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5. OVERVIEW OF IMPACT ASSESSMENT METHOD

This chapter describes the environmental, social, and cultural heritage impact assessment process including the methods used to assess impacts due to construction and operation of the Papua LNG Project – Downstream (the Project).

The impact assessment process is based on similar methods adopted for the PNG LNG Project Environmental Impact Statement (EIS). Impact assessment methods have become more refined in the decade since the PNG LNG Project EIS was prepared, and these refinements have been adopted to apply current leading practice in impact assessment to assess the Project. For example, more explicit (and tailored) definitions of magnitude and sensitivity introduce greater robustness and rigour into a significance assessment method, in many cases, based on international guidance.

An overview of the assessment process is provided in Figure 5.1 and includes the following steps:

- **Scoping:** Identifying the important environmental, cultural, and social issues that may result from project activities. This step frames the initial spatial and temporal boundaries of the assessment.
- **Characterisation of existing environment:** Describing the existing physical, biological, social, and cultural environments, as well as any aspects of those environments (values) that may be impacted by the Project.
- **Identifying mechanisms of change:** Identifying and describing project related activities that will impact on physical, biological, social, and cultural environments (that is, what will cause the change in the status of a value that can be attributed to the Project).
- **Impact assessment:** Identifying and assessing the significance of the potential direct and indirect impacts of project activities and developing management measures that reduce the significance level.
- **Cumulative impact assessment:** Identifying and assessing the potential impacts of the Project in combination with the impacts of other known or planned projects in the Project area of influence.
- **Reporting:** Presenting the main assessment outcomes in this EIS report.

5.1 SCOPING

Scoping is an important first step of the assessment process as it identifies the environmental, social, and cultural issues that are likely to be most important. Issues that are deemed to be of little or no concern are eliminated at this stage of the EIS process. All remaining issues are then considered in the impact assessment.

The scoping process also identifies the project stakeholders and boundaries of the assessment. That is, the period the assessment will consider, as well as the spatial (physical) boundaries. It also identifies the information requirements needed to inform the impact assessment.

The steps in the scoping process carried out for this EIS are described below.

5.1.1 Area of influence

The Project area is defined as the footprint of the Project construction and operation activities. Impacts may extend beyond the physical footprint of the Project and hence the spatial boundaries of the impact assessment need to reflect this. For the purpose of scoping, the spatial boundaries for the assessment were therefore broadly defined as the areas which may potentially be directly or indirectly impacted as a result of construction and operation of the Project and subsequently required further investigation. These areas are referred to as the Project area of influence.

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FIGURE 5.1

Overview of impact assessment approach

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The temporal boundaries for the purposes of scoping were defined as the duration of the Project, including construction (four and a half years), operation (30 years) and decommissioning (two years) phases. The Project area of influence is shown in Figure 5.2.

The Project is one component of the Papua LNG Project, a gas development project for the Papua LNG co-venture participants:

- TotalEnergies EP PNG Limited (Total Energies, an affiliate of TotalEnergies SA)
- ExxonMobil PNG Antelope Limited and ExxonMobil PNG Elk Limited
- Pac LNG Assets Limited, Pac LNG International Limited, Pac LNG Investments Limited, Pac LNG Overseas Limited and Pac LNG Holdings Limited (affiliates of Santos Limited)
- JX Nippon Oil and Gas Exploration Pty Ltd.

The other component of the Papua LNG Project is the Papua LNG Project – Upstream, which was assessed under a separate EIS that was completed in December 2019 by ERIAS Group Pty Ltd and TotalEnergies EP PNG Ltd. The Papua LNG Project – Upstream project will operate in accordance with an applicable Environment Permit as, although interconnected, the two components of the Papua LNG Project have different operators, geographical locations, and development timelines.

This EIS will assess the following Project components:

- Expansion of the LNG Plant.
- Construction and operation of a catenary anchor leg mooring (CALM) buoy and associated navigational areas and exclusion zones.
- Operation of the naphtha and condensate pipelines located to the south of the existing LNG Plant jetty that connect to the CALM buoy and deliver export gas.
- Construction and operation of the onshore portion of the pipelines (the LNG Plant side after the tie-in point from the Papua LNG Project – Upstream) including hydrotest activities.

5.1.2 Data and information review

A scoping study was completed in early 2019. Previous studies and data were reviewed to characterise the existing physical, biological, cultural, and social environments including:

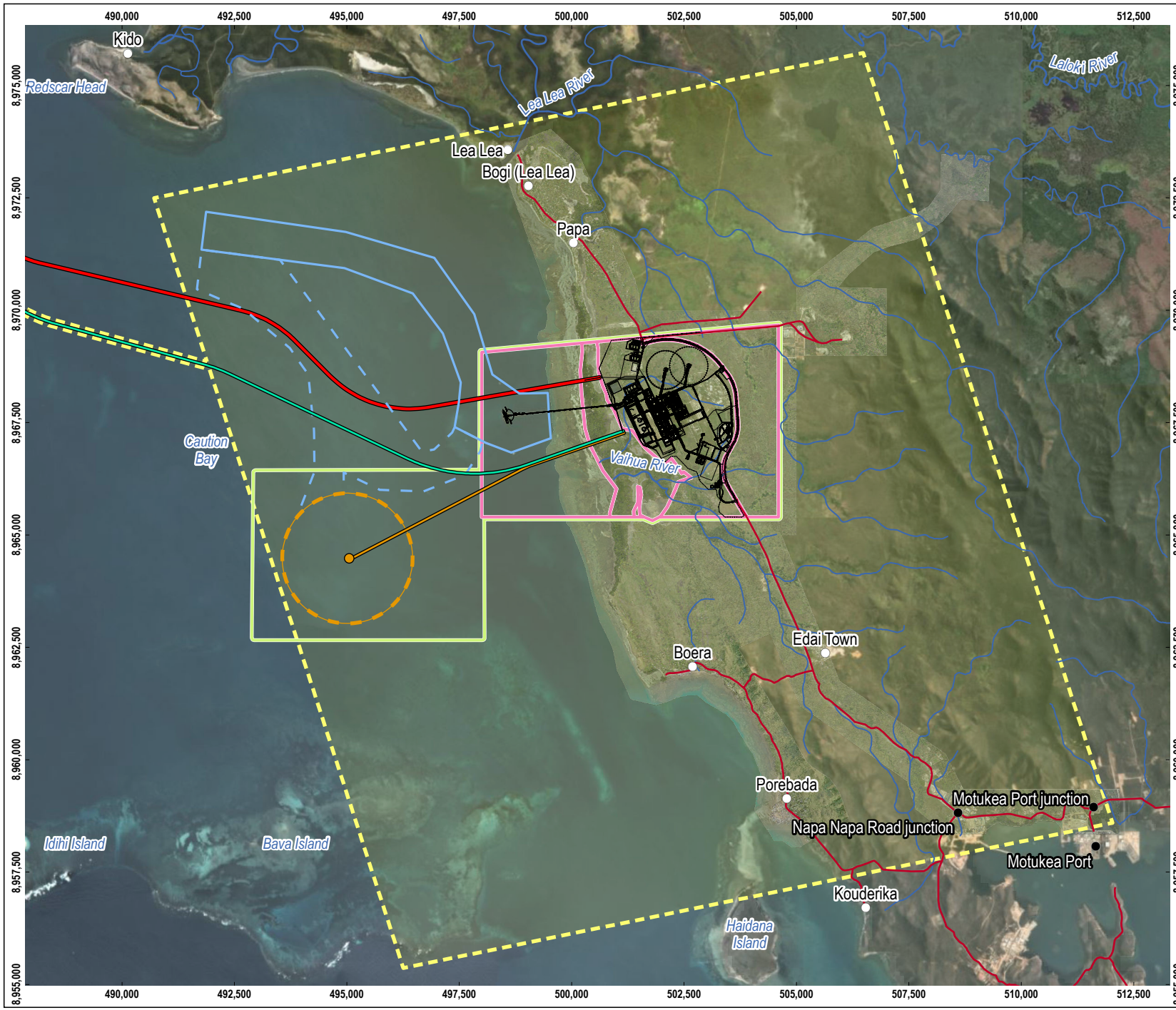
- Information from environmental and social impact assessments, management plans, social mapping and landowner identification studies conducted for the Papua New Guinea Liquified Natural Gas Project (PNG LNG Project), and relevant updates to these aspects as appropriate, when conducted in conjunction with the Project.
- Environmental and socio-economic monitoring data from the PNG LNG Project.
- Spatial data and landscape mapping products, such as satellite and aerial imagery.

Further detail on the information and data reviewed for each study is presented in Chapter 7 Receiving Environment: Onshore, Chapter 8 Receiving Environment: Marine, Chapter 9 Social Environment and Chapter 10 Cultural Heritage Environment, which detail the receiving environment for the Project.

5.2 EXISTING ENVIRONMENT CHARACTERISATION

The existing physical, biological, cultural and social environment was characterised using data and information identified during the scoping study and gathered as part of field surveys and site visits.

The steps taken to characterise the existing environment as part of the EIS are described in this section. Further details on each study area, field surveys, and the definition of values are presented in the characterisation of existing environment chapters of this EIS (chapters 7 to 10).



LEGEND

- Village
- Point of interest
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout
- PPFL2 boundary
- APPFL boundary
- Current navigational channel
- Proposed navigational channel
- Area of influence

Proposed CALM buoy components

- CALM buoy
- Naphtha and condensate pipelines
- CALM buoy navigational area

SOURCE
Area of influence from Tetra Tech Coffey.
Infrastructure, roads, watercourses and lease boundary from EMPNGA.
Imagery from EMPNGA and Planet Labs.

0 1 2 3 km

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FIGURE 5.2

Project area and area of influence

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5.2.1 Study areas

The study area relevant to each technical discipline was further refined and framed by the predicted area of influence of the Project for each discipline. In defining the local study area, technical specialists considered the outcomes of the scoping studies and the information required by other studies to support their impact assessments. A broader study region was investigated to provide context for certain investigations. For example, surveys were undertaken at local villages close to the LNG Plant. This data was compared to regional and national data to understand the potential impacts of the Project in a broader context.

5.2.2 Site visits and field surveys

Site visits and field surveys were carried out early in 2019 to further inform the characterisation of the existing environment. The surveys aimed to fill gaps in existing baseline data available for the study area. The focus of the surveys was determined during the scoping process and included:

- Noise monitoring at the LNG Plant and nearby sensitive receptors to characterise the ambient noise environment.
- Groundwater sampling to characterise groundwater within and around the LNG Plant site.
- Nearshore marine surveys for water and sediment quality, marine ecosystems, and mangrove and tidal habitat to provide data on existing condition of the environmental values.
- Traffic and road use surveys to characterise traffic use in the Project area.
- Targeted terrestrial biodiversity surveys to collect baseline data on existing fauna and weeds.
- Household surveys, key informant interviews, and focus group discussions within the local study area to inform the development of social studies.
- Cultural heritage survey of the proposed laydown area outside the LNG Plant boundary.

Additional site visits and field surveys were undertaken in 2022 to update or expand on the findings of the 2019 investigations. These included:

- Traffic and road use surveys to characterise traffic use in the Project area.
- Key informant interviews, interviews with market stallholders and focus group discussions to inform the development of the social baseline and impact assessment study, traffic, and land use study.
- Nearshore marine surveys to collect additional data at the locations of proposed marine infrastructure.
- Mangrove field survey to further characterise the mangrove environment adjacent to the LNG Plant.

5.2.3 Description of baseline conditions

Baseline information is presented in EIS chapters 7, 8, 9 and 10. These chapters describe the main characteristics of the existing physical, biological, social, and cultural environment relevant to the proposed project activities. The local-level baseline data is supported by regional (and national) data where relevant.

5.2.3.1 Values

The characterisation of the existing environment includes identifying and describing the physical, biological, social and cultural values within the relevant study area. Only values that may be affected in some way by direct and indirect project activities are identified. These values provide the basis for the impact assessment that follows.

Of importance in understanding and identifying values is the concept that to be valued, the quality or feature of the environment must be of value to someone or for something. In some cases, the value is prescribed in legislation, guidelines or convention (for example, cultural heritage legislation). In other instances, values may

be perceived by individuals, communities or societies who value aspects of the environment differently depending on their dependency on the environmental asset or resource, the benefits they derive from these assets or resources, or the nature of the perceived changes to their assets or resources.

A value in this context can be defined as:

- A measure of how an aspect of the environment in which we live is esteemed, desirable or useful
- A quality or physical characteristic of the environment that is conducive to ecological health or public amenity and safety (State of Queensland 1994).

Defining biophysical values

The existing physical and biological environmental values in the relevant study areas were identified by analysing the baseline information as presented in this EIS (see Chapter 7 Receiving Environment: Onshore, Chapter 8 Receiving Environment: Marine, and their supporting appendices) and/or by reference to relevant legislation, policies and guidelines.

Defining social and cultural values

Social and cultural values present in the relevant study areas were identified taking into account the concept of quality of life and wellbeing. For cultural heritage, the values are embodied in the beliefs, spirituality, and rituals of people and in the evidence of their past occupation and practices.

The concept of wellbeing is defined by the World Health Organization (1997) as:

> *an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment.*

This concept is further elaborated on in Millennium Ecosystem Assessment framework as presented in Ecosystem Services: A guide for decision makers (WRI 2008). The guide lists five components of wellbeing:

- Basic material for a good life (adequate livelihood, food, shelter, other goods)
- Health (strength, feeling well, access to clean air and water)
- Good social relations (social cohesion, mutual respect, ability to help others)
- Security (personal safety, access to resources, safety from disasters)
- Freedom of choice and action (ability to control personal circumstances).

Dodge et. al. (2012) defines wellbeing 'as the balance point between an individual's resource pool and the challenges faced'. This definition recognises the vulnerability of individuals and communities, and their capacity to absorb, adapt to, and recover from change.

The existing social and cultural values were identified in the relevant study areas by analysing the baseline information presented in this EIS (see Chapter 9 Social Environment and Chapter 10 Cultural Heritage Environment and supporting appendices) and by reference to relevant legislation, policies, and guidelines.

5.3 IDENTIFYING MECHANISMS OF CHANGE

Project related activities that may lead to direct and indirect impacts on, or changes in, environmental, social, and cultural values were identified. These activities, or mechanisms of change, occur in the construction, operation, and decommissioning phases of the Project.

Mechanisms of change can also be indirectly attributable to the Project as opposed to those that are a direct result of project activities. The mechanisms of change were identified through analysis of the project description and impact assessments.

5.4 ASSESSING POTENTIAL PROJECT-RELATED IMPACTS

The potential impacts that the Project could have on environmental, social, and cultural values have been assessed using one of three methods: significance, compliance, and benchmarking.

These methods were used to undertake the impact assessments presented in this EIS in Chapter 11 Environmental Impact Assessment: Onshore, Chapter 12 Environmental Impact Assessment: Marine, and Chapter 13 Social and Cultural Impact Assessment, and documented in the technical reports appended to this EIS. Figure 5.3 shows the main assessment steps in these methods. This section also briefly introduces the benchmarking method used to assess the project's greenhouse gas emissions relative to other fossil fuels (see Chapter 15 Greenhouse Gases and Climate Change).

The methods that have been adopted are dependent on the aspect that is assessed. The methods are:

- **Significance assessment**. A sensitivity-based significance assessment uses the sensitivity of the value (receptor) and magnitude of impact on that value to determine the significance of an impact. This method has been used to assess impacts on bio-physical environment and social values that are not subject to a compliance assessment.
- **Compliance assessment.** The compliance assessment method was adopted where international, national, or best practice standards or guidelines define the upper limits of certain parameters (such as pollutants) in the environment. This method requires quantitative assessment (including in some cases, modelling) to determine the predicted levels of these parameters that will result from the Project. The compliance assessment was adopted for air quality, noise, and water quality.
- **Benchmarking assessment.** Benchmarking is standard practice for assessing the emissions intensity of greenhouse gases generated from a project relative to other fossil fuels (see Chapter 15 Greenhouse Gases and Climate Change). In this EIS, climate change has been considered through the benchmarking assessment and modelling conducted to quantify flood characteristics under future 2050 and 2090 climate change scenarios (Appendix I Flood Assessment).

The impact assessment methods are described further below.

5.4.1 Significance assessment method

This method identifies the degree to which the existing status or condition of a value is expected to change due to project activities. These changes (impacts) have different levels of significance (for example, low, moderate, high).

For most impacts, significance depends on the sensitivity (or vulnerability) of the value to change, as well as the severity (or magnitude) of the impact. In other words, the significance assessment method is a function of the sensitivity of a value and the magnitude of impact on that value, which are combined to determine the level of significance. The method also assumes that an identified impact will occur, avoiding any subjectivity about which impacts will or will not materialise.

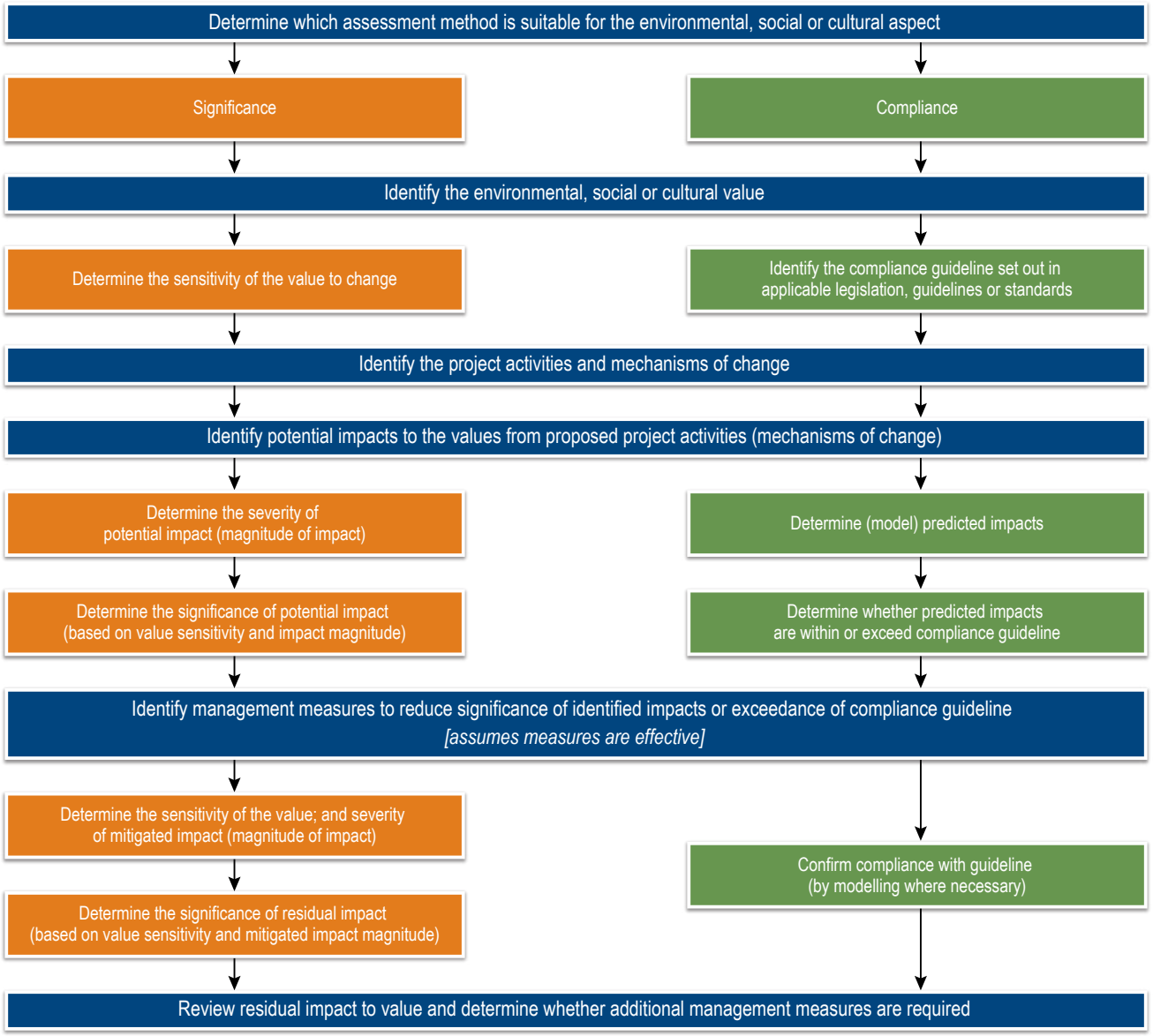

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FIGURE 5.3

Significance and compliance methods of impact assessment

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5.4.1.1 Sensitivity

Biophysical

Sensitivity is defined as the susceptibility of the value to change, including its capacity to adapt to, or accommodate, the kinds of changes that the Project may bring about. The sensitivity of a physical and biological environmental value is determined with respect to its intrinsic worth (societal value), intactness, uniqueness or rarity and adaptability, recovery, and replacement potential. These contributing factors or attributes are described as follows:

- **Intrinsic worth** is defined differently for each environmental aspect. It is the worth or value placed on a natural resource or asset by communities. It encompasses such factors as dependency, level of use, benefit, and economic value. In many instances it is prescribed in legislation, policy, guidelines, and international conventions.
- **Intactness** is an assessment of how intact the physical or biological environmental value is. It is a measure (with respect to its characteristics or properties) of its existing condition, particularly its representativeness.
- The **uniqueness or rarity** of a physical or biological environmental value is an assessment of its occurrence, abundance, and distribution within and beyond its reference area (for example, bioregion or biosphere).
- The **extent** to which a physical or biological environmental value can recover from change or return to its original state determines its adaptability and recovery potential.
- The potential for a **representative** or equivalent example of the physical or biological environmental value to be replaced determines its replacement potential.

The sensitivity of a value is therefore an assessment of the degree to which the attributes of the value allow it to adapt or recover from change without adversely affecting its intrinsic value, intactness, uniqueness, or rarity. The levels of sensitivity (extremely sensitive to not sensitive) and generalised definitions for the physical and biological environmental values are set out in Table 5.1.

Table 5.1 General definitions for sensitivity of physical and biological environmental values

Sensitivity	Definition
Extremely sensitive	• Internationally recognised • Very low abundance and highly restricted distribution • Cannot recover from, or adjust to, change or disturbance • Intact and retains its intrinsic value prior to project development • Very rare natural resource.
Very sensitive	• Nationally recognised • Low abundance and restricted distribution • Can recover from, or adapt to, very limited change or disturbance • In good condition prior to project development • Rare natural resource.
Sensitive	• Regionally or provincially recognised • Abundance and distribution are limited • Can recover from or adjust to some change or disturbance • In moderate condition prior to project development • Restricted natural resource.

Sensitivity	Definition
Not very sensitive	• Locally recognised. • Abundant and widely distributed within region. • Can recover from or adapt to major changes or disturbance. • In poor condition prior to project development. • Locally widespread natural resource.
Not sensitive	• Not valued or recognised • Abundant, widespread, numerous representative examples occur • Not sensitive to change or disturbance and is able to fully recover • In very poor condition prior to project development • Nationally or regionally widespread natural resource.

Social

Social sensitivity to change is determined with respect to its uniqueness or rarity, importance, and resilience to change. These contributing factors are described below:

- **The importance** of a place or community service or other aspect of a social value to the community. Importance may be indicated by conservation status, cultural importance, or its economic value. It may also be indicated by the uniqueness or rarity of a place or service, including its occurrence, abundance, and distribution within and beyond the study area.
- **Resilience to change** is determined by the extent to which a place, service or community can cope with or withstand changes without affecting the level of value.

The levels of sensitivity (extremely sensitive to not sensitive) and generalised definitions for social values are set out in Table 5.2.

Table 5.2 General definitions for the sensitivity of social values

Sensitivity	Importance	Resilience to change
Extremely sensitive	An aspect of the social environment that has been identified as essential to livelihoods, health, safety, or culture in the impact assessment process. The social aspect subject to change may: • Have been identified by the community as a matter of critical importance; the social aspect affects multiple and intersecting aspects of social wellbeing. • Contribute to the national or state economy in terms of the number of jobs or gross domestic product, and livelihood resources. • There are no available alternative resources available to people at a national level.	• The place, service, or receptor has no capacity to adapt to change. • Affected people have no access to resources to support their capacity to adapt to change.
Very sensitive	An aspect of the social environment that has been identified to contribute materially to livelihoods, health, safety, or culture in the impact assessment process. The social aspect subject to change may: • Have been identified during consultation or by community stakeholders publicly as a matter of high importance; the social aspect affects multiple and intersecting aspects of social wellbeing.	• The place, service, or receptor has a limited capacity to adapt to change. • Affected people have limited access to resources to support their capacity to adapt to change.

Sensitivity	Importance	Resilience to change
	• Contribute to the state or regional economy in terms of the number of jobs or gross domestic product, and livelihood resources. • No alternative resource or service is available for people to access or use at a regional level.	
Sensitive	An aspect of the social environment that has been identified to contribute to livelihoods, health, safety, or culture in the impact assessment process. The social aspect subject to change may: • Have been identified during consultation or by community stakeholders publicly as a matter of moderate importance. • Contribute to the state or regional economy in terms of the number of jobs or gross domestic product, and livelihood resources. • There are no locally available alternative resource available; however, alternative resources are available and have capacity at a regional level.	• The place or service has the capacity to adapt to change. • Affected people have some access to social resources to support their capacity to adapt to change.
Not very sensitive	An aspect of the social environment that is recognised by the local community, but it is seen to have limited use or has limited importance to the broader community. The social aspect subject to change may: • Have been identified during consultation or by community stakeholders publicly as a matter of limited importance. • Contribute to community events or uses at a local level by groups within the community, but there are other or equivalent places or services that support a similar social function. • Contribute to the local economy in terms of small number of jobs or contributes to the livelihoods of small number of families. • There are alternative resource available at a local level.	• The place, service, or receptor has the capacity to adapt to change. • Affected people have access to social resources to social resources to support their capacity to change.
Not sensitive	An aspect of the social environment that is not valued within the community. The social attribute: • Has not been identified as important by the community. • Does not contribute to community events or uses at a local level by groups within the community. • Does not contribute to the local economy or livelihoods. • There are many alternative services or places available at a local level.	• The place or service has the capacity to adapt to change. • Affected people have access to social resources to support their capacity to change.

Cultural heritage

Sensitivity is not used for cultural heritage significance assessment. Instead, the significance of each cultural heritage site or value is established, using internationally recognised criteria developed by Australia's International Council on Monuments and Sites (ICOMOS) in the *Charter for Places of Cultural Significance 2013*, otherwise known as 'The Burra Charter' (ICOMOS 2013) (the Burra Charter), as well as the opinions of the local communities.

The Burra Charter (ICOMOS 2013) notes:

- Cultural significance means aesthetic, historic, scientific, social, or spiritual value for past, present or future generations.
- Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places, and related objects.
- Places may demonstrate a range of these significance criteria for different individuals or groups.

Cultural heritage significance of a site or value is assessed using four criteria: the historic, scientific, social, and spiritual values and each site rated as being either low, medium, or high for each criteria. Table 5.3 details the criteria ratings used, based on Australia ICOMOS (2013).

Table 5.3 Cultural heritage significance assessment criteria ratings

Criterion	Examples	Rating
Historic	The place or value may be associated with an important event or theme in history, or a particular person or cultural group important to the history of the local area, state or nation.	Historical value was rated as follows: • Low (1) for places or values which are not associated with any known historical event, person or theme. • Medium (2) for sites or values which are associated with a moderately significant historical event, person or theme at either the local, provincial and/or national level. • High (3) for sites or values which are associated with a highly significant historical event, person or theme at either the local, provincial and/or national level.
Scientific	Using scientific techniques such as archaeology, the place of (if relevant) value has the potential to reveal new information or understandings about people, places, processes, or practices.	Ratings for scientific value are mostly applied to archaeological sites, and consider: • Site contents (e.g., size and patterning of site where 0 = no materials remaining, 1 = small number of artefacts with limited diversity (0 to 10 artefacts), 2 = larger number but limited range of artefacts, 3 = large and diverse range of artefacts). • Site condition (0 = destroyed, 1 = deteriorated, 2 = fair to good, 3 = excellent). • Site representativeness (1 = common, 2 = occasional, 3 = rare). The rating for overall significance is calculated based on the cumulative score for site contents, site condition and site representativeness where: • cumulative score 1 to 3 = Low (1) • cumulative score 4 to 6 = Medium (2) • cumulative score 7 or greater = High (3)
Social	The place or value may be an important local marker or symbol or contribute to the identity of a particular cultural group.	Social value was rated as follows: • Low (1) for places or values which do not appear to have any clear social connection at either the local, provincial and/or national level. • Medium (2) for places or values which have a moderately significant social connection for a cultural group at either the local, provincial and/or national level. • High (3) for places or values which have a highly significant social connection for a cultural group at either the local, provincial and/or national level.

Criterion	Examples	Rating
Spiritual	The place or value may contribute to the spiritual identity or belief system of a cultural group and/or may be important to maintaining the spiritual health and wellbeing of a culture or group.	Spiritual value was rated as follows: • Low (1) for places or values which do not appear to have any clear spiritual connection with a cultural group at either the local, provincial and/or national level. • Medium (2) for places or values which have a moderately significant spiritual connection for a cultural group at either the local, provincial and/or national level. • High (3) for places or values which have a highly significant spiritual connection for a cultural group at either the local, provincial and/or national level.

5.4.1.2 Magnitude

Biophysical

The magnitude of impacts on a value requires the level of severity of potential impacts to be determined, as defined by the technical specialists using available information and professional judgement.

In general, the magnitude of a potential impact on a value takes into account the extent of the impact and how quickly the effect materialises or is felt, whether it is sustained, and for how long (duration), as described below:

- **Geographic extent.** The geographic extent where project activities may directly or indirectly impact a value.
- **Intensity.** The scale, degree and/or severity of change or disturbance experienced by a value, including the rate of change.
- **Temporal extent.** The timing of when the impact materialises and its duration (project phases and post-project phase), whether the impact will be immediate or delayed, occur during the day or at night and in which season, is a once-off, periodic, cyclical or is continuous.

Definitions for different levels of the magnitude of impacts on physical and biological values are provided in Table 5.4.

Table 5.4 General definitions for magnitude of impacts on physical and biological values

Magnitude	Definition
Very high	An impact that is widespread, long-lasting and results in substantial and possibly irreversible change or disturbance to a value. Avoidance through appropriate design responses is required to avoid or reduce the magnitude of the impact.
High	An impact that would be widespread and potentially long lasting if specific management controls are not implemented to reduce the intensity and/or temporal extent of the impact.
Medium	An impact that extends beyond the area of disturbance (footprint) to the surrounding area. The impacts are short-term and result in changes that can be addressed with specific management measures.
Low	A localised impact that is temporary or short-term and can be effectively addressed with standard management controls.
Very low	A localised impact that is temporary or short-term and can be effectively addressed with standard management controls or does not require management as it will resolve itself in a short period of time without intervention.

Social

The magnitude of an impact on a social value considers the scale, affected population, and duration of an impact. These criteria are described below and are set out in Table 5.5.

- The **intensity,** scale, or degree of change from the existing condition. The change can be positive or negative.
- The **affected population** is an assessment of the distribution of the effect amongst the population of affected people.
- The **duration** is the time the impact is expected to affect people.

Table 5.5 Definitions for the magnitude of impacts on social values

Score	Intensity	Affected population	Duration
Very high	A fundamental change from the baseline conditions. The change to livelihoods, health, safety, culture, or other social value means that the social aspect is fundamentally changed and no longer holds the value it previously provided to the community.	Affects most of the population within the local study area communities (e.g., >76%) and extends beyond the local study area to result in provincial impacts.	The effect is permanent or will not cease for greater than five years.
High	A considerable change from baseline conditions. Consequences on livelihoods, health or other social values that cause considerable change to aspects of a social value. The social aspect provides very few or considerably more social function to the community.	Affects the majority (>51% to <75%) of communities within the local study area and extends beyond this area to result in district impacts.	The effect long term (e.g., the effect is expected to last between one and five years).
Medium	A noticeable change from the baseline conditions. Consequences on livelihoods, health or other social values that cause damage to aspects of a social value. The social aspect may continue to provide some of its social functions, but these are noticeably changed (diminished or enhanced).	Affects notable proportions of the communities within the local study area (>21% to 50%). Impacts are generally restricted to the local study area and are unlikely to result in impacts to people at the district, provincial, or national level.	The effect is medium-term (e.g., it is expected to last longer than six months and less than one year).
Low	A small but measurable change from the baseline condition. Consequences on livelihoods, health or other social values that cause change to aspects of a social value; however, the social aspect will generally continue to provide the same level of social value to the community.	Affects discrete populations of the communities within the local study area (e.g., >11% to 20%); although the impact is generally confined to the local study area.	The effect is short-term and is often intermittent (e.g., the effect may occur for longer than a month but is expected to last less than six months).
Very low	Marginal change from baseline conditions. Those affected would not notice the change.	Affects a small number of individuals or households.	The effect is temporary (e.g., it lasts less than a month).

Cultural heritage

The magnitude of an impact on a cultural heritage site or value is assessed based on the geographical extent, duration, and severity of the impact. Table 5.6 details the impact magnitude criteria used for cultural heritage.

Table 5.6 Impact magnitude criteria for cultural heritage

Criterion	Nil	Low (Rating 1)	Medium (Rating 2)	High (Rating 3)
Severity	No impact	Loss of up to one third of site contents. Site condition rating decreases by one rating point. Site representativeness rating unchanged. Minor impact to the site's scientific value. Minor community reaction; attracts stakeholder concern at a local level.	Loss of up to two thirds of site contents. Site condition rating changes by two rating points. Site representativeness rating decreases. Moderate impact to the site's scientific value. Substantial community reaction; results in stakeholder concern at local and provincial levels.	Loss of greater than two thirds of site contents. Site condition rating changes by three rating points. Site representativeness rating decreases. Major impact to the site's scientific value. Major community reaction; results in stakeholder concern at a national or international level (i.e., media, shareholder, government, international non-government organisation concern).
Extent	No impact	Impact damages less than one third of site. No loss of access to site.	Impact damages up to two thirds of site and/or access to site restricted.	Impact damages greater than two thirds of site and/or permanent loss of access to site.
Duration	No impact	Temporary or short-term impact or loss of access to site limited to Project construction phase.	Medium-term impact or loss of access to site that will alleviate within life of Project.	Long-term (extends beyond the life of the Project) or permanent impact.

5.4.1.3 Significance

Biophysical and social

The level of significance is evaluated before management measures are applied to reduce the magnitude of impacts. The level of significance is then evaluated after management measures are applied to determine the effectiveness of these measures in reducing the impact magnitude (residual impact significance).

The level of significance (of unmitigated and residual impacts) on a value will be determined by applying the matrix in Table 5.7.

Cultural heritage

The significance of a cultural heritage impact is determined by assessing the significance of a cultural heritage site or value in relation to the magnitude of the potential impact on it. Table 5.8 presents the cultural heritage impact significance assessment matrix.

Table 5.7 Significance-based assessment matrix

Magnitude of the impact	Sensitivity of the value					Positive social impacts*
	Extremely sensitive	Very sensitive	Sensitive	Not very sensitive	Not sensitive	
Very high	Major	Major	Major	High	Moderate	Major
High	Major	Major	High	Moderate	Low	High
Moderate	High	High	Moderate	Low	Low	Moderate
Low	Moderate	Moderate	Low	Low	Very low	Low
Very low	Moderate	Low	Very low	Very low	Very low	Very low

*Only applies to positive social impacts. Impacts assessed as having a negative impact direction will be assessed using the matrix.

Table 5.8 Cultural heritage impact significance assessment matrix

Magnitude of the impact	Cultural heritage site/value significance		
	High	Medium	Low
High	Extreme	Major	Moderate
Medium	Major	Moderate	Minor
Low	Moderate	Minor	Negligible
Nil	Nil	Nil	Nil

5.4.2 Compliance assessment method

Statutory guidelines set out in policies and other regulatory documents are designed to protect values. The guidelines include an implicit assessment of the sensitivity of the value through the setting of limits or thresholds or provide the framework for determining the sensitivity of a value.

Limits and thresholds set out in guidelines are generally based on established scientific knowledge and societal aspirations relating, in most instances, to the quality of life. These limits can also be indicators of ecosystems health, as evidenced by water quality standards.

Assessments using this method typically use modelling to predict project emissions or discharges enabling compliance with published limits or thresholds to be determined before and, if necessary, after, the application of management measures.

Where applicable, the relevant guidelines from the PNG LNG Project Environment Permit (EP L3(210)) formed the basis of the compliance assessment, on the premise that the conditions for the PNG LNG Project will be similar for the Project.

5.4.3 Benchmarking assessment method

Benchmarking is standard practice for assessing the emissions intensity of greenhouse gases generated from a project relative to other fossil fuels. This approach compares the emissions from the combustion of natural gas, black coal, brown coal, fuel oil and diesel. The efficiency of these fossil fuels in producing electrical energy is compared to the emissions per unit of electrical energy generated.

In this EIS, climate change has been considered through the benchmarking assessment. Emissions from the Project were compared against Papua New Guinea's national emissions inventory to assess the Project's contribution. Emission factors were used to quantify the greenhouse gas emissions from the Project. The factors were sourced using the following hierarchy:

- IPCC Guidelines for National Greenhouse Gas Inventories
- Australian National Greenhouse Accounts Factors Workbook
- Published industry guidelines for greenhouse gas emission inventory development.

Climate change risks have also been considered through modelling conducted to quantify flood characteristics under future 2050 and 2090 climate change scenarios (Appendix I Flood Assessment).

5.5 ASSESSING COMBINED IMPACTS

A standalone Combined Impact Assessment will be developed separately on behalf of the Papua LNG Project to address Upstream and Downstream impacts in the Caution Bay area, inclusive of the LNG Plant.

5.6 ASSESSING CUMULATIVE IMPACTS

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

The cumulative impact assessment for the Project aims to:

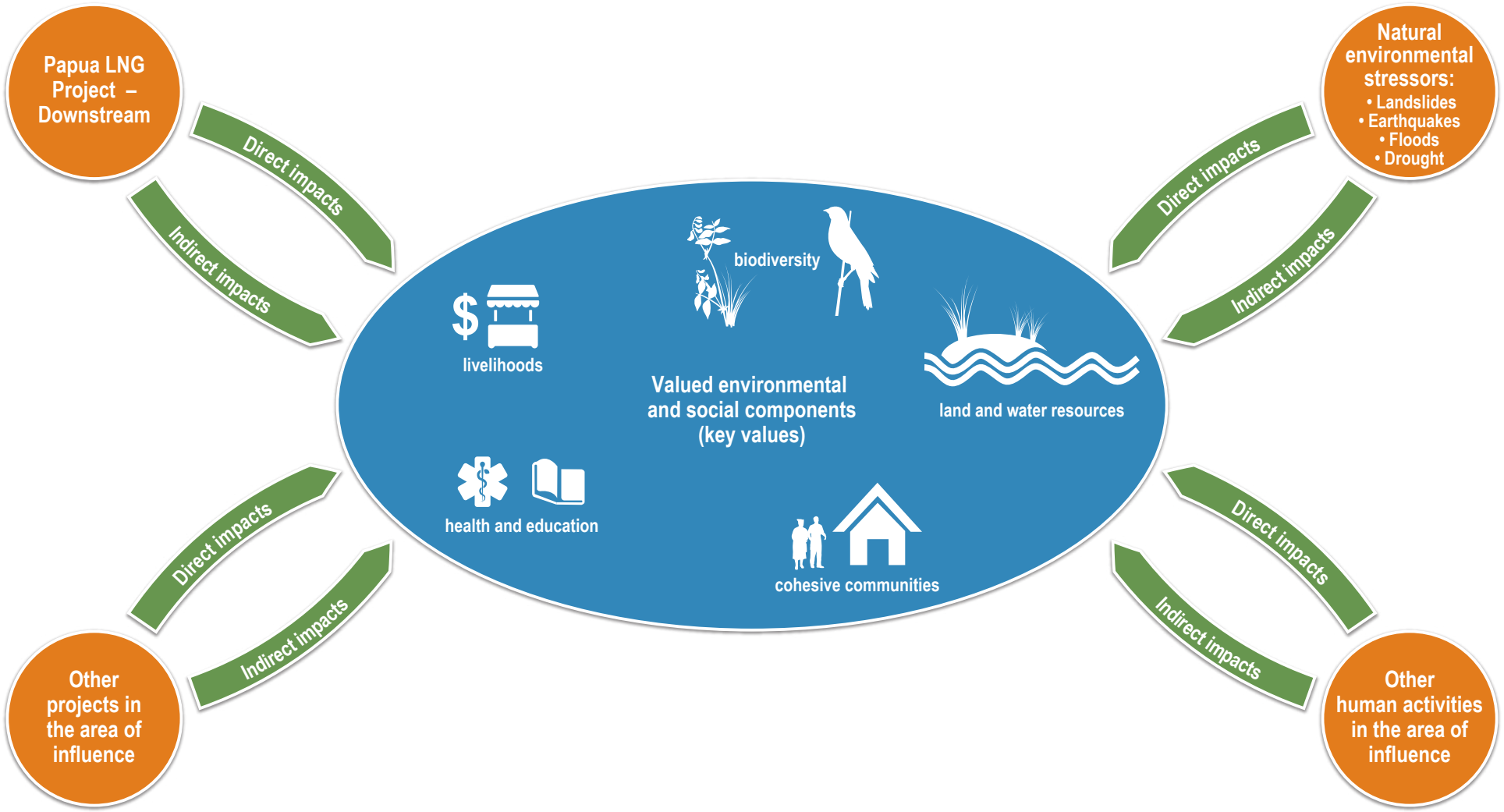
- Identify potentially significant impacts of other approved or proposed developments in the area of influence of the Project and assess the contribution of the Project to the overall cumulative impact on relevant environmental, social and cultural values.
- Demonstrate how the contribution of the Project to cumulative impacts can be reduced through implementing management strategies to address potentially significant cumulative impacts.

The method used in the cumulative impact assessment for the Project is based on the approach set out in the Good Practice Handbook for Cumulative Impact Assessment and Management produced by the International Finance Cooperation (IFC 2013). An overview of this approach is illustrated in Figure 5.4 and described further below. This approach puts valued components of the environment at the centre of the assessment and identifies other projects that might also impact on the future state of those values. The cumulative impact assessment is detailed in Chapter 14 Cumulative Impact Assessment.

5.6.1 Assessment method

The steps for assessing the cumulative impacts of the Project comprised of:

- Identifying the pathways or mechanisms that might lead to cumulative impacts.
- Identifying the key environmental, social, and cultural values that might be impacted by cumulative impacts.
- Understanding whether other projects are credible or not.
- Understanding whether the Project's activities overlap or connect in space with those of the other projects, i.e., there is a spatial relationship.



EXXONMOBIL PNG ANTELOPE LIMITED

PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 5.4

Cumulative impact assessment model

SOURCE
Adapted from IFC, 2013

TETRA TECH COFFEY

DATE: 03.07.23 PROJECT: 754-MELEN300733 FILE: 300733_02_F05.04_GRA DOC REFERENCE: \\ETSS772GISFS1\DATA$\GIS\300733_EMPNG_PAPUALNGDOWNSTREAM\2_GRAPHICS\02_EIS\300733_02_GRA025.AI 2

- Understanding whether the Project's activities overlap in time with those of the other projects, i.e., there is a temporal relationship.
- Assessing the cumulative impacts and their significance.
- Proposing mitigation strategies.

Pathway / mechanism

A review of the Project activities and environmental, social and cultural impacts of the Project, as documented in this EIS, was conducted to identify the pathways or mechanisms that could potentially contribute to cumulative impacts.

Key environmental, social and cultural values

Key environmental, social and cultural values in the local and regional context identified during the impact assessment process were reviewed for relevance to the cumulative impact assessment. The key values taken forward to the cumulative impact assessment were selected where the value was:

- Determined to be extremely or highly sensitive to change or disturbance
- Potentially subject, or exposed to, a cumulative impact issue
- Identified as most relevant to local communities through the project stakeholder engagement process.

Credible projects

Projects that have the potential to contribute to cumulative impacts were also identified and termed 'credible projects'. Credible projects are those that are:

- In operation and seeking approvals for expansion
- Under construction or being commissioned
- Approved by the Papua New Guinean Government but not yet started construction
- In an approvals process and likely to proceed if approval is obtained.

Information and data on the current and potential impacts of each of the identified projects was sourced and reviewed where readily available. This information included environmental impact statements, environmental monitoring and performance reports, and other information available on proponent or operator websites, such as press releases. For projects where, specific information needed to inform the cumulative impact assessment was not available, generic information about other similar or typical projects, and their potential impacts was used. For projects to be considered credible, there must be a spatial and temporal relationship with the Papua LNG Project – Downstream.

Spatial boundary

The spatial scope for the cumulative impact assessment was defined to determine the geographical area over which impacts would be assessed. The area of influence varied depending on the value that was impacted. In some cases, the area of influence extended beyond the immediate project area.

The spatial scope of the assessment was defined as the areas where direct and indirect impacts of the Project are likely to occur, including areas in the wider region where:

- Key environmental, social, and cultural values identified for the Project also occur
- Other developments could impact on the identified environmental, social, and cultural values.

Temporal extent

A project's construction, operation and decommissioning activities must overlap with the life of the Project for a cumulative impact to occur. The temporal scope of the assessment was defined as the period that overlaps wholly or partially with the Project, and a 30-year operating period.

5.6.2 Assessing and managing cumulative impacts

Potential environmental, cultural, and social impacts from all credible projects within the area of influences that could adversely impact key values were identified. The assessment focused on those impacts with the greatest potential to affect change in the condition of the key value.

The assessment took a high-level approach, taking into consideration the degree to which the impact would change the value beyond an acceptable level, threshold or standard. This level was determined through reference to relevant guidelines, criteria and through professional judgement.

Management strategies were identified where the Project could contribute to significant cumulative impacts, to the extent that ExxonMobil can influence them.

5.7 MANAGEMENT AND MITIGATION

5.7.1 Mitigation hierarchy

The mitigation hierarchy is a tool that is intended towards limiting as far as possible the negative impacts from development projects. The IFC expressly incorporates the mitigation hierarchy within IFC Performance Standard 1 and Performance Standard 6 and accompanying guidance notes.

The mitigation hierarchy consists of a series of steps, as follows:

- Avoidance
  - The hierarchy commences with the most beneficial method of mitigation, avoidance. This requires the identification of impacts and, where available and technically[1] and financially feasible[2], changes to the project's design (or potential location) to avoid adverse risks and impacts on social and/or environmental features. Avoidance is generally accepted to be the most acceptable form of mitigation.
- Minimisation
  - Minimisation recognises that the environmental impact cannot be completely avoided, and that necessary measures need to be implemented to minimise the impact. Where avoidance is not possible, adverse impacts and risks can be minimised through environmental and social measures, treatments or design. Acceptable options to minimise will vary and include abate, rectify, repair, and/or restore impacts, as appropriate.
- Restoration, remediation and rectification
  - Remediation or rectification of an impact implies that the impact has already happened, and measures are required to address or reverse the effects.

[1] Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, demography, infrastructure, security, governance, capacity, and operational reliability.
[2] Financial feasibility is based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared to the project's investment, operating, and maintenance costs, and on whether this incremental cost could make the project nonviable to the client.

- Offset
    - Environmental offset is commonly defined as action taken outside of the development site to compensate for the impacts in the development site. In effect, this means that activities to compensate for impacts are required to achieve no net loss, or in some situations such as where critical habitat is affected, net gain is required. Offsetting does not eliminate the identified adverse risk or impact but seeks to offset with an (at least) comparable positive one.

The desired outcomes of the mitigation and management measures should be set as measurable events to the extent possible, such as performance indicators, targets or acceptance criteria that can be tracked over defined time periods.

The preferred development concept for the Project has been refined through the impact assessment process and through the application of the mitigation hierarchy. Potential impacts have been avoided and minimised through iterative project design; this has involved the assessment of various design options and optimisations of project components. Environmental, social, and cultural impacts were considered in the selection of development options for marine facilities, logistic routes, LNG processing technology, equipment optimisation and water sources. Chapter 3 Assessment of Alternatives discusses potential impacts that have been avoided through the selection of the preferred design of project components.

Chapter 11 Environmental Impact Assessment: Onshore, Chapter 12 Environmental Impact Assessment: Marine and Chapter 13 Social and Cultural Impact Assessment and the Papua LNG Project – Downstream Environmental and Social Management Plan (and associated appendices), detail how potential impacts and risks will be avoided, minimised as far as reasonably practicable, rehabilitated, and offset.

5.8 REPORTING

The final step in the environmental and social impact assessment process is reporting on the main outcomes of the assessment. These findings are included in the main report of this EIS which is supported by the technical reports prepared by specialists (included as appendices).

The main report focuses on presenting the key findings of the assessments, clearly documenting:

- The valued characteristics of the physical, biological, social, and cultural baseline.
- Project-related activities that could impact on those values.
- The impact of these activities on the values, where they occur, for how long, and the significance of the impact.
- The management measures to be implemented to address significant impacts.
- The level of significance of the residual impacts after the measures are implemented.

This EIS document will be submitted to the Papua New Guinea Conservation and Environment Protection Authority (CEPA) and the results presented to the potentially impacted stakeholders.