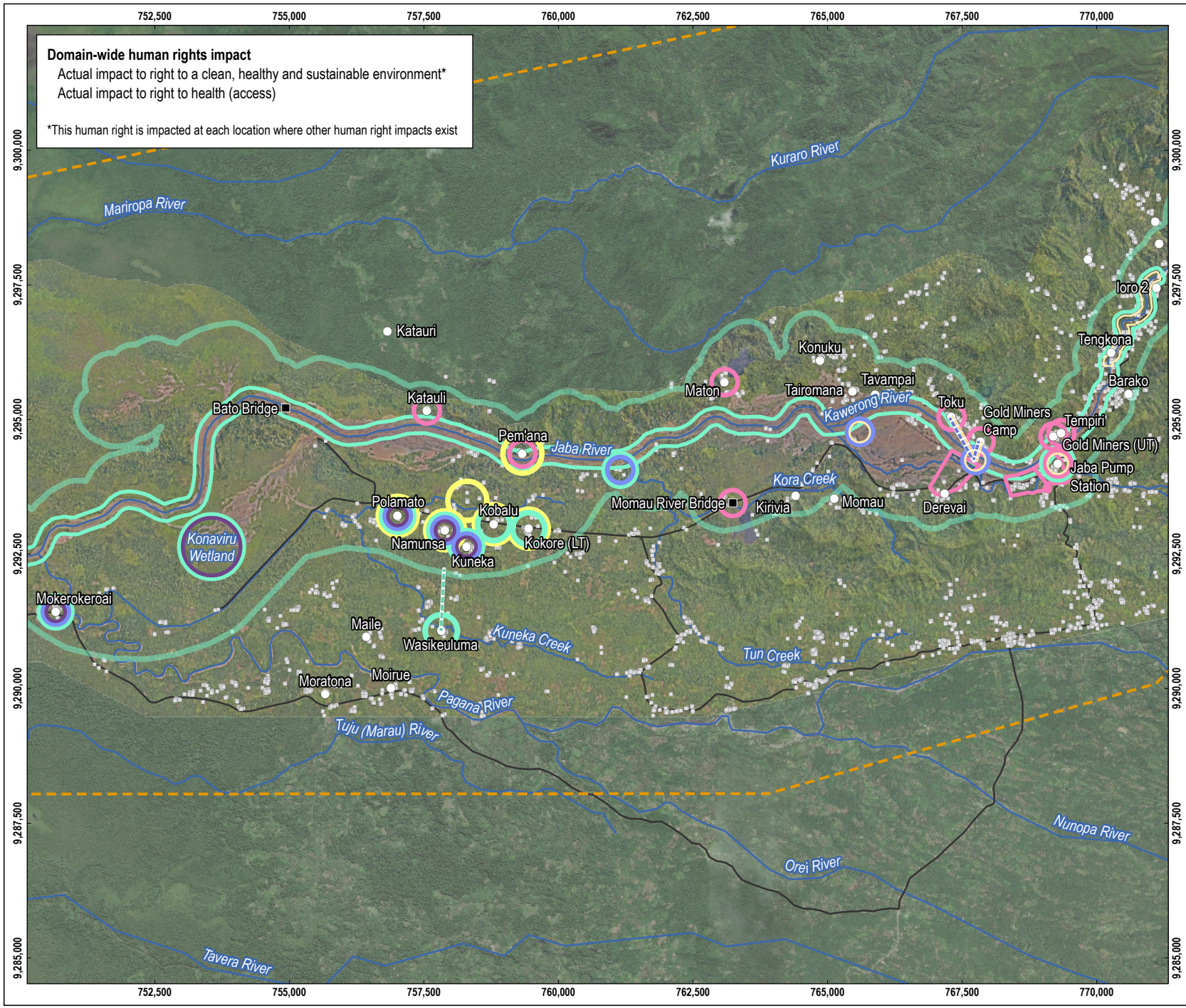
DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\305719_MELEN_PLAC_LEGACYIMPACTASSESSMENT\2_GRAPHICS\305719_R03_LIA\305719_R03_GRA220.AI_14 | SAVED BY: RH | 01.11.24



LEGEND

- Village
- Point of interest
- Main dwelling structure
- Road
- Watercourse
- Phase 1 study area

Human rights impact

- Actual impact to right to water
- Actual impact to right to education
- Actual, potential and possible impact to cultural rights
- Actual and possible impact to right to adequate food, housing and standard of living
- Potential impact to right to life
- Possible risk to right to health

Conservatively included community

- Actual impact to right to water
- Possible impact to right to adequate food, housing and standard of living
- Possible risk to right to health

Impact extents are approximate and circles shown are symbolic only. These areas should be used be used as a guide only.

SOURCE
Impacts, households, study area, villages, roads and watercourses from Tetra Tech Coffey.
Imagery from Woolpert (2023) and AGOL.

0 1 2 km

SCALE **1:100,000**
PAGE SIZE: **A4**
PROJECTION: **WGS 1984 UTM Zone 56S**

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.5

Summary of impacted human rights – River System Domain

TETRA TECH COFFEY

DATE: **31.10.24** PROJECT: **754-MELEN305719** FILE: **305719_R03_F12.05_GIS**

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DOC REFERENCE: \\TT.LOCAL\COF\S772\S\GIS\305719_MELEN_PLAC_LEGACY\MPACTASSESSMENT\1_PLAC_LIA_GIS\APRX\305719_R03_FIGS_P.APRX LAYOUT:305719_R03_GIS219.6 SAVED BY: JASON.ORAM 31.10.24 5:32 PM

During the participatory photography process, individuals raised concerns relating to the right to life in the River System Domain (Plate 12.2 and Plate 12.3).

12.6.1.1 Community rightsholders

Geotechnical hazards

Three areas in the River System Domain present an extreme or high risk geotechnical hazard to communities and have the potential to impact the right to life. These geotechnical hazards all relate to the potential failure of the Main/Pump Station Levee at the junction of the Kawerong and Jaba rivers.

Section 1 and 2 of the levee may fail in the future either from levee failure or liquefaction. As modelling of the runout area has not been undertaken, the area of geotechnical hazard has been used to identify the population at risk. These areas are not precise, and are used to precautionarily estimate the upper range of a potential area of impact, and therefore the upper range of the potentially affected population. Failure at each section of the Main/Pump Station Levee would affect an area as follows (Section 11.4.3):

- **Section 1 of the levee would affect the Jaba Pump Station village and Jaba River.** A modelled population of 220 live in 49 dwellings within this area. People may also travel, work, or collect resources (e.g., bush resource collection, gardening) in this area.
- **Section 2 of the levee and Jaba River would affect an area to the west and downstream of Jaba Pump Station.** A modelled population of 130 live in 29 dwellings. People may also travel, work, or collect resources (e.g., bush resource collection, gardening) in this area.

Section 4 of the levee may also fail, most likely due to further erosion of the headcut capturing the Kawerong River, leading to localised flooding immediately downstream on the Jaba River. No residential structures were identified in the predicted area of flooding, although failure may affect ASM workers. The impact of failure on the right to life for ASM workers is assessed in Section 12.6.1.2.

Based on the above and the results of the geotechnical and hydrology and fluvial geomorphology assessments, the likelihood of fatalities occurring in the event of levee failure is **likely**.

Consequently, their scale and remediability are the same, and rated as follows:

- **Scale:** The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Remediability**: The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Table 12.9 defines the scope of potential geotechnical hazard risks associated with levee failure based on the currently identified runout areas and the subsequent severity and salience rating for each failure event.

Table 12.9 Scope of potential geotechnical hazard risks that may affect right to life and subsequent severity and salience ratings – River System Domain

Event	Scope	Severity	Salience
Failure of Section 1 of the levee.	The scope of the potential impact is **minor**. An estimated modelled population of 220 people lives in 49 dwellings within this area.	Severe	**Very high**
Failure of Section 2 of the levee.	The scope of the potential impact is **minor**. An estimated modelled population of 130 people live in 29 dwellings.	Severe	**Very high**

"Safety is not guranteed."

Photo credit: Community participatory photography, 2023

Plate 12.2
Participatory photography photo and quote showing damaged land in Barako

"This levy was secured and safe when BCL/CRA was operating the mine. In 2000 heavy rain caused flooding which washed out the road making it unsafe for us who live at the Jaba Pump Station."

Photo credit: Community participatory photography, 2023

Plate 12.3
Participatory photography photo and quote showing the levy near the Jaba Pump Station

Other factors not related to the Panguna Mine that contribute to the geotechnical hazards in the River System Domain include environmental hazards (earthquakes, flooding) and behaviours of people interacting with the levees, particularly the extensive ASM activity. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

All potential impacts to the right to life from geotechnical hazard events have a **medium** degree of uncertainty, based on limitations detailed in the Geotechnical Assessment (Appendix C) and those identified relating to social data. These are summarised in Section 11.7.

Structural hazards

Two mine-related structures in the River System Domain may fail and adversely affect the right to life:

- The remains of the Jaba Pump Station are in critical condition and could collapse from an earthquake. The space next to the portal frame building is used as a gathering place and place of worship.
- The Momau River Bridge could collapse from a vehicle crossing. The bridge connects a modelled population of approximately 5,000 people to the west into higher order services in the east.

Given the regular use of these areas by people, along with the results of the structural assessment, the likelihood of fatalities occurring in the event of a failure is **likely**.

Consequently, the scale and remediability of the two structural failures are the same, and rated as follows:

- **Scale:** The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Table 12.10 defines the scope for each structural risk based on the potentially affected population.

Table 12.10 Scope of potential structural risk that may affect right to life and subsequent severity and salience ratings – River System Domain

Structure at risk of failure	Scope	Severity	Salience
Jaba Pump Station	The Jaba Pump Station is used regularly by people as a church. The number of people using the site may fluctuate. Taking a precautionary approach, it is assumed that greater than 50 people could be affected, equating to a **minor** scope.	Severe	**Very high**
Momau River Bridge	The Momau River Bridge is used by a large population; however, a failure would only adversely affect the right to life for those using the bridge at the time of failure. In an instance that a public motor vehicle carrying many people, the number is assumed to be less than 50 people, equating to a **minimal** scope.	Major	**High**

Other factors not related to the Panguna Mine that contribute to the structural hazards in the River System Domain include environmental hazards (strong winds, earthquakes) and behaviours of people interacting with infrastructure, such as salvaging, and undermining of building foundations. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **low** degree of uncertainty, based on limitations detailed in the Structural Assessment (Appendix F) and those identified relating to social data. A summary of these is provided in Section 11.7.

Riverine hazards

As with any river system that receives around 4 m of rain per year, there are regular periods of high flow, particularly during the monsoon season from December to May. Irrespective of the riverine impacts of the Panguna Mine, all communities on the northern banks of the Jaba River would be effectively cut off during such high flow events unless they have access to a bridge. This has the potential to affect a range of human rights, including right to health (Section 12.6.1), right to adequate food, housing, and standard of living (Section 12.6.3), and right to education (Section 12.6.5). This section considers potential impacts to the right to life where river crossing conditions are hazardous under normal or non-flood events.

Communities have reported that crossing the Kawerong and Jaba rivers can be hazardous (Section 11.4.1.8). The conditions of the Kawerong and Jaba rivers have changed substantially from before mining and areas have continued to change since 1989 due to ongoing mine-related sediment movement. These changes can impact the safety of crossing the river at different points.

The Hydrology and Fluvial Geomorphology Assessment (Appendix D) analysed 2023 river conditions to identify hazardous crossing areas under normal flow conditions (below 50% peak flows). River conditions along populated stretches of the western banks of the Kawerong River and the northern banks of the Jaba River that were greater than 2 km from a bridge were examined.

The analysis used flow modelling to calculate the percentage of time the river would typically exceed low hazard criteria for adults, and a separate criteria for young children and physically vulnerable people (e.g., the elderly) based on Engineers Australia (2010) standards.

Importantly, low hazard conditions do not mean that there is no hazard as there is a level of hazard for all river crossings. No analysis was provided for infants, small children, and older individuals, as they are assumed to require assistance in crossing rivers under all conditions.

Villages and surrounding residences with greater relative hazards for river crossing that do not have nearby access to a bridge include:

- The villages of Tempiri, Gold Miners (UT), Gold Miners Camp, and Toku, where conditions are hazardous for adults about 20% of the time or 73 days per year. Modelling estimated that the population in this area was 183 households, or 580 adults. Conditions are hazardous for children/physically vulnerable people about 50% of the time or 182 days per year. Modelling estimated the vulnerable population including children and elderly people to be 240.
- The villages north of the lower end of Tailings Basin 1, which includes Maton, where conditions are hazardous for adults about 20% of the time or 73 days per year. Modelling estimated that the population in this area included 160 adult persons. Conditions are hazardous for children/physically vulnerable people about 50% of the time or 182 days per year. Modelling estimated the vulnerable population including children and elderly people to be 50.

Although communities reported that they know a number of ‘warning signs’ that flooding will occur, flow conditions can change quickly, increasing the hazard for people. The Complaint reported fatalities in the past from river crossings, including people from Pem’ana and Derevai village (also referred to as Rerevai).

Riverbed conditions also affect the safety of a crossing. Some mining sediment has created a quicksand-like effect, primarily in the lower end of Tailings Basin 1 to the end of Tailings Basin 2 (Appendix D Investigation Report: Hydrology and Fluvial Geomorphology). Communities affected include Maton, Pem’ana, and Katauli. Modelling estimated that the population in this area was 72 households, or 400 persons, including a vulnerable population around 280.

Based on the above, the likelihood of fatalities occurring from river crossings due to hazards associated with flow conditions is **almost certain**. The severity of the potential impact is **severe**, based on:

- **Scale:** The scale of the potential impact is severe and may result in fatalities. The effect is limited to around 20% of the year for adults, or around 73 days per year for flow conditions for people in the villages of Tempiri, Gold Miners (UT), Toku, and Maton.
- **Scope:** The scope of the potential impact is moderate. The population on the western banks of the Kawerong River or the northern banks of the Jaba River without access to a nearby bridge where there are hazardous conditions is estimated to be 370 people.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from river crossings in hazardous flow conditions for community rightsholders is **very high.**

Based on the above, the likelihood of fatalities occurring from river crossings due to hazards associated with riverbed conditions is **almost certain**. The severity of the potential impact is **severe**, based on:

- **Scale:** The scale of the potential impact is severe and may result in fatalities. The effect is likely to be year-round and exacerbated by changes in flow conditions.
- **Scope:** The scope of the potential impact is moderate. The population affected is estimated by modelling to be 400 people, equating to be greater than 1% and less than 10% of the overall population in the study area.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from river crossings in hazardous flow conditions for community rightsholders is **very high.**

Other factors not related to the Panguna Mine that contribute to the riverine hazards in this domain include period of high flow and flooding that occur naturally with any river system particularly one in a high rainfall environment such as Bougainville. Behaviours of people in relation to river crossings is also relevant, where during engagement river crossings were noted more of an access constraint than safety hazard as people normally avoid crossing the rivers when conditions are unsafe. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.1.2 ASM workers rightsholders

Geotechnical hazards

The area that would be affected by failure of Section 4 of the Main/Pump Station Levee was modelled as part of the Hydrology and Fluvial Geomorphology Assessment (Appendix D). All flows associated with the most likely failure of the levee in this location, including the scenario with a 1-in-100 flood event, remain contained within the main flowpath of the Jaba River. No formal housing structures were identified in this area most likely because the area is subject to regular flooding. The area is known to be used for ASM, and a small number of structures were established in the tailings/riverbed around the affected area. These are assumed to be ASM camps. The number of people undertaking ASM in the area is unknown and will fluctuate (Section 11.4.1.4).

The likelihood of fatalities occurring in the event of a failure is **possible**. The severity of the potential impact is **severe**, based on:

- **Scale:** The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Scope:** The potential impact is minor. People working and travelling through these areas are at risk. As there is limited understanding of the population at risk, it is conservatively assumed that a failure of Section 4 of the levee would affect between 50 and 310 people.
- **Remediability:** The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life for ASM workers from failure of Section 4 of the Main/Pump Station Levee is **very high.**

Other factors not related to the Panguna Mine that contribute to the geotechnical hazards in the River System Domain include environmental hazards (earthquakes, flooding) and behaviours of people interacting with the levees, particularly the extensive ASM activity. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Geotechnical Assessment (Appendix C) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.2 Right to health

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related impacts that have the potential to affect the right to health for some people in the River System Domain. This includes impacted access to healthcare due to structural hazard events.

Impacts to right to health may affect community rightsholders, as well as specific vulnerable groups, including women, children and physically vulnerable people. Unless otherwise stated, vulnerable groups were assessed to have the same impact as community rightsholders.

Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition or impact. Section 12.6.9 identifies where a possible health risk exists in the environment directly connected to the Panguna Mine, and where further investigations would improve understanding of the health risk.

12.6.2.1 Community rightsholders

Reduced access to healthcare due to riverine hazards

The River System Domain has low levels of locally available community infrastructure and services. People in the east of the domain must travel to Panguna Town to access a health centre. For people in Mokerokeroai, Kuneka and the west of the domain, Moratona hosts the closest health centre.

Floods in the Kawerong-Jaba River system were reported to disrupt community access to essential infrastructure and services. When floods happen, areas without safe crossings, like bridges, become inaccessible, impacting people's ability to reach health facilities. Although flooding would occur in this system without the effects of the Panguna Mine, due to the ongoing change in river morphology due to mine-derived sediment it has been conservatively included as a mine-related impact.

The following populations have been identified to be isolated during flood events. These populations have been identified on the basis that they live on the opposite side of a river from where there is access to a road and therefore services, and are located more the 2 km from a bridge. To calculate an accessible walkable

distance a pedestrian catchment of a 30-minute walk was adopted. In an urban context, this would be 2,400 m (Newman and Kenworthy, 2006). Given the rural context this has been reduced to 2,000 m or 2 km. This means that the communities must travel by foot greater than 2 km to reach a bridge. The following areas meet these criteria:

- The population on the **western banks of the Kawerong** River greater than 2 km from a bridge, including the villages of Tempiri and Gold Miners (UT), which was modelled as 51 households, or 220 persons.
- The population on the **northern banks of the Jaba River**, including the villages of Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Pem'ana and Katauli, which was modelled as 382 households, or 1,640 persons.
- The population **south of Kuneka Creek**, including the villages of Polamato and Kuneka, Maile, and Waikeuluma, which was modelled as 252 households, or 2,330 persons.
- The population **west of the lower Pagana River**, which was modelled as 33 households, or 130 persons.

People are also isolated during flood events if they rely on wet crossings to access services. Wet crossings refer to crossing a waterbody by moving through the water rather than using a bridge or dry path over it. This includes:

- The population reliant on the wet crossing at **Kuneka Creek**, which was modelled as 15 dwellings, or 70 persons.
- The population reliant on the wet crossing on **Tun Creek**, west of Momau River Bridge, which was modelled as 959 households, or 4,570 persons.

The likelihood of access to healthcare being affected by flooding is **almost certain**. The actual impact to right to health from flooding in the different location has the same scale and remediability rating, as follows:

- **Scale:** The scale of the actual impact is major and may result in a material reduction in health and wellbeing. This would continue until access is restored.
- **Remediability:** The remediability of the actual impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Table 12.11 defines the scope for each area that experiences temporary isolation from community infrastructure and services, and therefore impacts to the right to health, and the subsequent severity and salience rating for each area. Not everyone will need to access healthcare during the flooding events. NSO and the IFC (2019) reported around 37% of Bougainvillean women and 36% of Bougainvillean men visited a health facility in the past 12 months, and these figures were used to estimate the affected population.

Table 12.11 Scope of flooding events that may affect right to health and subsequent severity and salience ratings – River System Domain

Area	Scope	Severity	Salience
Villages located on the western banks of the lower reaches of the Kawerong River.	The scope of the actual impact is **minor**. Flood events are estimated to affect around 80 people.	Moderate	**Medium**
Villages on the Kawerong-Jaba River system on Tailings Basin 1.	The scope of the actual impact is **moderate**. Flood events are estimated to affect around 600 people.	Major	**High**
Villages south of Kuneka Creek.	The scope of the actual impact is **moderate**. Flood events are estimated to affect around 860 people.	Major	**High**
Villages west of the lower Pagana River.	The scope of the actual impact is **minor**. Flood events are estimated to affect around 50 people.	Moderate	**Medium**

Area	Scope	Severity	Salience
Hamlets located on the southwest of Kuneka Creek, along Kuneka Road.	The scope of the actual impact is **minimal**. Flood events are estimated to affect around 30 people.	Moderate	**Medium**
Villages located west of the wet crossing on Tun Creek.	The scope of the actual impact is **moderate**. Flood events are estimated to affect around 1,700 people.	Major	**High**

Other factors affect access to community infrastructure and services, including degradation of infrastructure, government provision of services and community infrastructure, lack of maintenance, and external hazards, such as earthquakes and natural flooding. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

Reduced access to healthcare due to geotechnical hazard events

As described in Section 12.5.2, geotechnical hazard events have the potential to reduce access to healthcare for individuals from communities in the River System Domain. Land instability events (e.g., landslides) along areas of the Port to Mine Access Road and Pirurari Road would mean that these routes would be un-usable until restored. Loss of road access due to landslide would result in communities west of the affected areas having to travel to Arawa via Buin (approximately 180 km) to access hospital level care until the road was restored. Health care is provided at the Moratona Health Centre, although this facility has limited capacity to respond to complex emergency events. Although temporary, a reduction in access to health care could have notable effects on health for rightsholders, particularly during an emergency.

The total population catchment in the River System Domain that could be affected by a failure that affects either the Port to Mine Access Road or the Pirurari Road is estimated to be around 15,500 people. Not all people will need to access healthcare during the period when road access is disrupted. Data from NSO and the IFC (2019) indicates that in 2019, around 37% of Bougainvillean women and 36% of Bougainvillean men had visited a health facility in the past 12 months. Applying these proportions to the catchment, it is estimated around 5,700 persons would be affected if a failure affected the Port to Mine Access Road or the Pirurari Road. However, individuals would be still able to travel to Moratona Health Centre. As such this estimate, is conservative and likely overestimates the affected population.

Given the high use of these areas and the results of the geotechnical assessment, the likelihood of access to healthcare being affected by geotechnical failure is **likely**. The severity of the potential impact is **moderate**, based on:

- **Scale:** The scale of the potential impact is moderate and may result in a notable reduction in health and wellbeing. Alternative health care is provided at the Moratona Health Centre.
- **Scope:** The scope of the potential impact is major. If failure occurred, an estimated 5,700 people in the River System Domain would be affected.
- **Remediability:** The remediability of the potential impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of the potential impact to the right to health from geotechnical hazard events for community rightsholders in the River System Domain is **medium.**

Other factors not related to the Panguna Mine that contribute to human health and wellbeing in this domain include challenges for service delivery faced by the Bougainvillean and Papua New Guinean health system more broadly, such as medicine, funding and staffing shortages.

This impact has a **high** degree of uncertainty, as detailed in Section 11.7.

12.6.3 Right to adequate food, housing, and standard of living

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified several environmental impacts having a detrimental effect on land and water quality since the cessation of mining 1989. These include contamination from tailings, altered flooding and sediment deposition regimes affecting productive land in communities and the Konaviru Wetland, and mine-related effects on aquatic ecology.

Impacts to the right to adequate food, housing and standard of living may affect community rightsholders, and specifically women. An assessment of these impacts is provided in the following sections.

During the participatory photography process, individuals raised concerns relating to the right to adequate food, housing and standard of living, for example (Plate 12.4 and Plate 12.5).

Mine-related contamination in tailings that exceeded the agricultural ecological screening criteria for copper, molybdenum and selenium concentrations was reported in areas of the River System Domain, possibly reducing soil productivity. In general terms, the level of effect can differ depending on the soil, and the crop or plants being grown, among other factors (Mohanta, Pradhan and Behera 2023). The impact of the exceedances on the productivity of gardening land in the contaminated areas of the River System Domain cannot be determined based on the available data. Taking a precautionary approach, it is possible that these exceedances would constrain the productivity of the gardening land and contribute to food security and livelihood issues that are experienced in this domain that affect the right to adequate food and standard of living.

12.6.3.1 Community rightsholders

Impacted capacity to grow enough food enough food to eat and earn income due to mineralised contamination

As previously discussed, by 2023 the area of exposed tailings from the disposal of mine-derived sediment was 1,250 ha. New areas of tailings deposition have occurred since 1989, with the most significant areas in the Konaviru Wetland and the associated channels that affect Kuneka Creek and to a lesser degree the lower Pagana River. The maximum footprint of tailing deposition is now around 2,600 ha, including areas that have been revegetated.

The tailings have elevated copper, molybdenum and selenium concentrations at levels above the agricultural ecological screening criteria which are protective of soil ecology, crop growth and livestock health (Chapter 6). Gardens on land or in soil that have elevated copper, molybdenum and selenium concentrations are not expected to support favourable conditions for growing crops for consumption or to generate an income (Section 10.3).

"We made a big cocoa plantation but the trees don't yield good pods and when we harvest, the supply is so small and we don't earn big cash."

Photo credit: Community participatory photography, 2023

Plate 12.4
Participatory photography photo and quote showing cocoa plantation tree near Gold Miners Camp

"Diversion of the Kawerong River has brought extensive damage to our gardens and cocoa blocks. It is more complicated when there is heavy rainfall."

Photo credit: Community participatory photography, 2023

Plate 12.5
Participatory photography photo and quote raising concerns about gardening in Kuneka

Mapping of land use on areas affected by tailings to identify the number of households or area of land impacted has not been undertaken for Phase 1. Instead, an estimate was developed using a precautionary approach, counting houses within an approximate 400 m buffer from the mapped maximum extent tailings (which in many areas is the extent of tailings at the cessation of mining in 1989). This likely overestimates the number of affected households because:

- Sampling taken from 9 out of 12 (75%) gardens in the tailings extent exceeded the agricultural ecological screening criteria, suggesting not all land affected by tailings is unsuitable or constrained for gardening or cash cropping from mine-related contamination. Further sampling would be required to understand the extent and scale of contamination.
- The buffer is based on the median distance households travel to garden, indicating most people use closer areas.
- People may garden on land elsewhere. Consultation with rightsholders indicated that people generally understand the tailings extent and perceive it as a constraint.

This indicated all villages named in the River System Domain have land use that may be impacted by tailings, except for Moratona, Maile and Moirue, which are instead located along the lower Pagana River upstream of the deposition of tailings at the confluence of the Kuneka Creek Diversion Channel and the lower Pagana River. The modelled estimate can be broken into:

- 846 dwellings, equating to 3,980 people in the Upper and Mid tailings sub-domain.
- 181 dwellings, equating to 690 people in the Lower tailings sub-domain.

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the River System Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact.

Taking a precautionary approach, and based on the current understanding of the contamination associated with tailings and the known tailings extent, the likelihood of mineralised contamination impacting capacity to grow food and generate income is **possible**. The severity of this possible impact is **moderate**, based on:

- **Scale**: The scale of the possible impact is moderate, and may result in a notable impact on livelihoods, although this land is still being used for gardening.
- **Scope**: The scope of the possible impact is major. The effect on soil productivity may occur across the extent of tailings, with a highly conservative estimate indicating a modelled effected population of 1,030 households and a population of 4,670.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

Other factors not related to the environmental impacts of the Panguna Mine after 1989 that may affect a household's livelihood and food security include displacement from customary land, loss of land suitable for agriculture due to establishment of tailings deposition areas during mine operation, population increase and impact on land availability and the subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Water Quality and Geochemical Assessment (Appendix A) and those identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to grow enough food enough food to eat and earn income due to flooding

Mine-related overbank flooding occurs in a small area near the Jaba Pump Station, and is widespread in the Lower tailings sub-domain, and affects communities on either side of Kuneka Creek, including Namunsa, Polamato, and Kuneka (and surrounding hamlets). There is extensive flooding of the area surrounding Mokerokeroai village. While the contribution of flow and sediment from the Kuneka Creek Diversion Channel may have a small impact on the Mokerokeroai and other communities surrounding the lower Pagana River, the extent to which the Kuneka Creek Diversion Channel impacts flooding cannot be accurately estimated. Consequently, mine-related effects on flooding regimes have contributed in a minor manner to flooding in this area.

Depending on rainfall levels, multiple flood events may occur annually, although no flood frequency modelling has been conducted for Phase 1. Flooding events can reduce or destroy crops and garden plots, and have a subsequent effect on food security and income generation and the right to adequate food and standard of living.

As noted previously, communities reported that not everyone in their community is affected by flooding and that households are affected based on where their gardening and cash cropping land is located.

As detailed land mapping has not been undertaken, a highly conservative estimate of the affected population of this impact has been developed based on households within an approximate 400 m buffer[5] of the 2023 flood modelling.

The modelled estimate of affected households can be summarised as:

Upper and Mid tailings sub-domain

- **The Kawerong-Jaba River system on Tailings Basin 1:** Jaba Pump Station and surrounding areas: seven households, equating 30 persons.
- Jaba River – ‘the narrows’, along lower Tun Creek: 20 households, equating to 90 persons.

Lower tailings sub-domain

- **Kuneka Creek:** Namunsa, Polamato, Kuneka, Kobalu, Kokore, and Wasikeuluma and surrounding hamlets: 383 households, equating to 1,890 persons.
- **The lower Pagana River:** Mokerokeroai and villages surrounding the lower Pagana River: 104 households, equating to 460 persons.

Based on the outcomes of flood modelling, and the general understanding of flood frequency, the likelihood of flood events impacting rightsholders’ capacity to grow food and generate income is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The scale of the actual impact is major, and may result in a material impact on livelihoods, although this land is still being used for gardening. The level of impact for each rightsholder would depend on the area of land used that is affected, how often it floods, and their capacity to access other areas. The rating has been made precautionarily.
- **Scope**: The scope of the actual impact is moderate. The area of land affected by flooding is estimated to impact a total of 514 households with a modelled population of 2,470 persons.
- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

[5] This is based on the same assumption outlined in the mineralised contamination section. Based on participatory mapping, the median distance households travel to garden is around 400 m, indicating most people use closer areas.

Consequently, the salience of the actual impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

Other factors not related to the Panguna Mine that may affect a household's livelihood and food security include displacement from customary land, loss of land suitable for agriculture due to establishment of tailings deposition areas during mine operation, population increase and impact on land availability and the subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to grow enough food enough food to eat and earn income due to impacts to Konaviru Wetland

In 2023, bush collection continues to contribute to people's livelihoods and overall social wellbeing, particularly in the Lower tailings area.

Sediment deposition and buildup continued to occur post-1989 in the river system and in the lower floodplains. In 2017, sediment buildup led to flows in the lower Jaba River rapidly changing course, creating a new channel through the Konaviru Wetland upstream of Bato Bridge, depositing tailings into the Konaviru Wetland. Tailings have consequently smothered vegetation and fundamentally changed and the resources that people may have collected in this area are no longer available to them. These resources are likely to include firewood, larger trees for building houses, palm leaves for house construction, foods, and hunting and fishing targets.

There is limited understanding of the number of households or communities that use or have rights to this area, as this was outside of the Scope of Work for Phase 1. As a result, this impact is categorised as a possible impact. Based on the results of participatory mapping, bush resource collection is generally limited to an area within 3 km of a settlement, noting that other areas, such as sago stands in this area used to be travelled to.

Using a 3 km buffer from the affected area, 375 households, equating to 1,800 persons were modelled as having general loss of bush resources. Further investigation regarding resource use would improve understanding of specific uses of this area, along with rights associated with this use.

Based on the above, the likelihood of sediment build-up in Konaviru Wetland impacting rightsholders' capacity to grow food and generate income is **likely**. The severity of this possible impact is **moderate**, based on:

- **Scale**: The scale of the possible impact is moderate. Bush resource collection supplements people's livelihood strategies and the value of the Konaviru Wetlands for bush collection has been completely lost for this purpose. The level of impact for each rightsholder would depend on their use of the area, and their capacity to access other areas. Some rightsholders may have difficulty securing access to other resources, depending on cultural rights to access these resources.
- **Scope**: The scope of the possible impact is moderate. An upper limit estimate using the population modelling identified 375 households, equating to 1,800 persons as potentially being affected.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

Other factors not related to the Panguna Mine that may affect a household's livelihood and food security include population increase and the subsequent intensification in the collection of bush resources. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to fish for food and earn income due to impacts to the Kawerong-Jaba River system

Since 1989, mine-related impacts have continued to affect the functioning of the Kawerong-Jaba River system in the River System Domain. Continued effects on aquatic ecology in the Kawerong-Jaba River system are likely to constrain the amount of edible riverine resources (e.g., fish and crustaceans) available to communities.

As aquatic ecology surveys were outside the Scope of Work for Phase 1, the extent of impacts to fish, crustacean and other resources that communities may rely on is unquantified. These impacts are predicted to continue to affect aquatic ecology in the River System Domain for the reasonably foreseeable future due to the quality of the water in the river.

Although the functioning of much of the Kawerong-Jaba River system is impacted communities in the Lower tailings reported that they fish in the lower Pagana River, and small creeks and watering holes connected to Kuneka Creek and the lower Pagana River.

Communities reported that the lack of fish in the river meant that people must buy fish, one of their main protein sources, from markets. Indicatively, compensation payments in the 1980 compensation agreement were based on each person catching and consuming 50 pounds of fish per year (AGA, 1989). Very limited fishing was reported, in the Upper and Mid tailings sub-domain, and only small amounts were reported in the Lower tailings sub-domain.

Based on the results of the aquatic ecology assessment and the social and human rights characterisation, impacting rightsholders capacity to fish and generate income from aquatic resources is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The scale of the actual impact is moderate. Fishing supplements people's food security and livelihood strategies and the value of the Kawerong-Jaba River system has continued to be completely lost for this purpose.
- **Scope**: The scope of the actual impact is major. Impacts to fishing continue to occur throughout most of Kawerong-Jaba River system, noting that some households from Mokerokeroai and Kuneka reported undertaking fishing. It has been conservatively estimated that communities along the Kawerong-Jaba River system have been impacted by this. This is modelled to be up to 895 households, with a modelled population of 3,920 people.
- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the actual impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

Other factors not related to the Panguna Mine that may affect a household's livelihood and food security from riverine resources include ongoing ASM activities in the Kawerong-Jaba River (including likely use of mercury). Similarly, the growth of population in this area likely also places pressure on the limited riverine resources. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations identified relating to social data. A summary of these is provided in Section 11.7.

12.6.4 Right to water

Access to water is fundamental to people's productive capacity. The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified changed flooding regimes and mineralised contamination affecting water sources in the River System Domain.

All samples collected from community identified water sources in the River System Domain were below the adopted health drinking water screening criteria for mine-related contaminants.

Impacts to the right to water may affect community rightsholders from communities along the northern Jaba River bank, the community along the lower Tun Creek, Kuneka, Namunsa, Polamato and Mokerokeroai. Vulnerable groups, such as women and those who are physically vulnerable, were assessed to have the same impact as community rightsholders. An assessment of these impacts is provided in the following sections.

During the participatory photography process, individuals raised concerns relating to the right to water in the River System Domain, for example (Plate 12.6 and Plate 12.7).

Reduced water security due to changed flooding regimes and mineralised contamination

The flood modelling indicates that the physical presence of tailings in the Kawerong-Jaba River system has led to changes in flood regimes in Tun Creek, Kuneka Creek and to a lesser degree the lower Pagana River. Communities in these areas reported that they primarily relied on these water courses for domestic (drinking and bathing) purposes.

Flooding in these watercourses reduces the overall acceptability of water available to households as flood water is perceived to be unsafe to drink by communities therefore, impacting water security. No engagement was conducted with the community along Tun Creek, therefore there is limited understanding of water use in this area. As a result, this impact is categorised as a possible impact.

As noted in Section 12.6.3, this is a conservative estimate and mine-related effects on flooding regimes have contributed in a minor manner to flooding in the lower Pagana River.

Mineralised contamination was identified at 13 sampling locations in the River System Domain above the drinking water screening criteria in the Kawerong-Jaba River, including in the Kawerong River on northern side of Tailings Basin 1. Communities in these areas, such as Gold Miners Camp and other temporary ASM camps, may rely on these water sources.

"The drinking water source was safe before [the] diversion of Kawerong River. When there is flooding and the water level rises, we do not drink the water until the water level drops."

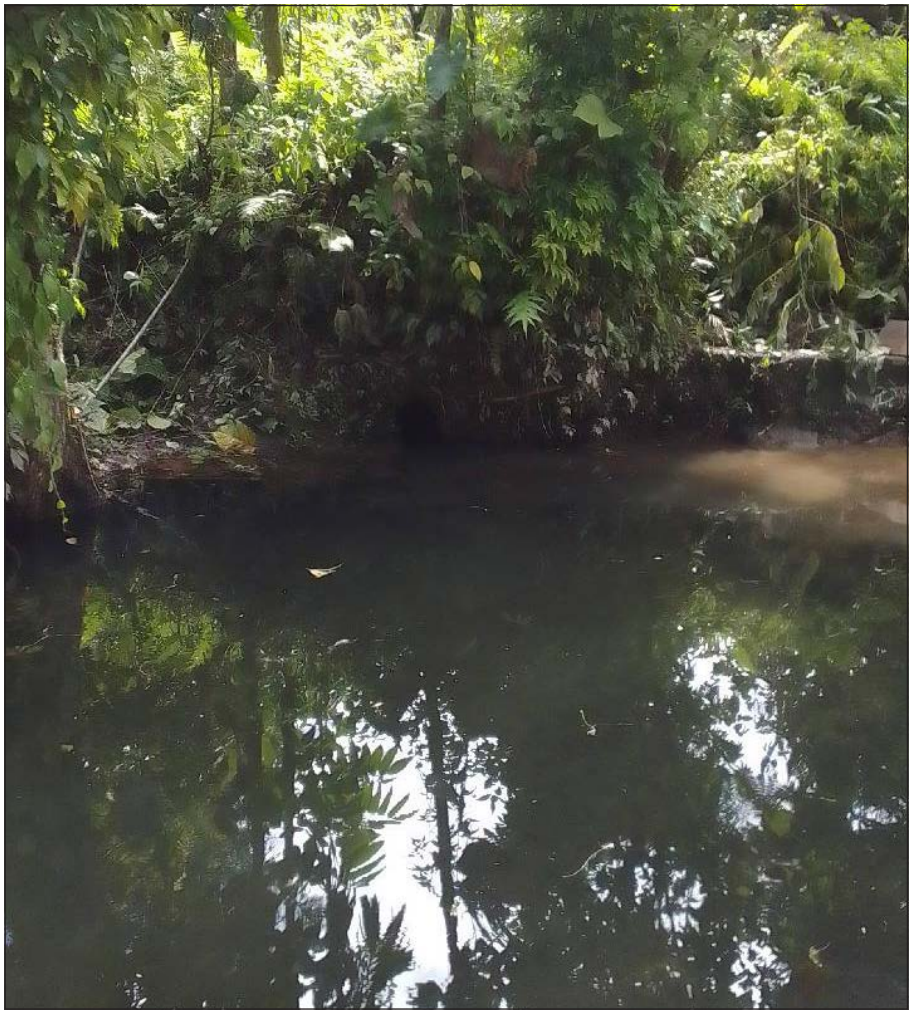


Photo credit: Community participatory photography, 2023

Plate 12.6
Participatory photography photo and quote showing drinking water sources in Kuneka

"Our (family) drinking water was covered by Kawerong River. In 1989, when the tailing waste subsided, we started using it to drink and bath. We know that it is not safe, but we have no other safe water to use here."

Photo credit: Community participatory photography, 2023

Plate 12.7
Participatory photography photo and quote showing drinking water sources in Gold Miners Camp

Additionally, the adopted recreational water health screening criteria were also exceeded at five sampling locations in the Kawerong River including between Onove and Barako and in Tailings Basin 1.

The identified exceedances of copper and manganese reduce the quality of the water sources available to households and individuals in these areas. Given that limited alternative water sources are available in the area during the dry season, and that some households may not have rights to access other water sources (e.g., temporary ASM camps), water security for households and individuals is reduced.

The likelihood that changed flooding regimes adversely affects the right to water in some areas is **almost certain**, except for Tun Creek where the likelihood is **likely**. The severity of the actual and possible impacts is **moderate**, based on:

- **Scale**: The scale of the actual and possible impacts is moderate and may result in a notable impact on livelihoods and wellbeing, although limited alternative water sources are still available.
- **Scope:** The scope of the actual and possible impacts is minor. People who rely on these watercourses as their main water source are at risk, which is likely to include individuals living in the community along the lower Tun Creek, Kuneka, Namunsa, Polamato, and Mokerokeroai. It is estimated to affect a modelled population of around 330.
- **Remediability**: The remediability of the actual and possible impacts is minor. Restoration of the human right that have been impacted is readily achievable with the implementation of simple, established practices.

Consequently, the salience of the actual and possible impacts to the right to water for community rightsholders from the community along the lower Tun Creek, Kuneka, Namunsa, Polamato, and Mokerokeroai is **medium.**

As sediment moves downstream, it is likely that the flood extent and tailing deposition will change. Further changes in flooding extent may impact currently unaffected water sources. The extent of future impacts on the right to water is unknown, as the extent of future flooding has not been predicted as part of Phase 1. Potential impacts to the right to water for community rightsholders in the River System Domain would have a similar severity level to actual and possible impacts. Therefore, the potential impact on the right to water has a salience of **medium**.

The likelihood that mineralised contamination adversely affects the right to water is **almost certain**. The severity of the actual impact is **moderate**, based on:

- **Scale**: The scale of the actual impact is moderate and may result in a notable impact on livelihoods and wellbeing, although limited alternative water sources are still available.
- **Scope:** The scope of the actual impact is minor. People who rely on the Kawerong-Jaba River for their water source are at risk, which is likely to include individuals living in communities along the northern Jaba Riverbank. It is estimated to affect a modelled population of around 80.
- **Remediability**: The remediability of the actual impact is minor. Restoration of the human right that have been impacted is readily achievable with the implementation of simple, established practices.

Consequently, the salience of the actual impact to the right to water for community rightsholders who use the Kawerong-Jaba River for their water is **medium.**

Other factors not related to the Panguna Mine that may affect household's water security include population increase and subsequent intensification in the consumption of water, general sanitation practices and maintenance of water supply infrastructure. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.5 Right to education

Reduced access to education due to riverine hazards

As detailed in Section 12.6.1, the Kawerong-Jaba River system floods (for detail see Section 11.4.1.4). Although flooding would occur in this system without the effects of the Panguna Mine, due to the ongoing change in river morphology due to mine-derived sediment it has been conservatively included as a mine-related impact.

When floods occur, areas without safe crossings, like bridges, become inaccessible. This may affect rightsholders' access to school. This interruption, though temporary, may occur multiple times per year, depending on the level of rainfall. Communities reported that access can be disrupted for up to several days.

Table 12.12 outlines the population that is isolated from schools during flood events. All other areas that experience isolation flooding are still able to access schools, generally, because a school is located within walking distance and does not require crossing a river.

This analysis has been undertaken for primary school children only, as in general students board closer to areas where there is a high school, if they have achieved a place in a school. The frequency that the isolation-level flooding may occur cannot be assessed, as flood frequency has not been modelled.

Table 12.12 Access to education – catchment of schools subject to mine-related affects to access

School and mine-related affect	Known catchment
Kuneka School is in Kuneka. Mine-related changes in the Jaba River have caused Kuneka Creek and an associated tributary to flood more often and to greater levels than previously experienced.	The catchment of Kuneka School includes children from communities in and around: • Namunsa • Polamato • Kobalu • Kokore • Kuneka (north of the creek). The modelled estimated population of primary school age children is 240, out of a residential population of 660 people.
	Children from Pem'ana attend Kuneka School. Access for students in Pem'ana is also affected by the condition of the riverbed, which is discussed in Section 12.6.1.1. The modelled estimated population of primary school age children is 60, out of a residential population of 130 people.

The likelihood of access to education being affected by flooding is an **almost certain.** The severity of the actual impact is **minor**, based on:

- **Scale:** The scale of the actual impact is minor, and results in a small reduction in access to education. The effect may occur multiple times per year.
- **Scope:** The scope of the actual impact is minor. The modelled estimate of the affected population is 240 children, based on a total residential population of 660.
- **Remediability:** The remediability of the actual impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of the actual impacts to the right to education from riverine hazard events for children rightsholders in Namunsa, Polamato, Kobalu, Kokore, and parts of Kuneka in the River System Domain, is **medium.**

Children in Pem'ana permanently face regular hazards while crossing the river. The likelihood of access to education being affected by hazards associated with river crossing is an **almost certain.** The severity of the actual impact is **minor**, based on:

- **Scale:** The scale of the actual impact is moderate results in a notable reduction in access to education. The effect is present permanently, and is expected to last into the foreseeable future.
- **Scope:** The scope of the actual impact is minor. The modelled estimate of the affected population is 60 children, based on a total residential population of 130.
- **Remediability:** The remediability of the actual impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of the actual impacts to the right to education from riverine hazard events for children rightsholders Pem'ana is **medium.**

Other factors affect children's right to education include degradation of infrastructure, government provision of services and community infrastructure, lack of maintenance and involvement in subsistence livelihood activities and income generation such as ASM. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.6 Cultural rights

Impacts to cultural rights stemming from impacts to cultural heritage sites and practices associated with these are discussed in this section. These impacts are connected to mine-related river conditions, in particular changes in flooding extent and tailings deposition since 1989. In some areas, this may have affected cultural heritage sites.

Impacts to cultural rights may affect customary groups. Depending on the site affected, impacts may affect different groups. For example, some sites are used by men only or women only. The level of information collected as part of Phase 1 is insufficient to differentiate these impacts, and impacts are discussed for customary group rightsholders as a collective.

Impacts to land from tailings deposition and flooding may also affect community rightsholders from participating in customary activities connected to gardening produce, affecting their right to participate in cultural life. These are assessed below.

12.6.6.1 Customary groups

Impacts on access and value of cultural heritage sites due to changes in flooding and tailings deposition extents

Since 1989, sediment buildup has altered parts of the Jaba River, Kuneka Creek, Konaviru Wetland, and the lower Pagana River, changing flood regimes and spreading tailings into new areas (Section 10.3.2). According to the Complaint and community reports during field investigations, these changes have damaged or destroyed sacred sites since 1989. Areas where sacred sites have potentially been impacted include but are not limited to:

- In flood impact areas in the Lower tailings sub-domain, following the change in the direction of the Jaba River that has deposited tailing from the main Jaba River into new areas, including the Konaviru Wetlands.
- In flood impact areas surrounding Kuneka Creek.

Communities living on leased land were reluctant to discuss sacred sites that do not belong to them. Similarly, there was reluctance to note areas of sacred sites at risk, or to show these places to the field investigation team. Consequently, limited spatial data on sacred sites was collected and there is limited understanding of what sites have been affected by the changed flooding extent/new areas of tailing deposition. Taking a precautionary approach, it is assumed that there has been impacts to sacred sites from changed flooding extent and new tailings deposition areas since 1989. Impacts to sacred sites caused during the construction and operation of the mine are outside the scope of work for Phase 1.

The loss of sacred sites has a flow on effect of preventing and interrupting participation in customary practices.

Based on available information it is **almost certain** that sacred sites have been affected by changes in the extent of flooding and tailings deposition since 1989 and that this has had an actual impact on the cultural rights of customary groups. The severity of the actual impact is **severe**, based on:

- **Scale:** The scale of the actual impact is severe. Loss or damage to sacred sites may result in a material reduction in participation on cultural life and a diminishment of rightsholders cultural rights.
- **Scope:** The scope of the actual impact is minor based on the following identified sites and areas of tailing deposition or flooding extent since 1989:
    - Flooding is extensive in the Lower tailings sub-domain, which includes the communities around Namunsa, Polamato, and Kuneka, and Mokerokeroai. Although less than five sites were identified in this area, communities engaged in this area were leaseholders and, generally, did not comment on cultural heritage.
    - Areas of new tailings deposition, which equate to around 350 ha, including the Konaviru Wetland.
- **Remediability:** The remediability of the actual impact is severe. Restoration of the human right is reported to be irremediable, or restoration may be difficult, complex, lengthy and be incomplete despite remediation efforts.

Consequently, the salience of the actual impact to the cultural rights for customary groups in the River System Domain associated with impaired access to and value of cultural heritage sites due to flooding and tailings deposition extents is **very high.**

As sediment moves downstream, it is likely that the flood extent and tailing deposition will change. Further changes in flooding extent may impact currently unaffected cultural heritage sites. The extent of future impacts on cultural rights is unknown, as the extent of future flooding has not been predicted as part of Phase 1, and a cultural heritage survey has not been undertaken to identify the extent of sites in affected areas. Potential impacts to cultural rights for customary groups would have a similar severity level to actual impacts, resulting in a salience of **very high**.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D), and those identified relating to social data, in particular the identification and understanding of sacred sites. A summary of these is provided in Section 11.7.

Impacts on customary land and resources and associated capacity to participate in cultural life due to changes in flooding and tailings deposition extents

The changes in flooding and tailings extents detailed above and in Section 12.6.3 has reduced the value of customary land and resources.

No social mapping was undertaken as part of Phase 1. Consequently, there is no detail on how many customary groups or rightsholders are affected. The affected areas are the same as those detailed above for those impacted by flooding and tailings deposition.

The likelihood of flooding and tailings deposition impacting the value of customary land and resources and having an associated impact on rightsholders' ability to participate in cultural life is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The level of impact for each rightsholder would depend on the area of land used that is affected, the level of effect of the flooding/tailing (gardening in areas affected by flooding still occurs), and their access to other areas. This level of investigation was not conducted in Phase 1; taking a precautionary approach, the scale of the actual impact on cultural rights is moderate.
- **Scope**: The scope of the actual impact is major.
    - Flooding is extensive in the lower tailings area around Kuneka Creek and the lower Pagana River, potentially affecting customary land and resources of affected villages including Namunsa, Polamato, and Kuneka (and surrounding hamlets), and Mokerokeroai.
    - Areas of tailings deposition, including the Konaviru Wetlands, and potentially affecting the customary lands and resources of the nearby villages to this area which include all villages in the River System Domain except for Moratona, Maile and Moirue that are not impacted by mine-related flooding.
- **Remediability**: The remediability of the actual impact is major. Restoration of the human rights that have been impacted is likely to be difficult, complex, lengthy and/or an incomplete restoration.

Consequently, the salience of the actual impact to the cultural rights for customary groups in the River System Domain associated with reductions in the value of traditional land and resources impacting capacity to participate in cultural life due to changes in flooding and tailings extents is **medium.**

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D), and those identified relating to social data as summarised in Section 11.7. The social data limitations include that there was no social mapping conducted in Phase 1 so no detail on how many customary groups or rightsholders associated with these areas of impact can be provided. The population estimates are indicative but also include non-customary groups, particularly in some areas where there are large numbers of leaseholders or in-migrants.

12.6.6.2 Community groups

Flooding and tailings deposition on land has impacted on the capacity to participate in cultural life

As identified above, regular flooding has reduced the value of land and its usability. Land-based activities, such as gardening, support participation in customary practices, for both customary groups and leaseholders. Reduced availability and quality of gardening land thereby reduces rightsholders' capacity to participate in cultural life. The affected areas are the same as those detailed above for changed extent of flooding and tailings deposition.

The likelihood of increasing flooding and tailings deposition extent impacting the value of land, and capacity to grow food and participate in customary activities occurring is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The level of impact for each rightsholder would depend on the area of land used that is affected, the level of effect of the flooding/tailing (gardening in areas affected by flooding still occurs), and their access to other areas. This level of investigation was not conducted in Phase 1, taking a precautionary approach, the scale of the actual impact on cultural rights is moderate.
- **Scope**: The scope of the actual impact is major.
    - Flooding is extensive in the lower tailings area around Kuneka Creek and the lower Pagana River, potentially affecting customary land and resources of affected villages including Namunsa, Polamato, and Kuneka (and surrounding hamlets), and Mokerokeroai.

  - Areas of tailings deposition, including the Konaviru Wetlands, and potentially affecting the customary lands and resources of the nearby villages to this area which include all villages in the River System Domain except for Moratona, Maile and Moirue that are not impacted by mine-related flooding.

- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the actual impact to the cultural rights for community groups in the River System Domain associated with reductions in the value of traditional land and resources impacting capacity to participate in cultural life due to changes in flooding and tailings extents is **medium.**

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.7 Right to a clean, healthy and sustainable environment

Environmental conditions in the River System Domain were significantly changed prior to 1989 by the deposition of tailings from the Panguna Mine into the Kawerong River. The increased sediment load resulted in widespread changes to river morphology, hydrology and ecology and contamination in the river system. The environmental impact assessment (Chapter 10) identified a range of environmental impacts in the River System Domain caused by the mine since mining ceased in 1989.

The environmental impacts include mineralised and non-mineralised contamination of soil and water in areas of the River System Domain. The mineralised contamination is limited to areas in the domain where historic tailings deposition occurred along the Kawerong-Jaba River system. Non-mineralised contamination was identified in soil at the former Jaba Pump Station, which is consistent with the historic industrial use of the area.

These environmental impacts affect the right to a clean, healthy and sustainable environment for community rightsholders in the domain. Vulnerable groups identified in this domain, such as women, children and those who are physically vulnerable, and ASM workers were assessed to have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

12.6.7.1 Community rightsholders

Exposure to environmental impacts directly connected to the mine

The disposal of mine-derived sediment during the mine's operation resulted in an extensive area of exposed tailings in the River System Domain. All villages named in the River System Domain may be impacted by contamination in tailings, except for Moratona, Maile and Moirue.

Mineralised contamination from tailings affects three substantive elements of the right to a clean, healthy and sustainable environment for community rightsholders in this domain: a non-toxic environment; healthy ecosystems and biodiversity; and safe and sufficient water. Specific impacts include:

- **Lower reaches of the Kawerong River:** mineralised contamination of water associated with historic tailings deposition into the Kawerong River. Communities within this area include Barako, Tempiri, Tengkona, Ioro 2, Enamira and Gold Miners' (UT).
- **Northern banks of the Jaba River near Tailings Basin 1**: mineralised contamination of water associated with historic tailings deposition into the Kawerong-Jaba River system. Communities within this area include Gold Miners Camp, Konuku, Maton, Toku and temporary ASM camps.

- **Lower Pagana River:** mineralised contamination of water associated with historic tailings deposition into the Kawerong-Jaba River system. Communities within this area include Mokerokeroai.
- **Kawerong-Jaba River system:** continued effects on aquatic ecology due to mineralised contamination of water associated with historic tailings deposition.

In addition to mineralised contamination from tailings, the following areas have other environmental impacts:

- **Jaba Pump Station:** non-mineralised contamination of soil in the former Jaba Pump Station building that has been repurposed by the community into a church.
- **Konaviru Wetland:** post 1989 smothering of vegetation and loss of ecological function in the wetland due to sediment buildup in the lower Jaba River.

Based on the extent of contamination from tailings and confirmation of non-mineralised contamination at the Jaba Pump Station, the likelihood of environmental impacts directly connected to the mine adversely affecting the right to a clean, healthy and sustainable environment occurring is **almost certain**. The severity of this actual impact is **moderate** based on:

- **Scale**: The scale of the actual impact is moderate, and may result in a notable impact to livelihoods, health, safety, or culture.
- **Scope**: The scope of the actual impact is major. Based on the extent of tailings deposition, it is estimated that all villages named in the River System Domain may be impacted by tailings, except Moratona, Maile and Moirue. A highly conservative estimate indicates a modelled effected population of 1,031 households and a population of 4,670.
- **Remediability:** There is insufficient information to understand the remediability of the actual impact on the human right. Taking a precautionary approach, it is assumed to be major, meaning restoration of the human right is likely to be difficult, complex, lengthy and/or an incomplete restoration.

Consequently, the salience of the actual impact to the right to a clean, healthy and sustainable environment for community rightsholders in the River System Domain is **medium**.

This impact has a **low** degree of uncertainty, based on limitations detailed in the Water quality and Geochemical Assessment (Appendix A), Site Contamination Assessment (Appendix B), Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.6.8 Summary of human rights impacts in the River System Domain

Table 12.13 summarises the impacted human rights and the relevant rightsholders or vulnerable groups in the River System Domain that are directly connected to the environmental impacts of the Panguna Mine since 1989.

Human rights impacts extend across large areas within the River System Domain, as well as in seven discrete areas:

- Upper and Mid tailings sub-domain:
  - The lower reaches of the Kawerong River, including the communities of Tempiri and Gold Miners' (UT).
  - Areas in and around the Jaba Pump Station.
  - Villages on the northern banks of the Jaba River near Tailings Basin 1, including Gold Miners Camp, Konuku and Maton.
  - Villages on the northern and southern banks of the Jaba River at the lower end of Tailings Basin 1, including Pem'ana and the communities along Tun Creek.

- Lower tailings sub-domain:
  - Villages on the northern and southern banks of the Jaba River at the lower end of Tailings Basin 1, including Pem'ana and the communities along Tun Creek.
  - Villages around the Kuneka Creek and its associated tributaries, including Kobalu, Kuneka, Namunsa, Polamato, and Wasikeuluma.
  - Villages that rely on Konaviru Wetland.
  - Villages around the lower Pagana River, specifically, Mokerokeroai.

In these areas, overlapping human rights impacts have been identified. A summary of human rights impacts in each area is as follows and shown on Figure 12.5.

12.6.8.1 Domain-wide impacts

Environmental impacts directly connected to the Panguna Mine since 1989 may result in three human rights impacts for **community rightsholders** across the River System Domain:

- **Actual impact on right to health:** The River System Domain has low levels of locally available community infrastructure and services. A number of villages in the River System Domain are cut-off during high flow and flood events, which may impact on the right to health for individuals, particularly for physically vulnerable people. This temporary but substantive impact affects several modelled populations:
  - The population on the western banks of the Kawerong River greater than 2 km from a bridge, including the villages of Tempiri and Gold Miners (UT).
  - The population on the northern banks of the Jaba River, including the villages of Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Pem'ana and Katauli.
  - The population south of Kuneka Creek, including the villages of Polamato and Kuneka, Maile, and Waikeuluma.
  - The population west of the lower Pagana River.
  - The population reliant on the wet crossing at Kuneka Creek.
  - The population reliant on the wet crossing on Kuneka Road near Tun Creek.
- **Potential impact on right to health:** As described for the Mine Domain, there is a potential impact on the right to health for community rightsholders that would occur if unstable areas in the Mine Domain occur and affect the Port to Mine Access Road and road near Pirurari and disrupt access to health care facilities.
- **Possible impact on right to adequate food, housing and standard of living:** The disposal of mine-derived sediment during the mine's operation resulted in an extensive area of exposed tailings in the River System Domain. Tailings deposits contain elevated minerals and may constrain the capacity of land. The impact of these exceedances on the productivity of gardening land in the contaminated areas of the River System Domain cannot be determined based on the available data.

  These exceedances may place a constraint on the productivity of the gardening land in areas with tailings deposition and contribute to food security and livelihood issues that are experienced in this domain. All villages named in the River System Domain may be impacted by contamination in tailings, except for Moratona, Maile and Moirue. A modelled upper range estimate indicates that up to 4,670 people may rely on land affected by tailings in the River System Domain.
- **Actual impact on the right to adequate food, housing and standard of living:** Continued effects on aquatic ecology in the Kawerong-Jaba River system are likely to constrain the amount of edible riverine resources (e.g., fish and crustaceans) available to communities. This results in impacts on households' capacity to fish, which contributes to household food security and livelihood generation, noting that some households from Mokerokeroai and Kuneka reported undertaking fishing. It has been conservatively estimated that communities along the Kawerong-Jaba River system have been impacted by this.

- **Actual impact on right to a clean, healthy and sustainable environment:** Although the ecology and function of the Kawerong-Jaba River system was significantly impacted during mining operations, continued effects due to mineralisation contamination of water continues to affect the ecosystem and biodiversity in this area.

12.6.8.2 The lower reaches of the Kawerong River

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders along the lower reaches of the Kawerong River, including (see Figure 12.5):

- **Potential impact on right to life:** River crossing conditions for the villages of Tempiri and Gold Miners (UT) are hazardous for adults around 20% of the year, and hazardous for children/physically vulnerable people around 50% of the year. Although communities reported that they know a number of 'warning signs' that flooding will occur, flow conditions can change quickly and unpredictably, resulting in possible fatalities. It has been estimated that 51 households, or a modelled population of 220 people, may be impacted.
- **Actual impact on right to a clean, healthy and sustainable environment:** Mineralised contamination from tailings deposition has resulted in impacts to water in parts of the Kawerong River. This contamination may affect the receiving environment for 20 households, with a modelled population of around 100 people.

Area in and around the Jaba Pump Station

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for **community rightsholders** in and around the Jaba Pump Station, including (see Figure 12.5):

- **Potential impact on right to life:** Section 1 or Section 2 of the Main/Pump Station Levee may fail in the future either due to levee failure or liquefaction. If failure occurred at either of these locations, there is potential for fatalities of people in the area at the time. The failure of these sections of the Main/Pump Station Level would also impact on the right to life for ASM workers. There is an estimated modelled population of 340 people in this area.

  The former Jaba Pump Station building may collapse from an earthquake. This building is currently being used as a gathering place and place of worship. If failure occurred, there is potential for fatalities of people in the area at the time.
- **Actual impact on right to adequate food, housing and standard of living:** A small area of overbank flooding in the Jaba River near Jaba Pump Station may affect areas of gardening and cash cropping land. This flooding could affect the productivity of land, and subsequent food security and ability to generate an income.
- **Possible impact on right to adequate food, housing and standard of living:** Land and soil quality in areas of Jaba Pump Station is affected and has concentrations of copper above the agricultural ecological screening criteria. Three of these samples were taken from gardens established in the known extent of tailings. This contamination affects soil quality and may limit the type and volume of crops that can be grown in these gardens.
- **Actual impact on right to a clean, healthy and sustainable environment:** Non-mineralised contamination at the former Jaba Pump Station has resulted in contaminated soils in the area. This contamination may affect the receiving environment for 10 households, with a modelled population of around 50 people.

Table 12.13 Summary of human right impacts in the River System Domain

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to life						
Potential[2]	***Exposure to geotechnical hazard events that may result in fatalities impacting on the right to life*** Failure of the Main/Pump Station Levee could adversely affect the right to life. Three sections of the levee have a geotechnical risk of high or greater.	**Community**: People living, working or travelling through these areas are at risk. The estimated modelled population affected by failure of: • Levee Section 1: 220 people living in 49 dwellings. • Levee Section 2: 130 people in 29 dwellings.	Likely	Severe	Very high	Medium
		ASM workers The failure of levee Section 4 may affect people undertaking ASM in the tailings/Jaba River. The number of people undertaking ASM in the area is estimated to be 50 people in 12 dwellings but this can fluctuate.	Possible	Severe	Very high	Medium
Potential[2]	***Exposure to structural hazards events that may result in fatalities, impacting on the right to life*** The remains of the Jaba Pump Station are at risk of collapsing and affecting the people using these structures.	**Community:** The community uses the space next to the portal frame building as a gathering place/place of worship. There are dwellings located within 50 m of the structure.	Likely	Severe	Very high	Low
	The Momau River Bridge is at risk of collapsing. If the bridge fails while being used, there is an extreme risk of serious injuries or fatalities.	**Community:** People using this bridge are at risk. As only one vehicle at a time can use the bridge, failure is estimated to affect a small number of people.	Likely	Major	High	Low

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Potential[2]	**Exposure to riverine hazards that may result in fatalities, impacting on the right to life** River flow conditions exceed adopted safety criteria for adults and physically vulnerable people crossing by foot.	**Community:** Communities living on the western banks of the Kawerong River and the northern banks of the Jaba River in the identified areas are at risk. In Tempiri, Gold Miners (UT), Gold Miners Camp, and Toku, conditions are hazardous for about 580 adults for around 18 days a year and for 240 vulnerable individuals, including children and the elderly, for 73 days a year. In the Maton region north of Lower Tailings Basin 1, hazardous conditions affect 60 adults for 18 days a year and 50 vulnerable persons for 73 days a year.	Almost certain	Severe	Very high	Medium
		Community Communities affected include Maton, Pem'ana, and Katauli. Modelling estimated that the population in this area was 72 households, or 400 persons, including a vulnerable population of around 280 persons.	Almost certain	Severe	Very high	Medium

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to health						
Actual	***Reduced access to health care due to riverine hazards, impacting on the right to health*** Flood events in the Kawerong-Jaba River system are hazardous and can have an effect on community access to infrastructure and services. When floods occur, people living in an area with no safe access (i.e., a bridge) cannot cross the river and access community infrastructure and services.	**Community**: Population affected include: • The population on the northern banks of the Jaba River, including the villages of Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Pem'ana and Katauli, which was estimated at 600 persons. • The population south of Kuneka Creek, including the villages of Polamato and Kuneka, Maile, and Waikeuluma, which was estimated at 860 persons. • The population reliant on the wet crossing on Tun Creek, which was estimated at 1,700 persons.	Almost certain	Major	High	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
		Community: Population affected include: • The population on the western banks of the Kawerong River greater than 2 km from a bridge, including the villages of Tempiri and Gold Miners (UT), estimated at 80 persons. • The population west of the lower Pagana River, which was estimated at 50 persons. • The population reliant on the wet crossing at Kuneka Creek, which was estimated at 30 persons.	Almost certain	Moderate	Medium	High
Potential[2]	***Reduced access to healthcare due to geotechnical hazard events, impacting on the right to health*** Geotechnical hazard events may affect the Port to Mine Access Road and the Pirurari Road (cut-fill slope). This may prevent or change access to healthcare, including hospital level care, for communities in this domain. This impact would continue until access is restored.	**Community:** Failure at either of these locations would adversely affect access to health care for up to 5,700 people in the River System Domain. However, health care is still provided at Moratona Health Centre.	Likely	Moderate	Medium	High
Right to adequate food, housing, and standard of living						
Possible	***The presence of mineralised contamination may impact the right to adequate food, housing, and standard of living*** Mineralised contamination (copper and molybdenum) in tailings may reduce the quality and amount of food able to be grown, which places stress on food security.	**Community**: The effect on soil productivity may occur across the extent of tailings, which a modelled upper range estimate indicates may affect land used by up to 4,670 in the River System Domain.	Possible	Moderate	Medium	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Actual	***Flooding effects on land impact the right to* adequate food, housing, and standard of living** Flooding events in Jaba River, Kuneka Creek and Tun Creek can reduce or destroy crops and garden plots, which has a subsequent effect on food security and income generation.	**Community:** The impact of changed flood extents in discrete areas of the Jaba Pump Station, lower Tun Creek and extensive areas in the lower tailings may constrain food production and income generation. An estimated population of 2,470 may experience this impact.	Almost certain	Moderate	Medium	High
Possible	***Mine-related environmental changes in the Konaviru Wetland may impact the right to adequate food, housing, and standard of living*** Tailings have consequently smothered vegetation and fundamentally changed the dynamics of the ecosystem in the Konaviru Wetland. This has subsequent effect on the availability of resources available and may affect food security and income generation.	**Community:** Bush resource collection supplements people's livelihood strategies and the value of the Konaviru Wetlands for bush collection has been completely lost for this purpose. An upper limit estimate using the population modelling identified 375 households, equating to 1,800 persons as possibly being affected. Vulnerable groups are subject to the same assessment rating.	Likely	Moderate	Medium	High
Actual	***Environmental impacts to the Kawerong-Jaba River system have impacted the right to adequate food, housing, and standard of living*** Continued effects on aquatic ecology in the Kawerong-Jaba River system are likely to constrain the amount of edible riverine resources (e.g., fish and crustaceans) available to communities.	**Community:** Impacts to fishing continue to occur throughout most of Kawerong-Jaba River system, noting that some households from Mokerokeroai and Kuneka reported undertaking fishing. It has been conservatively estimated that communities along the Kawerong-Jaba River system have been impacted by this. This is modelled to be up to 895 households, with a modelled population of 3,920 people.	Almost certain	Moderate	Medium	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
		Vulnerable groups are subject to the same assessment rating.				
Right to water						
Actual	***Changed flooding regimes and mineralised contamination may have impacted the right to water*** Tailings have disrupted local river flood regimes, impacting the primary water sources for surrounding communities. The perception of floodwaters as contaminated has reduced their usability. Additionally, certain areas show contamination above safe levels, threatening the water security of dependent households.	**Community:** Impacts to water acceptability and access due to flooding may affect communities around Kuneka Creek and lower Pagana River. Impacts to water quality due to mineralised contamination affect 13 locations of the river and communities in Gold Miners Camp and ASM workers. Vulnerable groups are subject to the same assessment rating.	Almost certain	Moderate	Medium	High
Potential	***Future flooding regime changes and mineralised contamination could impact the right to water*** As sediment moves downstream, it is likely that the flood extent and tailing deposition will change. Further changes in flooding extent may impact currently unaffected water sources. The perception of floodwaters as contaminated has reduced their usability.	**Community:** Impacts to water acceptability and access due to flooding may affect communities around Kuneka Creek and lower Pagana River.	Possible	Moderate	Medium	High
Possible	***Changed flooding regimes may have impacted the right to water*** Tailings have disrupted local river flood regimes, impacting the primary water sources for surrounding communities. The perception of floodwaters as contaminated has reduced their usability.	**Community:** Impacts to water acceptability and access due to flooding may affect communities on the lower Tun Creek. Vulnerable groups are subject to the same assessment rating.	Likely	Moderate	Medium	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
	No engagement was conducted with the community along Tun Creek. As a result, this impact is categorised as a possible impact.					
Right to education						
Actual	***Flooding impacts on the Kawerong-Jaba River system impacts on the right to education*** When floods happen, areas without safe crossings, like bridges, become inaccessible. This may affect rightsholders to access to school. This interruption, though temporary, may occur multiple times per year, depending on the level of rainfall.	**Children:** Access to Kuneka School would be restricted by flood events. The catchment of Kuneka School includes children from communities in and around: • Namunsa • Polamato • Kobalu • Kokore • Kuneka (north of the creek). The modelled estimated population of primary school age children is 240, out of a residential population of 660 people.	Almost certain	Minor	Medium	Medium
Actual	***Changed riverine conditions on the Kawerong-Jaba River system impacts on the right to education*** Some of the mining sediment has a quicksand-like effect, increasing the hazards associated with river crossing by foot.	**Children** Children from Pem'ana attend Kuneka School. Access for students in Pem'ana is also affected by the condition of the riverbed. The modelled estimated population of primary school age children is 60, out of a residential population of 130 people.	Almost certain	Minor	Medium	Medium

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Cultural rights						
Actual	***Flooding and tailings deposition since 1989 has impacted on cultural rights*** Changes in flooding extent, and associated overbank flooding, along with the deposition of tailings sediment into new areas are conservatively assessed to have damaged or destroyed sacred sites. The extent of the impact to sites has been assessed conservatively: knowledge of the exact location and significance of individual sites is negligible.	**Customary groups** Areas include flood impacted areas in the Lower tailings and areas surrounding Kuneka Creek. Identifying cultural heritage sites was outside the scope of this study. Taking a precautionary approach, it is assumed that there has been impacts to sacred sites from changed flooding extent and new tailings deposition areas since 1989.	Almost Certain	Severe	Very high	High
Potential	***Future flooding and tailings deposition could impact on cultural rights*** Future changes in flooding extent, and associated overbank flooding, along with the deposition of tailings sediment into new areas could damage or destroy currently unaffected sacred sites.	**Customary groups** Areas include flood impacted areas in the Lower tailings and areas surrounding Kuneka Creek. Identifying cultural heritage sites was outside the scope of this study.	Possible	Severe	Very high	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Actual	***Flooding and tailings deposition has reduced the value of land and its usability, which are recognised as a cultural right for Indigenous people.*** Regular flooding has reduced the value of land and its usability. Land-based activities, such as gardening, support participation in customary practices. Reduced availability and quality of gardening land thereby reduces rightsholders capacity to participate in cultural life.	**Customary groups** Areas include flood impacted areas in the Lower tailings and areas surrounding Kuneka Creek. Although identifying land ownership was outside the scope of this study, impacts to customary groups are assessed to have occurred.	Almost certain	Moderate	Medium	High
		Community: This category includes leaseholders, i.e., people who do not have a traditional connection to land they are living on. Affected areas include people living in and around the Jaba Pump Station, along the lower Tun Creek, and in the lower Tailings area, associated with flooding of the Kuneka Creek and lower Pagana River.	Almost certain	Moderate	Medium	High
Right to a clean, healthy and sustainable environment						
Actual	***Exposure to environmental impacts directly connected to the mine may impact individuals' right to a clean, healthy and sustainable environment*** Mineralised and non-mineralised contamination from mine-related infrastructure has impacted land and water quality in large areas of the domain.	**Community:** Based on the extent of tailings deposition, it is estimated that all villages named in the River System Domain may be impacted by tailings, except Moratona, Maile and Moirue. It has been estimated that a modelled upper range of up to 4,670 people may be impacted.	Almost Certain	Moderate	Medium	Low

1. Where impacts have the same salience, they are presented here jointly for ease of reading, but these are assessed separately.
2. Risk rating based on risk characterisation determined in the Human Health Risk Assessment (Appendix G).

12.6.8.3 Villages on the northern banks of the Jaba River near Tailings Basin 1

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders in villages on the northern banks of the Jaba River near Tailings Basin 1, including (see Figure 12.5):

- **Potential impact on right to life:** River crossing conditions for the villages of Gold Miners Camp, Toku and Maton are hazardous for adults around 20% of the year, and hazardous for children and physically vulnerable people around 50% of the year. Although communities reported that they know a number of 'warning signs' that flooding will occur, flow conditions can change quickly and unpredictably, resulting in possible fatalities. Modelling estimated that the population in this area included 60 adults and 50 vulnerable people (children and the elderly).

  Quicksand-like riverbed conditions also affect the safety of crossing for individuals in Maton.
- **Actual impact on right to water:** The identified exceedances of copper and manganese reduce the quality of the water sources available to households and individuals from Gold Miners Camp. Given that limited alternative water sources are available in the area during the dry season, and that some households may not have rights to access other water sources (e.g., temporary ASM camps), water security for households and individuals is reduced.
- **Actual impact on right to a clean, healthy and sustainable environment:** Mineralised contamination associated with historic tailings deposition into the Kawerong-Jaba River system has resulted in contaminated water in areas. This contamination may affect the receiving environment for 15 households, with a modelled population of around 70 people.

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **ASM workers rightsholders**, including (see Figure 12.5):

- **Potential impact on right to life:** Potential failure of Section 4 of the Main/Pump Station Levee would result in flooding contained within the main flowpath of the Jaba River. This area is known to be used for ASM and contains a small number of structures assumed to be ASM camps. As such, if failure of Section 4 of the Main/Pump Station Levee happened, there is potential for fatalities of ASM workers in the area at the time.

12.6.8.4 Villages on the northern and southern banks of the Jaba River at the lower end of Tailings Basin 1

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders in villages on the northern and southern banks of the Jaba River at the lower end of Tailings Basin 1, including (see Figure 12.9):

- **Potential impact on right to life:** Some mining sediment has created a quicksand-like effect in the Kawerong-Jaba River system which has affected the safety of river crossings for people from Pem'ana and Katauli. River flow conditions can change quickly and unpredictably, as such hazardous river-bed conditions may result in fatalities.
- **Actual impact on right to adequate food, housing and standard of living:** Flooding events along lower Tun Creek can reduce or destroy crops and garden plots, which has a subsequent effect on food security and income generation. This is estimated to impact 20 households, with a modelled population of 90 people.
- **Possible impact on right to adequate food, housing and standard of living:** One soil sample from Pem'ana had concentrations of copper above the agricultural ecological screening criteria. This contamination affects soil quality and may limit the type and volume of crops that can be grown in these gardens.

- **Actual impact on cultural rights**: A small area of overbank flooding of land near Tun Creek affects land availability and quality, potentially constraining social capital and leading to land use disputes. While the extent of flooding is limited and is assumed to impacts a small number of households directly, reductions in social capital and land use disputes can affect the broader community.
- **Possible impact on right to water:** Flooding in Tun Creek reduces the overall acceptability of this water source for people in the area. No consultation was undertaken with the community in this area, therefore this impact has been categorised as a possible impact. This may place stress on water security for households in the area. Additional investigations would improve understanding of water use in this area and household vulnerabilities.
- **Actual impact on right to education:** When flooding occurs in the Kawerong-Jaba River, areas without safe crossings, like bridges, become inaccessible. This may affect the right to education for children rightsholders' from Pem'ana as households reported that they attended Kuneka School. Access to this school would be affected by hazardous river-bed conditions (e.g., quicksand-like effect) and under flood conditions. The modelled estimated population of children of primary school age is 60, out of a residential population of 130 people.

12.6.8.5 Villages around Kuneka Creek and its associated tributaries

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for **community rightsholders** in villages around Kuneka Creek, including (see Figure 12.9):

- **Actual and potential impact on right to adequate food, housing and standard of living:** Flooding events along Kuneka Creek can reduce or destroy crops and garden plots, which has a subsequent effect on food security and income generation. This is estimated to affect 383 households, with a modelled population of 1,890 people.
- **Actual and potential impact on right to water:** Flooding in Kuneka Creek reduces the overall acceptability of water available to individuals as flood water is not perceived to be safe to drink by communities. Given that limited alternative water sources are available in the area, the water security for households and individuals is reduced. It has been estimated that 50 households, or a modelled population of 240 people, may be affected.
- **Actual impact on right to education:** Mine-related changes in the Jaba River have caused Kuneka Creek and its associated tributaries to flood more often and more intensely than previously. When this flooding occurs, areas without safe crossings, like bridges, become inaccessible. This may affect the right to education for children from Namunsa, Polamato, Kobalu, Kokore and Kuneka north of the creek as they are reported to attend Kuneka School. Access to this school would be affected by under flood conditions. The modelled estimated population of children of primary school age is 239, out of a residential population of 660 people.
- **Actual and potential impact on cultural rights**: Less than five sites were identified in areas impacted by flooding. However, communities engaged in this area were leaseholders and generally did not comment on cultural heritage sites, even if they may have identified the location of sites. Additional investigations would improve understanding of the number of sites affected, and their significance, if any. The loss of sacred sites has a flow on effect of preventing and interrupting participation in customary practices.

12.6.8.6 Villages that rely on Konaviru Wetland

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders that rely on Konaviru Wetland, including (see Figure 12.9):

- **Possible impact on right to adequate food, housing and standard of living:** Loss of bush resources from the wetland affects livelihood strategies available to communities who rely on it. This may have subsequent effects on their right to adequate food, housing and standard of living. Further investigation regarding resource use would improve understanding of specific uses of this area, along with rights associated with this use.
- **Actual and potential impact on cultural rights**: Communities in the area surrounding the Konaviru Wetland were leaseholders, and generally did not comment on cultural heritage, so there is limited understanding whether cultural heritage sites have been impacted within the Konaviru Wetland. Taking a precautionary approach, it is assumed that there have been impacts to these sites due to the changed tailings deposition and flooding extent since 1989. The loss of sacred sites has a flow on effect of preventing and interrupting participation in customary practices.
- **Actual impact on right to a clean, healthy and sustainable environment:** Post-1989 smothering of vegetation in the wetland due to sediment buildup in the lower Jaba River has affected the ecosystem and biodiversity in this area.

12.6.8.7 Villages around the lower Pagana River

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders in villages around lower Pagana River, including (see Figure 12.9):

- **Actual impact on right to adequate food, housing and standard of living:** Flooding events in the lower Pagana River can reduce or destroy crops and garden plots in Mokerokeroai and other villages, which has a subsequent effect on food security and income generation. This is estimated to affect 104 households, with a modelled population of 460 people. As noted above, this is a conservative estimate and mine-related effects on flooding regimes have contributed in a minor manner to flooding in this area.
- **Actual impact on right to water:** Flooding in the lower Pagana River reduces the overall perceived acceptability of water available to individuals as flood water is not perceived to be safe to drink by communities. As noted above, this is a conservative estimate and mine-related effects on flooding regimes have contributed in a minor manner to flooding in this area. Given that limited alternative water sources are available in the area, the water security for households and individuals is reduced.
- **Actual and potential impact on cultural rights**: One cultural heritage site was identified near Mokerokeroai. Community members from Mokerokeroai are leaseholders, and generally did not comment on cultural heritage, so there is limited understanding whether sites have been impacted by environmental impacts directly related to the Panguna Mine since 1989. The loss of sacred sites has a flow on effect of preventing and interrupting participation in customary practices.

12.6.9 Possible risks to the right to health from contaminants in the environment

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related contaminants that pose a possible risk to the right to health for some people in the River System Domain. Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition.

These possible risks to right to health may affect community rightsholders, as well as specific vulnerable groups including ASM workers and children rightsholders. A description of these possible risks is provided in the following sections.

The possible risks to the right to health from contaminants in the environment have a **high** degree of uncertainty, given limitations detailed in the Water Quality and Geochemical Assessment (Appendix A), Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

During the participatory photography process, individuals raised concerns relating to the right to health in the River System Domain, for example (Plate 12.8).

Other factors not related to the Panguna Mine that contribute to human health and wellbeing in this domain include ongoing industrial activities, such as ASM (including likely exposure to mercury), and overall levels of nutrition. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

12.6.9.1 Community rightsholders

Exposure to contaminants of concern through direct contact with soil

Non-mineralised contamination was identified in soils at the former Jaba Pump Station. Concentrations of cadmium, iron, lead and PCBs were detected above the residential health (direct contact) criteria and present a possible risk to the right to health for individuals with regular contact with this soil. The local community has repurposed this building as a church with several households using this area regularly.

Exposure to contaminants of concern through soil and food

The disposal of around 800 Mt of mine-derived sediment during mining operation resulted in an area of approximately 2,000 ha of exposed tailings in 1989. By 2023, the area of exposed tailings had decreased to approximately 1,250 ha as natural revegetation has occurred, and people have established villages and gardens on some of these areas. New areas of tailings deposition have occurred since 1989, with the most significant areas in the Konaviru Wetland and the associated channels that affect Kuneka Creek and to a lesser degree the lower Pagana River. The maximum footprint of tailing deposition is now around 2,600 ha, including areas that have been revegetated.

Based on sampling undertaken for the Water Quality and Geochemical Assessment (Appendix A), no exceedances of the residential (direct contact) health criteria were detected in tailings samples. All metal concentrations in tailings, except copper and molybdenum, were also below the agricultural human health screening criteria. This means that a possible health risk exists associated with copper and molybdenum where consumption of fresh produce and animal products grown in tailings occurs.

"I built a church building at the old pump station location, and I know that this location is not safe, there are chemicals in the soil such as diesel/ transformer diesel for power."

Photo credit: Community participatory photography, 2023

Plate 12.8
Participatory photography photo and quote raising health concerns in the Jaba Pump Station

Exceedances of the agricultural human health screening criteria were identified for molybdenum, cadmium and copper in garden soils from Gold Miners Camp, Pem'ana and Mokerokeroai. However, where garden soil exceedances were found there was no corresponding exceedance in co-located food samples at these locations. The lack of exceedances of the same metal measured in soil and co-located food suggests that the contaminant intake in plants and raised animals is inconclusive based on the available data.

Of the 56 food samples collected in the River System Domain, eight samples (14%) exceeded the adopted food standard screening criteria for at least one metal:

Upper and Mid tailings:

- **Barako** – exceedances of mercury[6] and selenium in chicken meat.
- **Gold Miners Camp** – exceedance of arsenic (chicken meat) and two exceedances of selenium (chicken meat).
- **Jaba Pump Station** – exceedance of selenium (pork meat).
- **Konuku** – exceedances of arsenic (chicken meat), cadmium (cocoa) and selenium (chicken meat).

Lower tailings:

- **Pem'ana** – exceedance of selenium in chicken meat.
- **Mokerokeroai** – exceedance of zinc in dried fish.

To evaluate contaminant intake from foods in the River System Domain, the average concentrations of metals and metalloids in foods collected for the market basket survey across the study area were adopted, and food consumption data obtained from appropriately selected surrogate villages in PNG were used to estimate the contaminant intakes associated with diet.

Based on the contaminant dietary intake evaluation undertaken for the Human Health Risk Assessment (Appendix G), there is a **low risk** to the right to health of people due to potential mine-related contaminants in food in the River System Domain.

Exposure to mineralised contamination in drinking water sources

All samples from community identified water sources collected from representative communities in the River System Domain were below the adopted drinking water health screening criteria for mine-related contaminants and are unlikely to pose a risk to human health.

Approximately 15 households in the River System Domain indicated that they also used the Kawerong-Jaba River as a drinking water source during the dry season. Concentrations of contaminants of concern were above the adopted drinking water criteria at 13 sampling locations along the Kawerong-Jaba River (see Chapter 11). This means that water from the Kawerong-Jaba River is not suitable for consumption and may present a health risk if regularly consumed.

Specifically, water samples from areas of the Kawerong River near the Gold Miners Camp on the northern side of Tailings Basin 1 exceeded the adopted drinking water health screening criteria for copper and manganese. Some households in Gold Miners Camp indicated that they used the river here as their main source of drinking water during the dry season. Regular consumption of water from this area may pose a health risk to individuals, including people from Gold Miners Camp and other communities identified as potential users such as Toku and temporary ASM camps.

[6] This is not mine-related, and is likely due to ASM activities in the domain.

Consumption of river water in these areas that has recorded exceedances of copper and manganese above the adopted drinking water health screening criteria is a **possible risk** to the right to health for individuals in reliant on these water sources.

12.6.9.2 ASM workers rightsholders

Exposure to mineralised contamination in surface waters

Mineralised contamination in two areas of water in the River System Domain was identified as a possible health risk to ASM workers:

- **Kawerong River (from Onove footbridge to Barako):** Concentrations of manganese exceeded the recreational water health screening criteria in a stretch of approximately 3 km along this river. The communities near this location were not surveyed, so it is unknown if households use this water. ASM is undertaken in this area. Regular use of this water may pose a health risk to users.
- **Tailings Basin 1 seepage:** Copper, manganese and molybdenum were identified at levels above recreational water health screening criteria in seepage from tailings. This seepage is shallow surface water and would not be used for recreation. A number of structures associated with ASM activities have been built nearby, indicating that people likely use the area frequently. Exposure to contaminants may occur through direct contact (e.g., walking or standing in the area); however, accidental ingestion of contaminated water is the primary pathway of concern for metals in a recreation/other use setting.

Contaminants in water in these areas is a **possible risk** to the right to health for ASM workers rightsholders likely from Tengkona, Baiaruai, Ioro 2, Enamira and ASM workers accessing Tailings Basin 1.

12.6.9.3 Children rightsholders

Exposure to mineralised contamination in surface waters

As described above, concentrations of manganese in a 3 km section of the Kawerong River, from Onove to north of Barako, exceeded the recreational water health screening criteria. This section of the river is accessible to children from Onove (350 m), Ioro 2 and Baiaruai (100 m) and Tengkona (150 m). Children may not view the water as a possible health risk and are more likely to recreationally swim in the water and incidentally ingest water.

Contaminant in the water in this section of the river are a **possible risk** to the right to health for individual children from Onove, Ioro 2, Baiaruai and Tengkona that may use the water source.

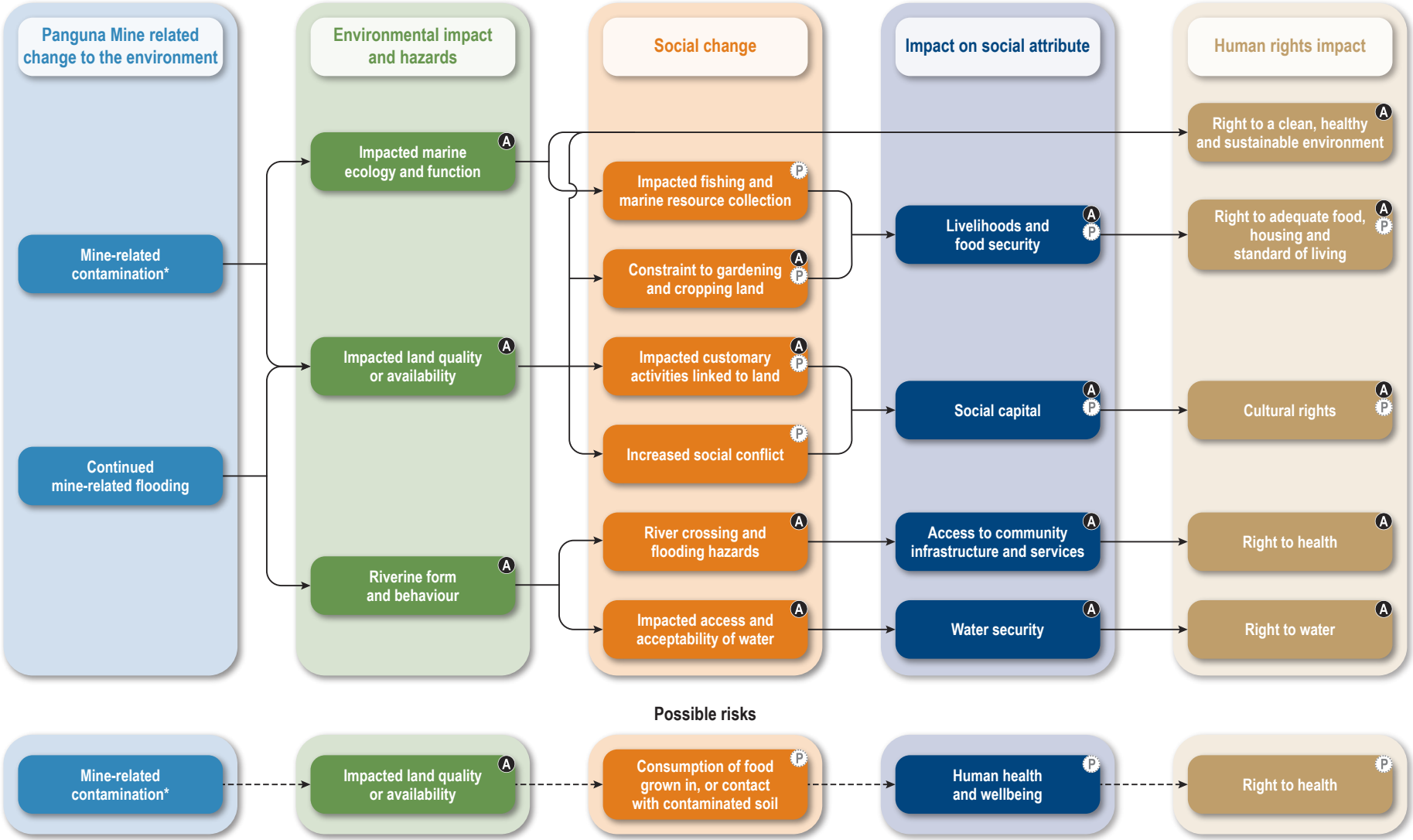
12.7 DELTA DOMAIN

This section identifies and assesses the actual, potential and possible human rights impacts in the Delta Domain that are directly connected to the environmental impacts caused by the Panguna Mine since the cessation of mining in 1989. This assessment considers the outcomes of the environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) undertaken for the domain.

The rightsholders relevant to this assessment in the Delta Domain are communities, including in Marau, Matoga, and surrounding hamlets.

Table 12.14 summarises the human rights impacts assessed for the Delta Domain, including the connected environmental and social impacts or hazards. Figure 12.6 shows these.

The following sections detail the assessment of these human rights impacts, and is structured based on the affected right, with a focus on which rightsholders are affected and where they are impacted. Figure 12.7 shows a spatial summary of the affected rights.



NOTE
*Mine-related contamination includes mineralised and non-mineralised contamination

SOURCE
Tetra Tech Coffey, 2024

LEGEND

- (A) Actual impacts
- (P) Potential impacts
- (P) Possible impacts / risks

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.6

Connections between environmental impacts, social impacts and human rights impacts in the Delta Domain

TETRA TECH COFFEY

DATE: 01.11.24 PROJECT: 754-MELEN305719 FILE: 305719_R03_F12.06_GRA

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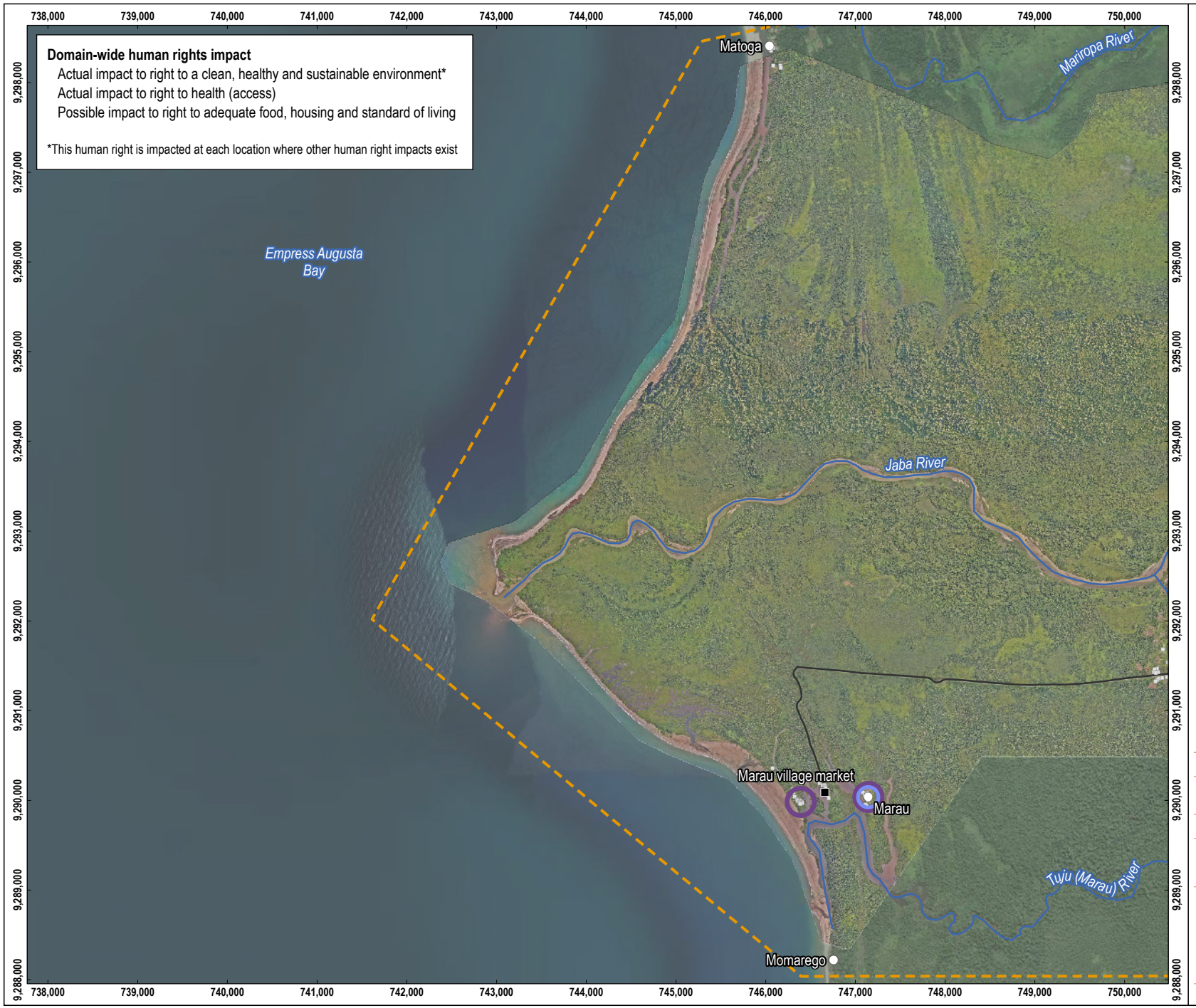

LEGEND

- Village
- Point of interest
- Main dwelling structure
- Road
- Watercourse
- Phase 1 study area

Human rights impact

- Actual impact to right to water
- Possible impact to cultural rights

Impact extents are approximate and circles shown are symbolic only. These areas should be used be used as a guide only.

SOURCE
Impacts, households, study area, villages, roads and watercourses from Tetra Tech Coffey.
Imagery from Woolpert (2023) and AGOL.

0 0.5 1 km

SCALE **1:60,000**
PAGE SIZE: **A4**
PROJECTION: **WGS 1984 UTM Zone 56S**

PANGUNA LEGACY ASSESSMENT COMPANY

PANGUNA MINE LEGACY IMPACT ASSESSMENT PHASE 1

FIGURE 12.7

Summary of impacted human rights – Delta Domain

TETRA TECH COFFEY

DATE: **31.10.24** PROJECT: **754-MELEN305719** FILE: **305719_R03_F12.07_GIS**

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Table 12.14 Environmental and social impact connections with human rights impacts – Delta Domain

Environmental impact or other hazard	Social impact/risk	Human rights	Relevant rights holders
Continued mine-related flooding.	Actual impact to access to community infrastructure and services due to flooding hazards.	Actual impact on **right to health** from constrained access to health services due to issues associated with flooding\	Community; physically vulnerable groups;
	Actual impact to livelihoods and food security due to impacted land availability from flooding	Actual impact on **right to adequate food, housing and standard of living** due flooding.	Community
	Actual impact to social capital due to reduced land availability.	Actual impacts on **cultural rights** from flooding.	Community
	Actual impact to water security due to continued flooding	Actual impacts on **right to water** from flooding.	Community
Impacted land and soil quality due to mineralised contamination.	Possible impact to livelihoods and food security due to impacted land quality.	Possible impact on **right to adequate food, housing and standard of living** due to mineralised contamination.	Community
		Actual impact on **right to a clean, healthy and sustainable environment** from exposure mine related environmental impacts	Community
	Possible risk to human health and wellbeing due to exposure to mine-related contaminants in soil and food.	Possible risk to the **right to health** from exposure to mine-related contaminants in soil and food.	Community; physically vulnerable groups
Impacted marine ecology and function in Empress Augusta Bay	Possible impact to livelihoods and food security due to impacted fishing and marine resource collection.	Possible impact on **right to adequate food, housing and standard of living** due to contaminants.	Community
		Actual impact on **right to a clean, healthy and sustainable environment** from exposure mine related environmental impacts	Community

12.7.1 Right to health

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related impacts that may affect the right to health for some people in the Delta Domain. This includes impacted access to healthcare due to flooding hazard events in areas of the domain.

Impacts to the right to health may affect community rightsholders and specific vulnerable groups, including women, children and physically vulnerable people. Unless otherwise stated, vulnerable groups were assessed to have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition or impact. Section 12.7.7 identifies where a possible health risk exists in the environment directly connected to the Panguna Mine, and where further investigations would improve understanding of the health risk.

12.7.1.1 Community rightsholders

Reduced access to healthcare due to riverine hazards

The Delta Domain has low levels of locally available community infrastructure and services. People must travel to Moratona or Buka to access health services. The villages in this domain are extremely remote. Access to and from Marau is dependent on boat access via the Tuju River from Marau village, where Marau Road ends or via Empress Augusta Bay by boat for Momarego, Matoga and Koiare.

Floods in the Jaba River disrupt community access to essential infrastructure and services. When floods happen, areas without safe crossings, like bridges, become inaccessible, impacting people's ability to reach health facilities. This interruption, though temporary, can be significant. Although flooding would occur in this domain without the effects of the Panguna Mine, due to the ongoing change in river morphology due to mine-derived sediment it has been conservatively included as a mine-related impact.

The total population in the Delta Domain potentially affected by flooding, restricting access to community infrastructure and services, is modelled at around 100 people. However, not everyone will require healthcare during these events and the access to Buka via boat is likely unaffected. Using healthcare visit data from the NSO and IFC (2019), the affected population is estimated to be around 40 people.

The likelihood of access to healthcare being affected by flooding is **almost certain.** The severity of the actual impact is **moderate**, based on:

- **Scale:** The scale of the actual impact is major and may result in a notable reduction in health and wellbeing. This would continue until access is restored.
- **Scope:** The scope of the actual impact is minimal. During a significant flood event access to health services is restricted for around 40 people.
- **Remediability:** The remediability of the actual impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of the actual impact to the right to health from riverine hazard events for community rightsholders in the Delta Domain is **medium.**

Other factors affect access to community infrastructure and services, including the extremely remote location, degradation of infrastructure, limited government provision of services and community infrastructure, lack of maintenance, and external hazards, such as weather affecting sea travel. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.7.2 Right to adequate food, housing, and standard of living

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified several environmental impacts as having a detrimental effect on land and water quality since 1989. In the Delta Domain, land has been affected by mineralised contamination from tailings deposition and flooding. Mineralised contamination and smothering from tailings deposition has also affected marine ecology values in Empress Augusta Bay.

Impacts to the right to adequate food, housing and standard of living may affect community rightsholders. An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in the Delta Domain raised concerns relating to the right to adequate food, housing and standard of living, for example:

- In the last 5 years, when it flooded everything was affected; our gardens and residences.
- We have to go further out to catch fish and it costs a lot of fuel as well. People have died from the river from crocodiles and when there is a flood, gardens are destroyed.

12.7.2.1 Community rightsholders

Impacted capacity to grow enough food to eat and earn income due to mineralised contamination

As detailed in Section 11.5.2.2, the migration of tailings deposited during the operation of the mine has led to the formation of the large delta landform, which effectively extends the land mass into Empress Augusta Bay. A small hamlet has been established on this delta, which is located west of Marau village market. Although no samples were taken in the hamlet, samples from tailings had elevated copper and molybdenum concentrations significantly above (e.g., 53-fold for copper and up to 4-fold for molybdenum) the agricultural ecological screening criteria.

Gardens on land or in soil that have elevated copper and molybdenum concentrations are not expected to support favourable conditions for growing crops for consumption or to generate an income (Section 10.4).

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the Delta Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact.

Based on the current understanding of the contamination associated with tailings, the known tailings extent, and the results of garden soil sampling, the likelihood of mineralised contamination impacting the right to adequate food, housing, and standard of living capacity to grow food and rightsholders income generation occurring is **possible**. The severity of this possible impact is **minor**, based on:

- **Scale**: The scale of the possible impact is moderate, and may result in a notable impact on livelihoods, although this land is still being used for gardening.
- **Scope**: The scope of the possible impact is minimal. The effect on soil productivity may occur where gardens have been established in tailings. Affected areas include the hamlet to the west of Marau village market, with an estimated modelled population of 40 people.

- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of standard practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for community rightsholders is **low**.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to grow enough food to eat and earn income due to flooding

The Delta Domain continues to experience extensive mine-related flooding that may impact food security and income generation. It is estimated that flooding would impact gardens and cropping land in areas to the south of the Jaba River in 2- and 100-year flood events. Flooding affects gardening areas to the north and south of Marau village and to the west of Marau market. It is unlikely this flooding has significantly changed since 1989.

Based on the outcomes of flood modelling, and the general understanding of flood frequency, the likelihood of flood events impacting rightsholders' capacity to grow food generate income is **almost certain**. The severity of this actual impact is **moderate**, based on:

- **Scale**: The scale of the actual impact is major, and may result in a material reduction in livelihoods, although this land is still being used for gardening. The level of impact for each rightsholder would depend on the area of land used that is affected, how often it floods, and their capacity to access other areas. The rating has been made precautionarily.
- **Scope**: The scope of the actual impact is minimal. It is estimated that flooding would impact gardens and cropping land used by 12 households with a modelled population of around 20 people.
- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the actual impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D) and those identified relating to social data. A summary of these is provided in Section 11.7.

Impacted capacity to fish for food and earn income due to impacts to Empress Augusta Bay marine ecology

Deposition of mine-derived sediments continue to have effects on the marine ecosystem function in Empress Augusta Bay which may constrain the availability of edible marine resources (e.g., fish and crustaceans) for communities in the Delta Domain. Households in this domain depend on fishing and marine resource collection for food and to generate an income, where 89% of households reported participating in fishing.

Communities reported that that they travelled further out to sea to catch fish than in the past due to the presence of what they assumed to be tailings in the bay.

This impact is categorised as a possible impact because aquatic ecology surveys were outside the Scope of Work for Phase 1 and the extent of impacts to fish, crustacean and other resources that communities may rely on is unquantified. Nevertheless, these effects are predicted to continue to affect aquatic ecology in the Delta Domain for the reasonably foreseeable future.

Based on the results of the aquatic ecology assessment and the social and human rights characterisation, the likelihood of mine-derived sediments impacting the right to adequate food, housing and standard of living is **likely**. The severity of this possible impact is **moderate**, based on:

- **Scale**: The scale of the possible impact is major; fishing is integral to people's food security and livelihood strategies in the Delta Domain, although communities are still able to source marine resources. The level of impact for each rightsholder would depend on the area of sea used that is affected their capacity to access other areas. The rating has been made precautionarily.
- **Scope**: The scope of the possible impact is minor. Impacts to fishing are expected to affect a modelled population of 100 people.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the possible impact on the right to adequate food, housing and standard of living for community rightsholders is **medium**.

This impact has a **high** degree of uncertainty, based on limitations identified relating to social data. A summary of these is provided in Section 11.7.

12.7.3 Right to water

Access to water is fundamental to people's productive capacity. The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified continued mine-related flooding in the Tuju (Marau) River affecting water security in Marau within the Delta Domain.

In other Delta Domain communities, no impacts to accessibility, availability, acceptability or quality of water directly connected to mine-related environmental impacts were identified.

Impacts to the right to water may affect community rightsholders in Marau. Vulnerable groups, such as women and those who are physically vulnerable, were assessed to have the same impact as community rightsholders. An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in Marau village raised concerns relating to the right to water, for example:

> When it is a regular flood, it does affect the water source and there is one source that usually remains unaffected during flooding, while the other sources are affected by the flood.

12.7.3.1 Community rightsholders

Reduced water security due to continued mine-related flooding

Continued mine-related flooding in the Tuju (Marau) River has impacted areas of the Delta Domain. Households in Marau reported that they mostly relied on water from wells dug next to the Tuju (Marau) River as their primary source for all domestic purposes (drinking, bathing, washing). In the wet season, households from Marau mostly rely on the community water tank at Marau market (accessible by boat) as their primary source of water.

Notwithstanding that no exceedances were found in water samples to indicate that this water would be unsafe to drink, flooding in this watercourse reduces the overall perceived acceptability of water available to households as flood water is not perceived to be safe to drink by communities.

Given that limited alternative water sources were identified, the likelihood that mine-related flooding is adversely affecting the right to water is **almost certain**. The severity of the actual impact is **minimal**, based on:

- **Scale**: The scale of the actual impact is minor, and may result in a small impact on livelihoods, noting alternative water sources are available for domestic use such as the community water tank.
- **Scope:** The scope of the actual impact is minimal. The effect on water security is expected to be limited to households from Marau and the hamlet to the west of Marau market, which is estimated to be 23 households, with a modelled population of 43 people. This estimate is based on the percentage of households that identified river water as their main source of water during field investigations (72%) (Chapter 6).
- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the actual impact to the right to water for community rightsholders from Marau and the hamlet to the west of Marau market is **low.**

This impact has a **medium** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.7.4 Cultural rights

Impacts to land from tailings deposition and flooding may also affect community rightsholders from participating in customary activities connected to gardening produce, affecting their right to participate in cultural life. These are assessed below.

These impacts are connected to mine-related river conditions, in particular continued mine-related flooding since 1989.

12.7.4.1 Community groups

Flooding and tailings deposition on land has impacted on the capacity to participate in cultural life

As identified above (Section 12.7.1), regular flooding and the deposition of tailings has constrained the value of land and its usability. Land-based activities, such as gardening, support participation in customary practices, for both customary groups and leaseholders. Reduced availability and quality of gardening land thereby reduces rightsholders' capacity to participate in cultural life.

The *affected areas* are the same as those detailed above for those affected by flooding and tailings deposition.

The likelihood of the flooding and tailings impacting the value of land, and capacity to grow food and participate in customary activities occurring is **almost certain**. The severity of this actual impact is **minor**, based on:

- **Scale**: The level of impact for each rightsholder would depend on the area of land used that is affected, the level of effect of the flooding/tailing (gardening in areas affected by flooding still occurs), and their access to other areas. This level of investigation was not conducted in Phase 1, so taking a precautionary approach the scale of the actual impact on cultural rights is moderate.
- **Scope**: The scope of the actual impact is minimal. It is estimated that flooding would impact gardens and cropping land used by 12 households with a modelled population of around 20 people.

- **Remediability**: The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with the implementation of established good practices.

Consequently, the salience of the actual impact to cultural rights for community rightsholders is **medium.**

This impact has a **high** degree of uncertainty, based on limitations detailed in the Hydrology and Fluvial Geomorphology Assessment (Appendix D), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.7.5 Right to a clean, healthy and sustainable environment

Environmental conditions in the Delta Domain were significantly changed prior to 1989 by the deposition of tailings into the river system and subsequently Empress August Bay. The environmental impact assessment (Chapter 10) identified a range of mine-related environmental impacts in the Delta Domain that have continued since mining ceased in 1989.

The environmental impacts include mineralised contamination of soil and water in terrestrial, riverine and marine environment. The mineralised contamination is limited to areas in the domain where historic tailings deposition occurred along the Kawerong-Jaba River system and also in Empress August Bay.

These environmental impacts will affect the right to a clean, healthy and sustainable environment for community rightsholders in the domain. Vulnerable groups identified in this domain, such as women, children and those who are physically vulnerable have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

12.7.5.1 Community rightsholders

Exposure to environmental impacts directly connected to the mine

The disposal of mine-derived sediment during the mine's operation resulted in an extensive area of exposed tailings in the Delta Domain in addition to extensive deposition within Empress Augusta Bay. Impacts to Empress Augusta Bay were outside of the scope of Phase 1 investigations. Mineralised contamination from tailings affects three substantive elements of the right to a clean, healthy and sustainable environment for community rightsholders in this domain: a non-toxic environment, healthy ecosystems and biodiversity; and safe and sufficient water.

Based on the extent of contamination from tailings the likelihood of environmental impacts directly connected to the mine adversely affecting the right to a clean, healthy and sustainable environment occurring is **almost certain**. The severity of this actual impact is **minor**, based on:

- **Scale**: The scale of the actual impact is moderate, and may result in a notable impact to livelihoods, health, safety, or culture.
- **Scope**: The scope of the actual impact is minor. It has been estimated that communities in the domain, including Marau and the hamlet near Marau market may be impacted by this. This is modelled to be around 50 households with a modelled population of 100 people.
- **Remediability:** There is insufficient information to understand the remediability of the actual impact on the human right. Taking a precautionary approach, it is assumed to be major, meaning restoration of the human right is likely to be difficult, complex, lengthy and/or an incomplete restoration.

Consequently, the salience of the actual impact to the right to a clean and health environment for community rightsholders in the Delta Domain is **medium**.

This impact has a **high** degree of uncertainty, based on limitations detailed in the Water quality and Geochemical Assessment (Appendix A), Site Contamination Assessment (Appendix B), Hydrology and Fluvial Geomorphology Assessment (Appendix D), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.7.6 Summary of human rights impacts in the Delta Domain

Table 12.15 summarises the impacted human rights and the relevant rightsholders or vulnerable groups in the Delta Domain that are directly connected to the environmental impacts of the Panguna Mine since 1989.

Human rights impacts extend across the Delta Domain, as well as in Marau village and the hamlet to the west of Marau market as discrete areas. In these areas, overlapping human rights impacts have been identified. That is, an environmental impact may affect right to health, as well as affect right to adequate food, housing and standard of living for community rightsholders.

A summary of human rights impacts in each area is as follows and shown on Figure 12.7.

12.7.6.1 Domain-wide impacts

Environmental impacts directly connected to the Panguna Mine since 1989 may result in three human rights impacts for community rightsholders across the Delta Domain:

- **Possible impact on right to adequate food, housing and standard of living:** Continued effects on marine function in Empress Augusta Bay may constrain the amount of edible marine resources (e.g., fish and crustaceans) available to these communities. This results in impacts on households' capacity to fish, which contributes to household food security and livelihood generation. This is modelled to be around 50 households with a modelled population of 100 people.
- **Actual impact on right to a clean, healthy and sustainable environment:** Mineralised contamination from tailings deposition has resulted in impacts to land and the marine ecosystem. This contamination may affect the receiving environment for around 50 households, with a modelled population of 100 people.

12.7.6.2 Marau village

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for community rightsholders in Marau village, including (see Figure 12.7):

- **Actual impact on right to health:** The Delta Domain has low levels of locally available community infrastructure and services. Mine-related flooding in the lower Pagana River will impact the Marau Road wet crossing at Pagana River and the road to Moratona. Individuals from Marau rely on these roads to access community infrastructure and services in the east of the study area, including the Moratona Health Centre.
- **Actual impact on right to adequate food, housing and standard of living:** Continued mine-related flooding in the Tuju (Marau) River impacts gardening areas to the north and south of Marau village under all flood modelling scenarios. Flooding impacts the productivity of land used for gardening and cropping, and related food security and livelihoods.
- **Actual impact on right to water:** Continued mine-related flooding in the Tuju (Marau) River reduces the acceptability of water sources during flooding for households from Marau.
- **Actual impact on cultural rights:** Continued mine-related flooding constrains land availability in Marau and impacts the value of the land and its social use, contributing to reduced social capital and increase community conflicts.

Table 12.15 Summary of human right impacts in the Delta Domain

Impact type	Human rights impact[(1)]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to health						
Actual	***Reduced access to health care due to riverine hazards, impacting on the right to health*** Flood events in the Jaba and Kawerong river system are hazardous and can have an effect on community access to infrastructure and services. When floods occur, people living in an area with no safe access (i.e., a bridge) cannot cross the river and access community infrastructure and services.	**Community**: The population affected is around 40 people.	Almost certain	Moderate	Medium	High
Right to adequate food, housing, and standard of living						
Possible	***The presence of mineralised contamination may impact the right to adequate food, housing, and standard of living*** The migration of tailings deposited during the operation of the mine has led to the formation of the delta. A small hamlet has been established on this delta, which is located west of Marau market. The tailings have elevated copper and molybdenum concentrations at levels above the agricultural soil quality criteria.	**Community**: The effect on soil productivity may occur across the extent of tailings, affecting a modelled population of 40 people in a hamlet to the west of Marau market	Possible	Minor	Low	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Actual	***Flooding effects on land impact the right to adequate food, housing, and standard of living*** Flooding events can reduce or destroy crops and garden plots, which has a subsequent effect on food security and income generation. Flooding affects gardening areas to the north and south of Marau village and to the west of Marau market.	**Community:** The continued impact of flooding in the Delta Domain may constrain food production and income generation in Marau and the hamlet west of Marau market. An estimated population of 40 people may experience this impact.	Almost certain	Moderate	Medium	High
Possible	***Mineralised contamination may affect marine ecology in Empress August Bay, and impact on the right to adequate food, housing, and standard of living*** Deposition of mine-derived sediments continue to have effects on the marine ecosystem function in Empress Augusta Bay which may constrain the availability of edible marine resources (e.g. fish and crustaceans) for communities in the Delta Domain.	**Community:** Impacts to fishing are expected to affect a modelled population of 100 people within the study area.	Likely	Moderate	Medium	High
Right to water						
Actual	***Flooding has impacted on the right to water*** Continued mine-related flooding has impacted areas of the Delta Domain. Households in Marau reported that they mostly relied on water from wells dug next to the Tuju (Marau) River as their primary water source and this gets affected by flooding. Households reported that during flood events, one water source remains unaffected. Flooding in this watercourse reduces the overall acceptability of water available to households as flood water is not perceived to be safe to drink by communities.	**Community:** Impacts to water acceptability due to post 1989 mine related flooding is expected to be limited to households from Marau and the hamlet to the west of Marau market, which is estimated to be 23 households, with a modelled population of 43 people.	Almost certain	Minimal	Low	Medium

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Cultural rights						
Actual	***Flooding impacts on cultural rights*** Regular flooding has constrained the value of land and its usability. Land-based activities, such as gardening, support participation in customary practices. Constrained availability and quality of gardening land thereby reduces rightsholders capacity to participate in cultural life.	**Community:** The scope of the impact is minimal. It is estimated that flooding would impact gardens and cropping land used by 12 households with a modelled population of around 20 people.	Almost certain	Minor	Medium	High
Right to a clean, healthy and sustainable environment						
Actual	***Exposure to environmental impacts directly connected to the mine may impact individuals' right to a clean, healthy and sustainable environment*** Mineralised contamination from tailings has impacted land and marine environment in large areas of the domain.	**Community:** It has been estimated that communities in the domain, including Marau and the hamlet near Marau market may be impacted by this. This is modelled to be around 50 households with a modelled population of 100 people.	Almost certain	Minor	Medium	High

1. Where impacts have the same salience, they are presented here jointly for ease of reading, but these are assessed separately.

12.7.6.3 Hamlet west of Marau village market and Momarego

Environmental impacts directly connected to the Panguna Mine since 1989 may result in human rights impacts for **community rightsholders** in these communities, including (see Figure 12.7):

- **Actual impact on right to health:** The Delta Domain has low levels of locally available community infrastructure and services. Mine-related flooding in the lower Pagana River will impact the Marau Road wet crossing at Pagana River and the road to Moratona. Individuals from the hamlet west of Marau village market and Momarego rely on these roads to access community infrastructure and services in the east of the study area, including the Moratona health centre.
- **Actual impact on right to adequate food, housing and standard of living:** A review of aerial imagery in the community west of Marau village market indicates that possible gardening and cropping land in this community is impacted under all flood modelling scenarios. This may have subsequent effects on households' food security and livelihoods. No mine-related flooding was identified in Momarego.
- **Possible impact on right to adequate food, housing and standard of living:** The hamlet west of Marau village market has been established on a part of the delta created by tailings deposition. Gardens on land established on tailings may have elevated copper and molybdenum concentrations. This is not expected to support favourable conditions for growing crops for consumption or to generate an income.
- **Actual impact on right to water:** Continued mine-related flooding in the Tuju (Marau) River reduces the acceptability of water sources during flooding for households from the hamlet west of Marau village.

12.7.7 Possible risks to the right to health from contaminants in the environment

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified mine-related contaminants that pose a possible risk to the right to health in the Delta Domain. Exposure to contaminated food or soil can pose a health risk but it does not mean that someone will develop a health condition.

These possible risks to right to health may affect community rightsholders. A description of these possible risks is provided in the following sections.

The possible risks to the right to health from contaminants in the environment have a **high** degree of uncertainty, given limitations detailed in the Water Quality and Geochemical Assessment (Appendix A) and Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.7.7.1 Community rightsholders

Exposure to contaminants of concern through soil and food

The primary impact to land in the Jaba River delta area is related to tailings migration and deposition, which created the new delta landmass extending into Empress Augusta Bay. In the Delta Domain, the hamlet west of Marau market is the only community established on tailings.

Based on sampling undertaken for the water quality and geochemical assessment (Section 5.2), no exceedances of the residential (direct contact) health criteria were detected in tailings samples. All metal concentrations in tailings, except copper and molybdenum, were also below the agricultural human health screening criteria. This means that a possible health risk exists associated with copper and molybdenum where consumption of fresh produce and animal products grown in tailings occurs.

Garden soil samples were collected in the Delta Domain for the Social, Human Health and Human Rights Characterisation (Chapter 6). In the 16 garden soil samples collected, no exceedances of the residential (direct contact) health criteria or agricultural human health criteria were detected.

Of the 36 food samples collected in the Delta Domain, three samples (8%) exceeded the adopted food standard screening criteria for at least one metal, including zinc and copper:

- **Marau village** – exceedance of zinc (marine fish)
- **Marau market –** exceedances of copper (crab meat and smoked kina shellfish) and zinc (crab meat).

The source of these exceedances has not been determined as marine surveys were outside the Scope of Work for Phase 1.

To evaluate contaminant intake from foods in the Delta Domain, the average concentrations of metals and metalloids in foods collected for the market basket survey across the study area were adopted, and food consumption data obtained from surrogate villages in PNG were used to estimate the contaminant intakes associated with diet.

Based on the contaminant dietary intake evaluation undertaken for the Human Health Risk Assessment (Appendix G), there is a **low risk** to the right to health of people due to potential mine-related contaminants in food in the Delta Domain.

12.8 PORT AND TOWN DOMAIN

This section identifies and assesses the actual and potential human rights impacts in the Port and Town Domain that are directly connected to the environmental impacts caused by the mine since the cessation of mining in 1989. This assessment considers the outcomes of the environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) undertaken for the domain.

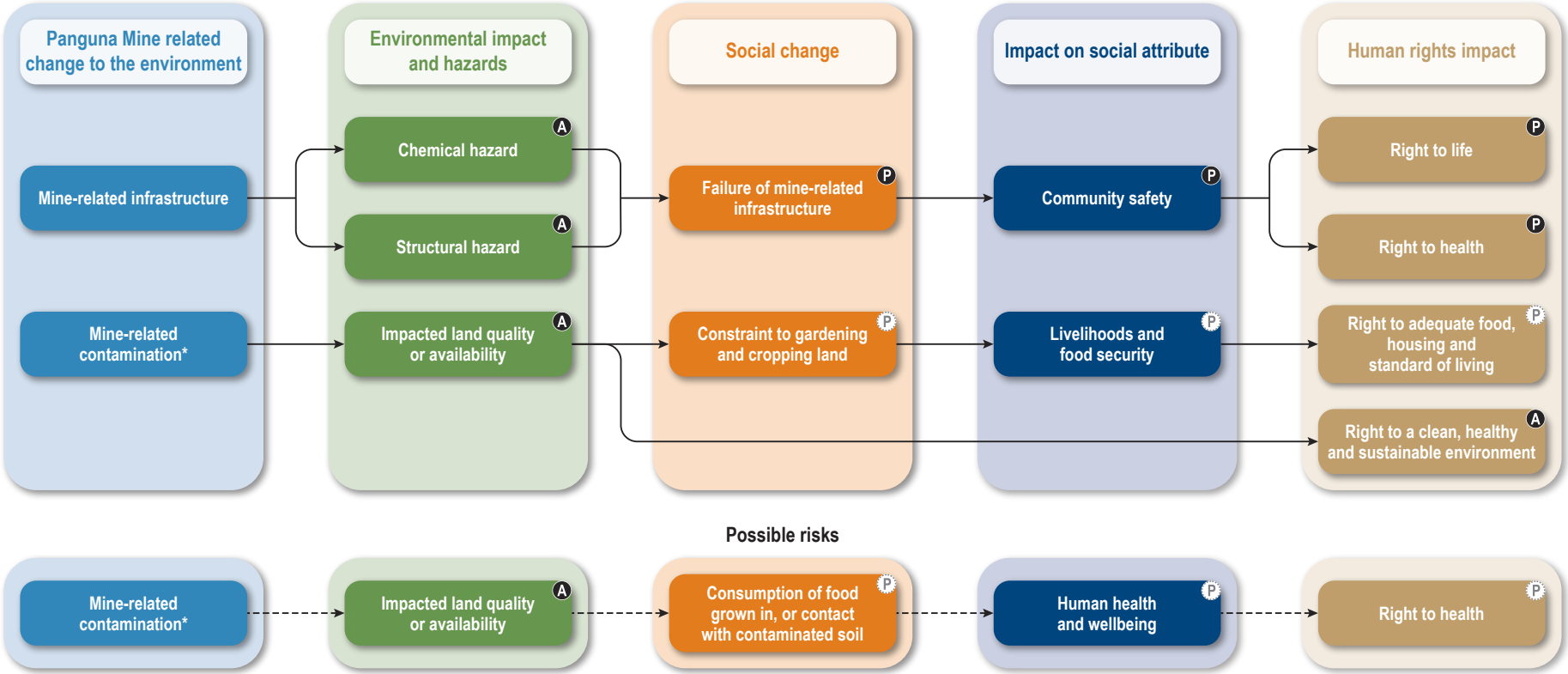
The rightsholders relevant to this assessment in the Port and Town Domain are:

- Communities, including Rorovana 1, 2 and 3, Loloho, Loloho Port area, Anewa Bay, Tunuru Mission, Sipusipu, Bikora, Pisinara, Pakia, and Parakake. As noted in the social impact assessment (Section 11.5) investigation of Arawa town was not part of Phase 1.
- Women.
- Children, particularly children attending Metonai Elementary School.
- Physically vulnerable groups, such as young children, the elderly and persons with a disability.
- Loloho Port workers.

Table 12.16 summarises the human rights impacts assessed for this domain, including the connected environmental and social impacts or hazards. Figure 12.8 shows the connections between environmental, social and human rights impacts. The following sections detail the assessment of these human rights impacts. Figure 12.9 shows a spatial summary of human rights impacts in each area.

Table 12.16 Environmental and social impact connections with human rights – Port and Town Domain

Environmental impact or other hazard	Social impact/risk	Human rights impacts	Relevant rightsholders
Structural hazards associated with legacy mine infrastructure.	Potential impact to community safety due to structural failure of mine related infrastructure.	Potential impact on **right to life** from exposure to structural hazards that may result in fatalities.	Community; Loloho Port workers; children; physically vulnerable persons
Chemical hazards associated with legacy mine infrastructure.	Potential impact to community safety due to exposure to chemical hazard and explosive events associated with mine-related hazards	Potential impact on **right to life** from exposure to chemical hazards and explosive events for the chemical hazards that may result in fatalities.	Community; children; physically vulnerable persons
		Potential impact on **right to health** from exposure to chemical hazards.	Community; children
Impacted land and soil quality due to non-mineralised contamination.	Possible impact to income generation and food security due to impacted land and soil quality.	Possible impacts on the **right to adequate food, housing and standard of living** from due to contaminants in soil.	Community, physically vulnerable persons
	Possible risk to human health and wellbeing due to exposure to mine-related contaminants in soil and food.	Possible risk to **right to health** from exposure to mine related contaminants in soil and food.	Community
		Actual impacts on **right to a clean, healthy and sustainable environment** from exposure mine related environmental impacts.	Community



NOTE
*Mine-related contamination includes mineralised and non-mineralised contamination

SOURCE
Tetra Tech Coffey, 2024

LEGEND

- (A) Actual impacts
- (P) Potential impacts
- (P) Possible impacts / risks

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FIGURE 12.8

Connections between environmental impacts, social impacts and human rights impacts in the Port and Town Domain

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DATE: 01.11.24 PROJECT: 754-MELEN305719 FILE: 305719_R03_F12.08_GRA

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LEGEND

- Village
- Point of interest
- Main dwelling structure
- Road
- Watercourse

Human rights impact

- Potential impact to right to life
- Potential impact to right to health
- Possible impact to right to adequate food, housing and standard of living*
- Possible risk to right to health

*Impacts in Anewa Bay differ depending on rightsholder groups across the domain

Impact extents are approximate and circles shown are symbolic only. These areas should be used be used as a guide only.

SOURCE
Impacts, households, villages, roads and watercourses from Tetra Tech Coffey.
Imagery from Woolpert (2023) and Pleiades (2020).

0 100 200 m

SCALE **1:15,000**
PAGE SIZE: **A4**
PROJECTION: **WGS 1984 UTM Zone 56S**

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FIGURE 12.9

Summary of impacted human rights – Port and Town Domain

TETRA TECH COFFEY

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12.8.1 Right to life

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified three structural hazards and seven chemical hazards in the Port and Town Domain. Exposure to these mine-related hazards may impact on the right to life.

Impacts to the right to life may affect community and worker rightsholders in the Port and Town Domain. Vulnerable groups such as women, children, and the physically vulnerable were assessed to have the same impact as community rightsholders. An assessment of these impacts is provided in the following sections.

Participants of focus group discussions in the Port and Town Domain raised concerns relating to the right to life, for example:

> Here, we have chlorine, chemicals, transformers are all around here. In the bush, the skull drawn on the drums is here, where we live and eat, some people have died from the pollution from the chemicals that were left lying around.

12.8.1.1 Community rightsholders

Structural hazards

Two mine-related structures in the domain may fail in the event of an earthquake: the power station and the reagent storage tanks. These structures have the potential to impact the right to life for individuals in communities in Anewa Bay.

Access to the power station is limited by dense vegetation and there are no residences in the immediate vicinity, with the closest building located 120 m north of the site. The area may be used as an access route through to other areas, as people move between residential areas along the coast to gardening areas on the west of Loloho Road.

Access to the reagent storage tanks is limited by dense vegetation and no community use was reported within, or near the structures. The closest area of resource use was 70 m to the south of the area, and the closest dwelling was 100 m to the south.

Given the limited use of these structures and the event trigger being an earthquake, the likelihood of an impact on the right to life occurring from structural failure is **unlikely**. The severity of the potential impact is **major**, based on:

- **Scale**: The scale of the potential impact is severe and may result in death or adverse health consequences that lead to an extreme reduction in quality of life.
- **Scope**: The scope of the potential impact is minimal. People living nearby, working or passing through these areas are at risk. Given the limited use of these areas, if failure occurred and people were present in the immediate area of impact it has been assumed to affect a small number of people.
- **Remediability**: The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality), it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impact to the right to life from structural hazards for community rightsholders in Anewa Bay is **medium**.

Other factors not related to the Panguna Mine that contribute to the potential that structural hazard events may occur in this domain include environmental hazards such as strong winds or earthquakes and behaviours of people interacting with infrastructure, such as salvaging. This assessment does not quantify the relative contribution of mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty, based on limitations detailed in the Structural Assessment (Appendix F) and those identified relating to social data. A summary of these is provided in Section 11.7.

Potentially fatal chemical hazards

Field investigations indicate there may be chlorine cylinders located at the former Camp 11 chemical storage warehouse and former sewage treatment plant at Rorovana 3. As chlorine gas can be harmful if inhaled, these sites have the potential to impact the right to life for individuals from nearby communities at Camp 11 and Rorovana 3. These sites have been included conservatively as the condition and quantity of chemicals at these sites is unknown, and there may not be any chemicals remaining. This impact has been assessed on a precautionary basis.

The area surrounding the Camp 11 chemical storage warehouse is actively being used by the community, with the closest building located 30 m from the site. A vegetable garden is maintained immediately to the east of the site, and a water source is located 25 m to the east of the warehouse.

The former sewage treatment plant in Rorovana 3 is actively used by the community, including a dwelling 70 m to the north. Gardens, water sources and gathering locations are in the broader area.

Given the frequent use of these sites and the potential toxicity of the chemicals should they exist and should individuals interact with them directly, the likelihood of an impact on the community rightsholders' right to life from chemical hazard impacts is **possible**. The severity of the potential impact is **major**, based on:

- **Scale**: The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Scope**: The scope of the potential impact is minimal. People living, working or travelling through these areas are at risk if they interact directly with the chlorine gas tanks and they leak or rupture. Although there is active use of the site and surrounds, exposure to chlorine gas would be limited to a small number of people.
- **Remediability**: The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality) it will not be possible to restore the human rights to those impacted.

Consequently, the salience of the potential impact to the right to life from chemical hazards for community rightsholders in Camp 11 area and at the former sewage treatment plant at Rorovana 3 is **high**.

This impact has a **high** degree of uncertainty given limitations Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.7.

Chemical explosion hazard

Three sites in this domain pose a potential explosive risk: the bulk fuel storage tanks and spill; reagent storage areas (KMH areas 1 and 3); and methyl isobutyl carbinol (MIBC) tanks and bund. These sites have been included conservatively, as the condition and quantity of chemicals at the sites that have explosive risks are unknown. In some instances, these may have degraded, thereby reducing the risk of an explosion, if any. These sites have the potential to impact the right to life for individuals within the community of Anewa Bay.

The bulk fuel store area in Anewa Bay is easily accessible and adjacent to the Loloho Port Road. Dwellings have been established around 60 m from the tanks, and the community reported that the area was used for a range of purposes, including gardening and water collection.

No regular community use was reported in the area surrounding the reagent storage tanks and the former chemical storage and warehouse north of Anewa Bay. The area may be used by the local community when passing through to other communities and water sources. Based on this, the likelihood of an impact on the community rightsholders' right to life from chemical explosion hazard is **unlikely**. The severity of the potential impact is **major**, based on:

- **Scale**: The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Scope**: The scope of the potential impact is minimal. Should an explosion occur, people living, working or travelling through these areas are at risk. Although these areas are not next to any residential areas, people may be in and around them, particularly for gardening and water collection. An explosion is assumed to affect a small group of people.
- **Remediability**: The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality) it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from an explosion for community rightsholders in Anewa Bay is **medium**.

This impact has a **high** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.8.1.2 Loloho Port workers rightsholders

Structural hazards

The weighing tower located within the private Loloho Port area may fail in the event of an earthquake. Given the size of the weighing tower, failure of this structure has the potential to impact on port workers' right to life. The weighing tower is in an operational port area with limited community access. While community access is limited, structural failure could result in serious injury or fatality of port workers in the immediate vicinity.

Given the current use of this area and the event trigger being an earthquake, the likelihood of an impact on the right to life occurring from structural failure is **unlikely**. The severity of the potential impact is **major**, based on:

- **Scale**: The scale of the potential impact is severe and may result in adverse health consequences that lead to an extreme reduction in quality of life or will cause death.
- **Scope**: The scope of the potential impact is minimal. People working in this area are at risk. Given the current use of this area, failure is assumed to be limited to port workers and may affect a small number of individuals.
- **Remediability**: The remediability of the potential impact is severe. In the most extreme consequence (i.e., a fatality) it will not be possible to restore the human rights to those impacted.

Consequently, the salience of potential impacts to the right to life from structural hazards for Loloho Port workers rightsholders is **medium**.

Other factors not related to the Panguna Mine that contribute to the potential that structural hazard events may occur in this domain include environmental hazards such as strong winds or earthquakes and behaviours of people interacting with infrastructure, such as salvaging. This assessment does not quantify the relative contribution of mine-related influences and these other factors.

This impact has a **medium** degree of uncertainty given limitations detailed in the Structural Assessment (Appendix F), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.8.2 Right to health

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified five locations in the Port and Town Domain where mine-related chemical hazards may impact on the right to health.

Impacts to right to health may affect community rightsholders, as well as children. An assessment of these impacts is provided in the following sections.

During the participatory photography process (Plate 12.9) and focus group discussions, individuals raised concerns relating to the right to health in the Port and Town Domain, for example:

> Five other tanks (MIBC – liquid chemical), this was cut but was asked to close it back [up]. White pigeons in the bush have died because of this.

Exposure to contaminated water, food or soil can pose a health risk but it does not mean that someone will develop a health condition or impact. Section 12.8.6 identifies where a possible health risk exists in the environment directly connected to the Panguna Mine, and where further investigations would improve understanding of the health risk.

12.8.2.1 Community rightsholders

Exposure to chemical hazards

Potential health risks were identified at two sites in this domain that may have a potential impact on the right to health:

- Shipping containers located to the north of Loloho Port Road (around 30 m before the port entrance) which contain polyacrylamide that may degrade into acrylamide, causing skin irritation with blistering and skin loss. The containers are located at the entrance to a working port and there are no barriers that would prevent community access.
- Two discarded drums near the former Camp 11 chemical storage warehouse contain raw xanthate-based reagents. As xanthates degrade, they produce carbon disulfide vapours which may impact air quality temporarily when a drum is opened. Inhalation of carbon disulfide vapours can harm human health. A dwelling is located next to one of the drums. The drums are next to a garden and the broader area is also used for gardening, water collection and gathering.

These potential health impacts affect rightsholders in Anewa Bay and Camp 11.

The condition and quantity of chemicals remaining at these sites is unknown; these sites have been conservatively included based on the potential health risk.

Given the frequent use of these sites, the likelihood of exposure to chemical hazards adversely affecting the right to health is **possible**, although people reported during consultation some awareness of the risks associated with remnant mine-related chemicals. The severity of the potential impact is **minimal**, based on:

- **Scale**: The scale of the potential impact is minor. Chemical hazards have the potential to result in serious injury, disability, or fatalities. In general, the chemical hazards present contact risks.
- **Scope**: The scope of the potential impact is minimal. People living, working or travelling through these areas are at risk. Although there is active use of the site and surrounds, based on the small number of sites and chemical quantities, potential exposure is assumed to affect a small number of people.
- **Remediability**: The remediability of the potential impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

"In the past it was a rich gardening ground. It yield healthy crops. Now the garden harvest is small. The land does not produce much. Furthermore I'm scared to plant under ground crops due to chemicals."

Photo credit: Community participatory photography, 2023

Plate 12.9
Participatory photography photo and quote showing gardens in Rorovana 3

Consequently, the salience of the potential impact to the right to health for community rightsholders in Anewa Bay and Camp 11 from chemical hazards is **very low**.

This impact has a **high** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.6.1.7.

12.8.2.2 Children rightsholders

Exposure to chemical hazards

The chemical hazards identified above (see community rightsholders section) are in actively used areas and are easily accessible to children. Children may not view the substances or areas as a potential health risk and are therefore more likely to interact with these chemicals. These chemical hazards have the potential to impact on the right to health for individual children in Anewa Bay and Camp 11.

Based on this, the likelihood of exposure to chemical hazards adversely affecting right to health for children is **likely**. The severity of the potential impact is **minimal**, based on:

- **Scale**: The scale of the potential impact is minor, and may result in a small impact to health and wellbeing.
- **Scope**: The scope of the potential impact is minimal. Based on the small number of sites and chemical quantities, potential exposure is assumed to affect a small number of individuals within a vulnerable group (e.g., children).
- **Remediability**: The remediability of the potential impact is moderate. Restoration of the human right is achievable with the implementation of established good practices.

Consequently, the salience of potential impacts to the right to health for children rightsholders in Anewa Bay and Camp 11 is **low**.

This impact has a **high** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.6.3.3.

12.8.3 Right to adequate food, housing and standard of living

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified that land quality in some areas of the Port and Town Domain had been impacted by contaminants entering the soil from mine-related infrastructure and activities.

Household food security and livelihood strategies, such as the sale of excess garden produce, rely on the availability and quality of productive land. Impacts to land quality may affect households' right to adequate food, housing and standard of living.

Impacts to the right to adequate food and standard of living may affect community rightsholders, and specifically women. An assessment of these impacts is provided in the following sections.

During the participatory photography process (Plate 12.10), individuals raised concerns relating to the right to adequate food, housing and standard of living in the Port and Town Domain, for example:

> In the past it was a rich gardening ground. It yield healthy crops. Now the garden harvest is small. The land does not produce much. Furthermore, I'm scared to plant underground crops due to chemicals.

"Before the place was free to walk around. Now it is polluted with chemicals and as a result most people suffered arthritis."

Photo credit: Community participatory photography, 2023

Plate 12.10
Participatory photography photo and quote showing perceived damaged land in Rorovana 3

12.8.3.1 Community rightsholders

Impacted capacity to grow enough food enough food to eat and earn income

Gardens located close to mine-related infrastructure were sampled to determine if they had been affected by mine-related contamination. Of these, 21 garden soil samples in the domain (78% of samples) exceeded the adopted agricultural ecological screening criteria for at least one metal. This may influence plant growth and produce in these locations:

- **Anewa Bay:** copper, lead, molybdenum and zinc were identified in 11 samples from gardens located near the Shell oil fuel storage, bulk fuel storage tanks and spill, and Loloho fire station.
- **Camp 11:** arsenic, copper, lead and zinc were identified in five samples from gardens near the former sewage treatment plant and former Camp 11 chemical storage warehouse.
- **Metonai Elementary School (former Itakaya Waste Disposal):** exceedances of arsenic, copper, lead, nickel, molybdenum and zinc exceeded were identified in six soil samples. These samples were taken from gardens established near the former waste disposal site.

The sampling for Phase 1 was targeted and was not designed to determine the extent of contamination. Based on the way these contaminants typically disperse in the environment, contamination is expected to be localised around mine-related infrastructure.

The impact of the exceedances on the productivity of gardening land in the contaminated areas of the Port and Town Domain cannot be determined based on the available data. Consequently, this impact is categorised as a possible impact.

Gardening is the primary source of food for households in this domain and impacts to land productivity as a result of contamination may affect the right to adequate food for households in Anewa Bay, Camp 11 and surrounding the Metonai Elementary School. It is noted that these areas are actively gardened and producing food.

As people in this domain earn money through selling excess garden produce, impacts to land productivity may affect rightsholders' ability to generate income and support an adequate standard of living.

Based on the number of sites, contaminants identified and the extent of exceedances (e.g., in one location in Anewa Bay lead exceeded the agricultural criteria 185-fold), the likelihood of an impact on the right to adequate food, housing food and standard of living occurring is **possible**. The severity of this possible impact is **minor**, based on:

- **Scale**: The scale of the possible impact is moderate, and may result in a notable impact to livelihoods, although this land is still being used for gardening
- **Scope**: The scope of the possible impact is minor. An estimate has been made on a precautionary basis assuming two households rely on one garden, resulting in a range of affected households from 11 to 22 households, or a modelled population of 50 to 150 persons.
- **Remediability**: The remediability of the possible impact is moderate. Restoration of the human rights that have been impacted is readily achievable with implementation of established good practices.

Consequently, the salience of the possible impacts to the right to adequate food, housing and standard of living for some community rightsholders in Anewa Bay, Camp 11 and Metonai is **low**.

Other factors not related to the Panguna Mine that may affect a household's ability to generate income and food security include the significant population increase (estimated to be 10% annually) and impact on land availability and the subsequent intensification in the use of land, and plant diseases and pests affecting productivity of gardens and crops. This assessment does not quantify the relative contribution of the mine-related influences and these other factors.

This impact has a **high** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided in Section 11.7.

12.8.4 Right to a clean, healthy and sustainable environment

The environmental impact assessment (Chapter 10) identified a range of environmental impacts in the Port and Town Domain caused by the mine since mining ceased in 1989. This includes non-mineralised contamination of soil and water in areas of the domain surrounding mine-related infrastructure.

These environmental impacts will affect the right to a clean, healthy and sustainable environment for community rightsholders in the domain. Vulnerable groups identified in this domain, such as women, children and those who are physically vulnerable, were assessed to have the same impact as community rightsholders.

An assessment of these impacts is provided in the following sections.

12.8.4.1 Community rightsholders

Exposure to environmental impacts directly connected to the mine

As described in the previous sections, a number of environmental impacts associated with non-mineralised contamination from mine-related infrastructure have been identified in three areas in the Port and Town Domain:

- **Anewa Bay**: contaminated soil and water associated with the power station, reagent storage tanks (KMH areas 1 and 3), bulk fuel storage tanks and spill, Shell oil fuel storage and Loloho fire station.
- **Camp 11**: potential impacts to air quality and contaminated water associated with the former Camp 11 chemical storage warehouse.
- **Metonai Elementary School** (former Itakaya Waste Disposal): contaminated soil associated with the former waste disposal site.

These environmental impacts affect the right to a clean, healthy and sustainable environment. Based on the number of sites and contaminants identified, the likelihood of environmental impacts directly connected to the mine adversely affecting the right to a clean, healthy and sustainable environment occurring is **almost certain**. The severity of this actual impact is **minor**, based on:

- **Scale**: The scale of the actual impact is moderate, and may result in a notable impact to livelihoods, health, safety, or culture.
- **Scope**: The scope of the actual impact is minor. Given the number and location of sites identified, it is estimated that around 40 households, with a modelled population of 180 people, may be affected.
- **Remediability:** The remediability of the actual impact is moderate. Restoration of the human rights that have been impacted is readily achievable with implementation of established good practices.

Consequently, the salience of the actual impact to the right to a clean and health environment for community rightsholders in Anewa Bay, Camp 11 and Metonai is **medium**.

This impact has a **low** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), and those identified relating to social data. A summary of these is provided Section 11.7.

12.8.5 Summary of human rights impacts in the Port and Town Domain

Table 12.17 summarises the impacted human rights and the relevant rightsholders or vulnerable groups in the Port and Town Domain that are directly connected to the environmental impacts of the Panguna Mine since 1989.

Actual and potential human rights impacts have been identified in five areas: Anewa Bay, Loloho Port, Rorovana 3, Camp 11, and near Metonai Elementary School. In these areas, overlapping human rights impacts have been identified. That is, an environmental impact may affect right to health, as well as affect right to adequate food, housing and standard of living for community rightsholders.

A summary of human rights impacts in each area is as follows (see Figure 12.9).

12.8.5.1 Anewa Bay

Identified human rights impacts directly connected to environmental impacts of the Panguna Mine since 1989 for **community rightsholders** in Anewa Bay, include:

- **Potential impact on right to life**: Two mine-related structures in the domain may fail in the event of an earthquake: the power station and the reagent storage tanks. If failure occurred, and people were present in the immediate area of impact it could affect a small number of people.
- **Potential impact on right to health**: A chemical hazard site in Anewa Bay, is a potential health risk to the community. The area surrounding the identified locations is actively used and exposure to contaminants may impact a small number of people.
- **Possible impact on right to adequate food, housing and standard of living**: Exceedances of metals were identified in 11 garden soil samples in Anewa Bay. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income.
- **Actual impact on right to a clean, healthy and sustainable environment**: Non-mineralised contamination from mine-related infrastructure has resulted in contaminated soil. This contamination may affect the receiving environment for 15 households, with a modelled population of 70 people.

Exposure to contaminants of concern in soil exceeding the residential (direct contact) screening criteria near mine-related infrastructure may result in different risks on the right to health for **women and young children rightsholders** in Anewa Bay. As gardening is primarily undertaken by women with young children present, women and children are exposed to contaminants in garden soils via direct contact more frequently than other community members.

A chemical hazard in shipping containers near Loloho Port could affect the right to health for **children rightsholders** as the site is easily accessible to children. Children may not view the substance or area as a potential health risk and are therefore more likely to interact with these chemicals.

12.8.5.2 Loloho Port

The weighing tower located within the private Loloho Port area could affect the right to life for **Loloho Port worker rightsholders**. The structure may fail in the event of an earthquake and given the size of the structure it has the potential to cause serious injury or fatality of port workers in the immediate vicinity.

12.8.5.3 Rorovana 3

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for **community rightsholders** in Rorovana 3, including:

- **Potential impact on right to life:** Chlorine cylinders at the former sewage treatment plant could release highly toxic chlorine gas and have the potential to impact the right to life for individuals from nearby communities. This site has been included conservatively as the condition and quantity of chemicals at these sites is unknown, and there may not be any chemicals remaining.

Table 12.17 Summary of human right impacts in the Port and Town Domain

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to life						
Potential	***Exposure to structural hazards events that may result in fatalities, impacting on the right to life*** Two structures located in the Anewa Bay community may fail: the power station and the reagent storage tanks. Field investigations generally indicate low social use of these structures, and no residential use, reducing the potential for people to be affected by structural failure.	**Community:** People working or travelling through these areas are at risk. Given the limited use of these areas, failure is assumed to affect a small number of people.	Unlikely	Major	Medium	Medium
	The weighing station located within Loloho Port may fail. Failure could cause serious injury or fatality to people in the immediate vicinity.	**Loloho Port workers** The weighing tower is located in an operational port, and access is restricted to the workforce. Structural failure may affect workers.	Unlikely	Major	Medium	Medium
Potential	***Exposure to chemical hazards events that may result in fatalities, impacting on the right to life*** There may be chlorine cylinders located at the chemical storage warehouse in Camp 11 and former sewage treatment plant at Rorovana 3. Chlorine gas is highly toxic if inhaled. The condition and quantity of chemicals at these sites is unknown, and there may not be any chemicals remaining.	**Community:** People living, working or travelling through these areas are at risk. Although there is active use of the site and surrounds, exposure to chlorine gas would be limited to a small number of people.	Possible	Major	High	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Potential	***Exposure to explosive events from chemical hazards may result in fatalities, impacting on the right to life*** Three sites may also pose an explosive risk. The above-ground fuel tanks, reagent storage tanks, former storage and warehouse are all located in Anewa Bay. The condition and quantity of chemicals at the sites that have explosive risks are unknown. In some instances, these may have degraded.	**Community:** People living, working or travelling through these areas are at risk. Although these areas are not next to any residential areas, people may be in and around them, particularly for gardening and water collection. An explosion is assumed to affect a small group of people.	Unlikely	Major	Medium	High
Right to health						
Potential	***Exposure to chemical hazards may impact the right to health*** Two sites pose a risk to health: • Polyacrylamide shipping containers in Anewa Bay may degrade into acrylamide, causing skin irritation with blistering and skin loss. • Two discarded drums near the former Camp 11 chemical storage warehouse may contain raw xanthate-based reagents, inhalation of which can harm human health. The condition and quantity of chemicals at the sites is unknown.	**Community:** People living, working or travelling through these areas are at risk. There is high use of these areas by the community. Given the small number of sites and chemical quantities, exposure would affect a small number of people.	Possible	Minimal	Very low	High
Potential		**Children:** The shipping container is in an actively used area. A substance is flowing out of the container and would be easily accessible to children. Similarly, there is no barrier to accessing the discarded drums. Children may not view the substance as a risk, and are therefore more likely to interact with these chemicals.	Likely	Minimal	Low	High

Impact type	Human rights impact[1]	Affected rightsholders and identified vulnerable groups	Likelihood	Severity	Salience	Uncertainty
Right to adequate food, housing, and standard of living						
Possible	***The presence of non-mineralised contamination may impact the right to adequate food, housing, and standard of living*** Contamination of land used for gardening reduces the quality and amount of food able to be grown, although this land is still being used for gardening. Twenty-one samples within 11 gardens (78%) exceeded the adopted agricultural screening criteria for at least one metal.	**Community:** Eleven gardens that were sampled reported exceedances. An estimate has been made on a precautionary basis assuming two households rely on one garden, resulting in a range of affected households from 11 to 22 households (50 to 150 persons).	Possible	Minor	Low	High
Right to a clean, healthy and sustainable environment						
Actual	***Exposure to environmental impacts directly connected to the mine may impact individuals' right to a clean, healthy and sustainable environment*** Non-mineralised contamination from mine-related infrastructure has impacted land and marine water quality in three areas of the domain.	**Community:** Contamination was identified in three areas in the domain. On a precautionary basis, it is assumed that around 42 households, with a modelled population of 200 people, may access these areas.	Almost certain	Minor	Medium	Low

1. Where impacts have the same salience, they are presented here jointly for ease of reading, but these are assessed separately.

- **Possible impact on right to adequate food, housing and standard of living:** Exceedances of metals were identified in four garden soil samples near mine-related infrastructure. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income. Based on the locations of these gardens, four households are likely affected.
- **Actual impact on right to a clean, healthy and sustainable environment:** Non-mineralised contamination from mine-related infrastructure has resulted in impacts to soil. This contamination may affect the receiving environment for 16 households, with a modelled population of 80 people.

12.8.5.4 Camp 11

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for **community rightsholders** in Camp 11, including:

- **Potential impact on right to life:** Chlorine cylinders at the former Camp 11 chemical storage warehouse could release highly toxic chlorine gas and have the potential to impact the right to life for individuals from nearby communities. These sites have been included conservatively as the condition and quantity of chemicals at these sites is unknown, and there may not be any chemicals remaining.
- **Potential impact on right to health:** Two chemical hazard sites pose a potential health risk to the community. Although the area surrounding the identified locations is actively used, potential exposure to contaminants is expected to be limited a small number of people.
- **Actual impact on right to a clean, healthy and sustainable environment:** Non-mineralised contamination from mine-related infrastructure has resulted in potential impacts to air quality and contaminated water near the former chemical storage warehouse. This contamination may affect the receiving environment for five households, with a modelled population of 30 people.

Two discarded drums near the former Camp 11 chemical storage warehouse could affect the right to health for **children rightsholders** as the site is easily accessible to children. Children may not view the substance or area as a potential health risk and are therefore more likely to interact with these chemicals.

12.8.5.5 Metonai Elementary School

Environmental impacts directly connected to the Panguna Mine since 1989 may result in a number of human rights impacts for **community and children rightsholders** near Metonai Elementary School, including:

- **Possible impact on right to adequate food, housing and standard of living:** Exceedances of metals were identified in six garden soil samples near the former Itakaya Waste Disposal site. These exceedances may affect the productivity of land, and subsequent food security and ability to generate an income. Based on the locations of these gardens, five households are likely affected.
- **Actual impact on right to a clean, healthy and sustainable environment:** Industrial contamination from the former Itakaya Waste Disposal site has resulted in contaminated soil in the surrounding area. This contamination may affect the receiving environment for six households, with a modelled population of 30 people.

Women rightsholders near Metonai Elementary School may experience heightened impacts to their right to adequate food, housing and standard of living due to their reliance on gardening and sale of excess gardening produce.

12.8.6 Possible risks to the right to health from contaminants in the environment and chemical hazards

The environmental impact assessment (Chapter 10) and social impact assessment (Chapter 11) identified five locations in the Port and Town Domain where land was identified as contaminated by non-mineralised contamination. Exposure to this non-mineralised contamination is a possible risk to the right to health for community rightsholders, as well as specific vulnerable groups, including women and children. An assessment of these impacts is provided in the following sections.

The possible risks to the right to health from contaminants in the environment have a **high** degree of uncertainty regarding the possible risks given limitations detailed in the Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

Exposure to contaminants of concern through direct contact with soil

Non-mineralised contamination of soils in the Port and Town Domain was identified in areas of mine infrastructure, where hazardous materials or waste were previously stored or used during mining. Concentrations of contaminants exceeded residential (direct contact) health criteria in four areas in Anewa Bay (north to south):

- **Reagent storage tanks (KMH areas 1 and 3)**: Concentrations of lead, PCBs and hydrocarbons were found in impacted soil within a bund. The area is not currently used by the community but local community members travel through this area to connect with other communities, gardens and water supply sources.
- **Loloho fire station**: PFAS compounds, which are associated with firefighting foam, were identified in soil samples. The former fire station is now being used as a residence, and the household has a garden at the rear of the shop.
- **Bulk fuel store area:** Concentrations of hydrocarbons were identified. As the hydrocarbons have aged and weathered, the proportion of volatile compounds is expected to be reduced. A marginal exceedance of PFAS compounds was also detected. This area is used for gardening, and the closest dwellings are approximately 60 m from the large tanks.
- **Shell oil fuel storage terminal:** Lead, iron and hydrocarbon concentrations were identified in the soil. The former administration building is being lived in and surrounding land used for gardening.

These areas present a possible health risk if regular direct contact, such as dermal contact or ingestion, occurs. Contaminated land in these areas may pose a risk to the right to health for households in communities in Anewa Bay and further work would improve understanding of the exposure risk.

Exposure to contaminants of concern through soil and food

Exceedances of the agricultural human health screening criteria were identified for arsenic, lead and nickel in garden soils from Anewa Bay, Rorovana 3 and Metonai Elementary School. However, where garden soil exceedances were found there was no corresponding exceedance in co-located food samples at these locations. The lack of exceedances of the same metal measured in soil and co-located food suggests that the contaminant intake in plants and raised animals is inconclusive based on the available data.

Of the 38 food samples collected in the Port and Town Domain, two samples (5%) exceeded the adopted food standard screening criteria for at least one metal. The exceedances identified were cadmium in a tuber vegetable (cassava) at Metonai Elementary School (formerly Itakaya Waste Disposal Site) and selenium in chicken meat at Rorovana 3.

To evaluate contaminant intake from foods in the Port and Town Domain, the average concentrations of metals and metalloids in foods collected for the market basket survey across the study area were adopted, and food consumption data obtained from surrogate villages in PNG, were used to estimate the contaminant intakes associated with diet.

Based on the contaminant dietary intake evaluation undertaken for the Human Health Risk Assessment (Appendix G), there is a **low risk** to the right to health of people due to potential mine-related contaminants in food in the Port and Town Domain.

This risk has a **high** degree of uncertainty given limitations detailed in the Site Contamination Assessment (Appendix B), Human Health Risk Assessment (Appendix G) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.8.6.1 Women and young children

Exposure to contaminants of concern through direct contact with soil

As described above, land used for gardening in Anewa Bay exceeded the residential (direct contact) screening criteria for contaminants. As gardening is primarily undertaken by women (see Section 6.2.2.2), women may be exposed to these contaminants via direct contact more frequently than other community members. Additionally, women often garden with young children present and as young children have increased hand to mouth contact, they are more likely to ingest soils than adults.

Based on this, women's and young children's right to health in Anewa Bay may be impacted differently than that of the general community; further work would improve understanding of the exposure risk.

These areas present a possible health risk if regular direct contact, such as dermal contact or ingestion, occurs. Contaminated land in these areas may pose a risk to the right to health for households in communities in Anewa Bay and further work would improve understanding of the exposure risk.

This risk has a **high** degree of uncertainty given limitations detailed in the Human Health Risk Assessment (Appendix G) and Site Contamination Assessment (Appendix B) and those identified relating to social data. A summary of these is provided in Section 11.7.

12.9 SUMMARY

This human rights impact assessment has identified human rights impacts directly connected to environmental impacts of the Panguna Mine since 1989. These impacts and risks include:

- Potential impacts to right to life from failure of mine-related infrastructure or river crossing and flooding hazards in the Mine, River System, and Port and Town domains. All impacts have been assessed to have a high to very high salience, except for the Port and Town Domain where structural and chemical explosion hazards were assessed as medium.
- Actual and potential impacts to the right to health from changed access to health care due to geotechnical or riverine hazards or flooding were identified in the Mine, River System and Delta domains. Impacts have been assessed to have a medium to high salience.
- Potential impacts to the right to health due to exposure to chemical hazards in the Port and Town Domain. These impacts have been assessed to have a very low to low salience.
- Actual, potential and possible impacts to the right to adequate food, housing and standard of living from changed flooding regimes and mine-related contamination in all domains. Impacts have been assessed to have a salience ranging from low to medium.

- Actual, potential and possible impacts to the right to water from sediment movement, continued and changed mine-related flooding, and mine-related contamination in the Mine, River System, and Delta domains. Impacts have been assessed to have a medium salience.
- Actual impacts to right to education from river crossing and flooding hazards in the River System Domain. Impacts have been assessed to have a medium salience.
- Actual and potential impacts to the cultural rights from changed flooding regimes in the River System Domain. Impacts have been assessed to have a salience ranging from medium to very high.
- Actual impacts to the right to a clean, healthy and sustainable environment in all domains. All impacts have been assessed to have a salience of medium.
- Possible risks to the right to health from mine-related contamination in all domains.

These results have been used to develop recommendations on what needs to be remedied, which is presented in Chapter 13.