

Assessment framework 5

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5 Assessment framework

5.1 Introduction

This section outlines the assessment framework for the GFD Project and provides an overview of the assessment methodology used to prepare this EIS as required by section 2.6.2 of the GFD Project ToR, dated March 2013.

The assessment framework has been designed to provide a structured and objective approach to identifying the GFD Project's environmental, social and economic impacts, and developing effective mitigation and management measures. It addresses the issues that are specific to coal seam gas projects and to be consistent with the regulatory approvals process for petroleum projects.

As indicated in Section 3: Natural gas from coal seams and Section 4: Project description, the development of large coal seam gas fields is an incremental process. Generally, gas resources are extensive and spatially variable, requiring geographically widespread project infrastructure that is progressively developed over the life of a project. Production requires progressive programs of exploration, appraisal and field development (constraints planning), which determine the optimal locations for project components (i.e. production wells, gathering lines, transmission pipelines, gas compression and treatment facilities, water management facilities and supporting infrastructure).

As a result of this incremental development there is no defined and fixed activity locations at the time of the EIS as the locations are progressively defined based on further exploration and appraisal, field development planning and negotiation with landholders. To enable a rigorous understanding and assessment of the possible impacts of the GFD project, a methodology has been developed for the EIS assessment that specifically addresses this issue.

The assessment framework used to assess impacts and develop mitigation strategies used in this EIS has the advantage of being consistent with the approach used in the approved GLNG Project, and hence, is based on knowledge and systems that have been previously assessed and approved by both the State and Federal Governments. This approach provides a high level of certainty about potential impacts by identifying those areas that are not amenable to development (i.e. no-go areas), or if they were to be developed, how development should proceed. This will occur by identifying constraints to development that exist within the GFD Project area and the environmental management controls that will be applied to the project's activities in these constrained areas.

Because of the experience developed from the existing GLNG Project, both the scope and the potential impacts for each GFD Project component are well defined. When combined with the existing management framework (refer to Section 6: Management framework) designed for avoidance, management and mitigation, this framework provides the basis for a robust assessment on a project component basis.

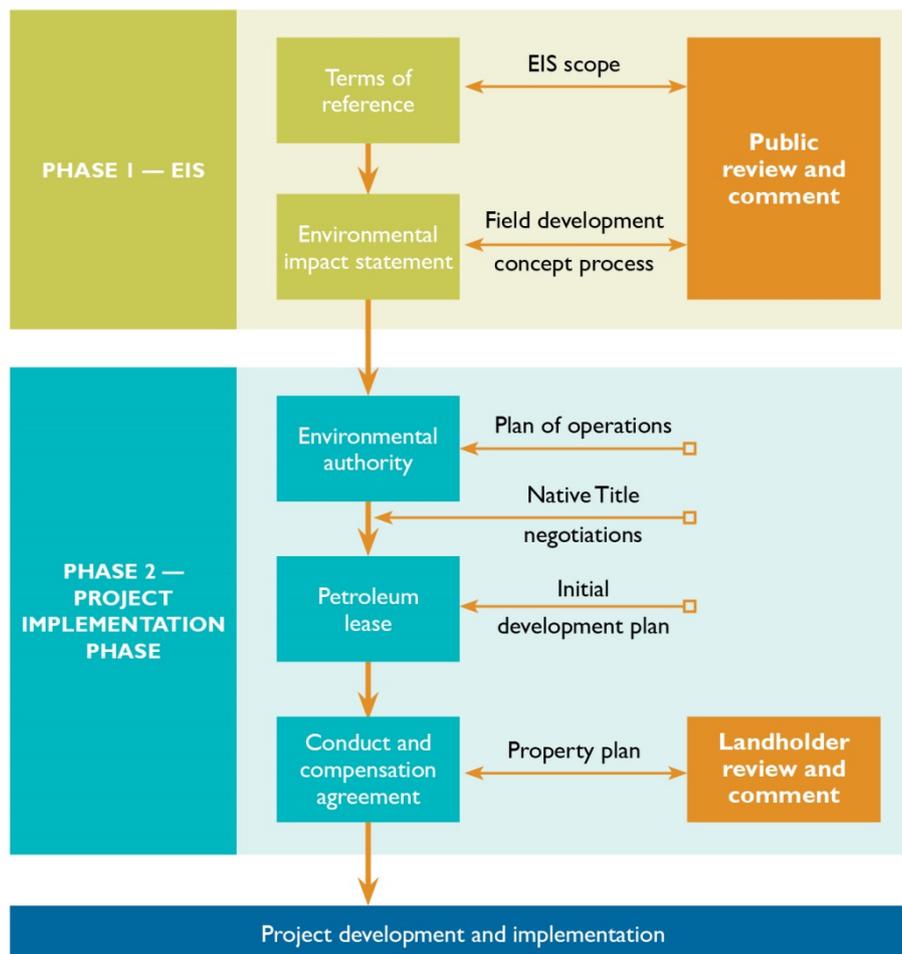
For the purposes of transparency this EIS shows an area off-tenure that may be used for infrastructure such as pipelines and temporary camps (supporting infrastructure area). While not assessed specifically in this EIS, any infrastructure that may be located within this area would be subject to further approval processes separate to this EIS.

5.2 Framework overview

While the GFD Project's main infrastructure types and quantities are known, their locations will be determined progressively during the project life (as discussed in section 3.3 of Section 3: Natural gas from coal seams, section 4.1 of Section 4: Project description and section 5.1). Hence, a two-phased approach has been used for the GFD Project's assessment framework. This approach is focused on providing the most sustainable outcomes by integrating environmental constraints and avoidance, management and mitigation strategies into the GFD Project's design and implementation process. This two-phased approach was successfully used for the approved GLNG Project and other gas field development projects, which confirms its suitability for the GFD Project.

The two-phased approach enables a rigorous impact assessment to be undertaken. Phase 1 involves the preparation of the EIS and Phase 2 (which occurs after the EIS) involves applications for other regulatory approvals such as environmental authorities (EA) and petroleum leases (PL) as well as the development of detailed agreements with landholders. This approach is shown in Figure 5-1 and is detailed throughout the rest of this section.

Figure 5-1 Two-phased assessment framework



5.2.1 Phase 1 – Environmental impact statement

During Phase 1 (the subject of this EIS) the assessment of environmental, social and economic impacts has been based on the predicted impacts at the project scale using a maximum development scenario. These impacts are well understood, given the experience of the GLNG Project, and are based on the GFD Project's conceptual field development schedule and field development process.

A conceptual field development schedule was initially prepared to indicate what the field development might consist of without consideration of environmental (or other) constraints. It was based on the known available gas resources in the GFD Project gas fields and what petroleum activities would be required to extract the gas. However, Santos GLNG understands that planning the proposed petroleum activities needs to consider the environmental (and other) constraints in the GFD Project area. Therefore, a subsequent field development concept process was used to indicate how the GFD Project area might develop over the GFD Project's life, taking relevant environmental constraints into account. The field development concept process also enabled an estimate to be made of the GFD Project's likely maximum disturbance footprint and informed the project description presented in Section 4: Project description.

The EIS assessment methodology has used the GFD Project information derived from the above approach to identify the GFD Project area's environmental values, to assess the relevant impacts, and to develop effective mitigation and management measures. These measures can provide stakeholders with a heightened level of confidence, as they are based on those currently in place for the approved GLNG Project.

5.2.2 Phase 2 – Project Implementation

The GFD Project will obtain a number of post-EIS approvals before the infrastructure and petroleum activities can proceed. These include an EA under the *Environmental Protection Act 1994* (Qld) (EP Act) and PLs under the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) (P&G Act) and the *Petroleum Act 1923* (Qld) (Petroleum Act).

The EA application and supporting plans will demonstrate the GFD Project's ongoing consistency with this EIS in regards to environmental impacts and proposed mitigation measures, and with the location and design of the GFD Project which will have been and continue to be developed in accordance with the constraints mapping process described in this section.

The EP Act requires Santos GLNG to develop a plan of operations prior to commencing development activities. The plan of operations, which is developed after completion of detailed design, provides information on how the EA conditions are going to be complied with (including an action program, rehabilitation requirements and the maximum financial assurance for the period of the plan). The plan of operations must include the stated period of the plan, which should be at least one year but cannot exceed five years duration.

In addition to the EA, Santos GLNG will apply for a number of PLs under the P&G Act and the Petroleum Act. The P&G Act requires that an initial development plan, which typically covers the first five years of a project's development, must be submitted with the PL applications. The initial development plan must contain detailed information about the nature and extent of activities to be carried out and the extent of the gas resource. Subsequent development plans will need to be submitted to provide similar information about ongoing development of the PL beyond the period of the initial development plan.

Furthermore, the P&G Act requires Santos GLNG to negotiate a conduct and compensation agreement with landholders on whose land the petroleum activities will be carried out. Negotiation of the agreement provides an opportunity for landholders to raise concerns specific to their property and to reach agreement with Santos GLNG on where, how and when development will occur on their property.

Further details on the GFD Project's approvals are given in Section 2: Project approvals.

This EIS seeks to obtain primary approvals for the project including the Queensland Government Coordinator-Generals Report and Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) approval.

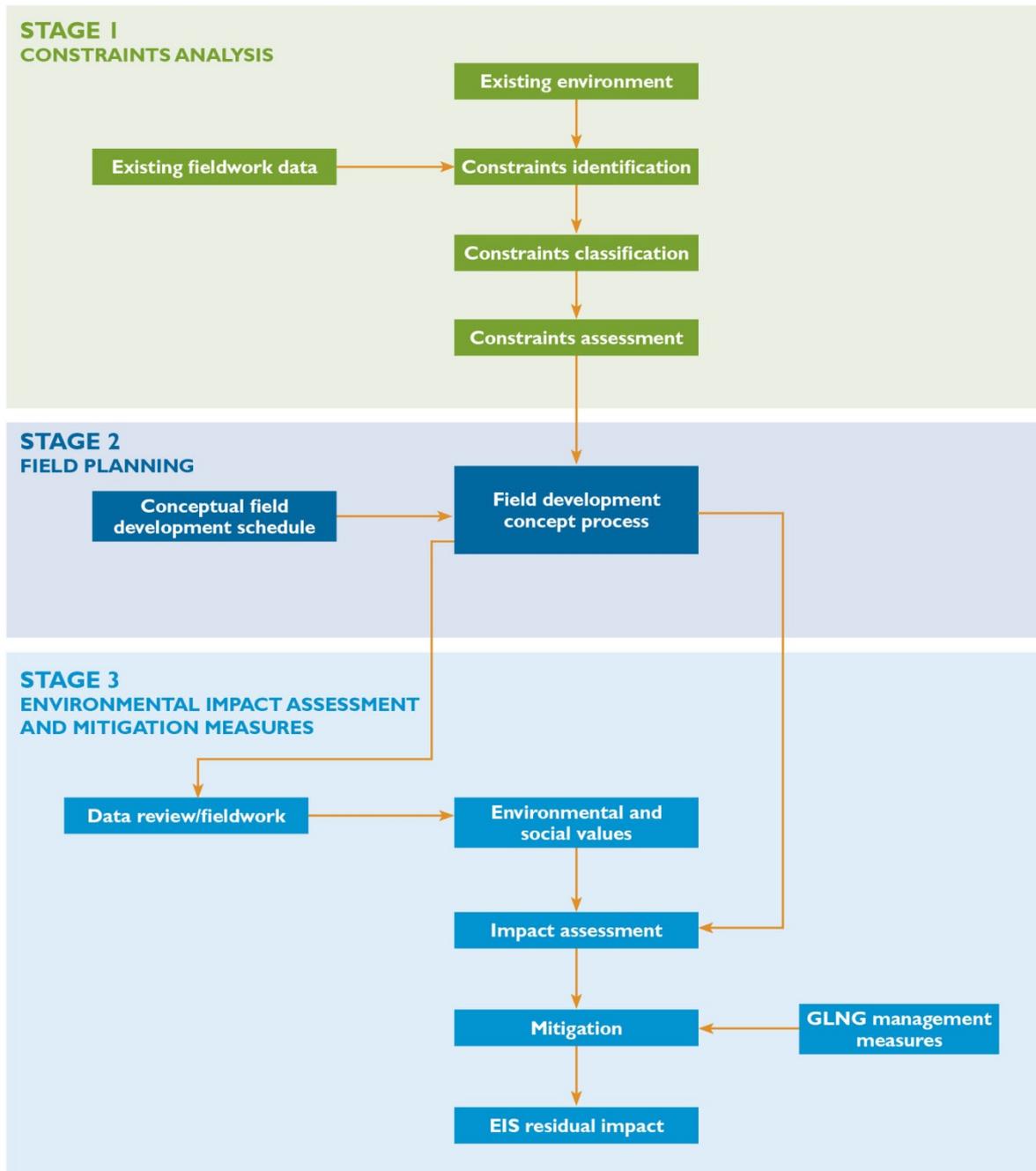
Application for or amendments to existing environmental authorities will occur subsequent to this EIS process. Other subsequent approvals required after the EIS process has been completed, corresponding triggers and legislative frameworks applicable to the GFD Project are identified in Section 2: Project approvals.

Approval of this EIS will trigger a number of subsequent approvals required for the GFD Project to proceed. Approvals will be required on tenure and off-tenure. Section 2: Project approvals summarises the key approvals necessary for the planning, construction, operations and decommissioning of the GFD Project. The triggers for each approval, the relevant administering authority and application details are provided. Consultation on the subsequent approvals will be ongoing with the administering authorities.

5.3 Phase 1 – Environmental impact statement

This EIS provides an assessment of the GFD Project's impacts on environmental, social and economic values with sufficient scientific rigour to ensure that there are effective measures in place to avoid or minimise adverse impacts. The methodology that has been used to do this is shown in Figure 5-2. A detailed description of each stage is given in the following subsections.

Figure 5-2 Environmental impact statement methodology flowchart



5.4 Stage 1 – Constraints analysis

5.4.1 Constraints approach

As discussed in section 5.1, the GFD Project will use the assessment framework approach, which has been approved and successfully implemented for the GLNG Project. This process is tried and tested, thus increasing certainty in the GFD Project’s environmental outcomes.

The constraints approach is based upon the *GFD Project environmental protocol for constraints planning and field development* (Constraints protocol). The Constraints protocol applies to all gas field related activities. The scope of the Constraints protocol is to:

- Enable Santos GLNG to comply with all relevant State and Federal statutory approvals and legislation
- Support Santos' environmental policies and the General Environmental Duty (GED) as outlined in the EP Act
- Promote the avoidance, minimisation, mitigation and management of direct and indirect adverse environmental impacts associated with land disturbances
- Minimise cumulative impacts on environmental values.

Constraints analysis is a key component of the framework approach and increases certainty about potential impacts by identifying those areas that are not amenable to development, or if they were to be developed, how development should proceed. This occurs by identifying the constraints to development that exist within the GFD Project area and the environmental management controls to be applied to project activities in these constrained areas. In this way, Santos GLNG can optimise environmental outcomes by avoiding sensitive receptors wherever practicable. Where avoidance is not practicable, Santos GLNG will use a range of management and mitigation measures. This hierarchy will be maintained throughout all phases of the GFD Project, providing multiple opportunities for refinement of scope and execution.

5.4.2 Existing environmental values and constraints identification

A review was undertaken to identify the known environmental, social and economic values (hereafter called environmental values) and sensitive receptors within the GFD Project area. The desktop assessment of the environmental values and constraints study included a review of available data, both spatial and non-spatial. The review included existing reports and documents, information sourced from various databases (government and other) and analysis of various spatial datasets, both government sourced datasets, and additional GIS datasets detailing results of field investigations / surveys recorded for the GLNG Project and the GFD Project. Full descriptions of the various data assessed as part of the environmental values and constraints desktop study are detailed in the individual EIS technical reports, presented in the appendices to this EIS.

The technical specialists assessing the environmental values for this EIS adopted criteria set out in statutory guidelines or policies, or if none were available, they defined values based on accepted practice and professional judgement.

A particular environmental value's sensitivity or vulnerability to change, as indicated by its conservation status or other criteria, provides an indication of the level of constraint it poses to the GFD Project infrastructure or activity. Where an environmental value is defined by a feature (such as an ecological community) the constraint can be expressed spatially and shown on a map.

For non-spatial values, modelling and subsequent impact assessment can indicate the degree of change that can be accepted before intervention is required. For example, a social assessment can nominate trigger levels when accommodation or community facilities may require upgrading.

5.4.3 Constraints classification

Constraint classifications have been established according to the potential for the proposed activities to cause adverse impacts on the identified environmental values. These classifications are set out in Table 5-1.

Table 5-1 Constraint classification

Constraint classification	Definition
No-go areas	Areas where GFD Project activities could cause significant impact to the receiving environmental value. Regulatory framework places restrictions on development activities (e.g. Category A environmentally sensitive areas). No petroleum activities (as defined in Table 5-2) permitted.
Surface development exclusion area	Areas where GFD Project activities could cause significant impact to the receiving environmental value. Regulatory framework places restrictions on development activities (e.g. primary protection zone (200 metre (m) buffer) of Category A environmentally sensitive areas). Low impact petroleum activities (as defined in Table 5-2) permitted.
High constraint area	Low impact petroleum activities and limited petroleum activities (linear only) (as defined in Table 5-2) permitted only with site-specific mitigation measures including pre-clearance surveys, stakeholder consultation, restrictive conditions and potential offsets.
Moderate constraint area	Low impact petroleum activities and limited petroleum activities (linear and non-linear) permitted with specific mitigation measures applied, which may include pre-clearance surveys, stakeholder consultation, site-specific controls and potential offsets.
Low constraint area	All petroleum activities permitted with standard mitigation and management conditions. Offsets are unlikely.

Based on the constraint classification given in Table 5-1, the type of GFD Project activity permitted in each constraint area has been determined according to the criteria set out in Table 5-2. The level of constraint mapped within a particular area will:

- Govern the type of GFD Project activity to take place in that area
- Determine the level of approval or assessment required
- Guide the level of mitigation or management measures to be applied.

Table 5-2 Permitted GFD Project activities

Constraint category	Low impact petroleum activities ¹	Limited petroleum activities ² (linear only ⁴)	Limited petroleum activities ² (linear and non-linear)	Petroleum activities ³
No-go area	No	No	No	No
Surface development exclusion area	Yes	No	No	No
High constraint area	Yes	Yes	No	No
Moderate constraint area	Yes	Yes	Yes	No
Low constraint area	Yes	Yes	Yes	Yes

¹ **Low impact petroleum activities** means petroleum activities that do not result in the clearing of native vegetation, earthworks or excavation work that cause either: a significant disruption to the soil profile; or permanent damage to vegetation that cannot be easily rehabilitated immediately after the activity is completed. Examples of such activities include (but are not necessarily limited to): chipholes, coreholes, geophysical surveys, seismic surveys, soil surveys, topographic surveys, cadastral surveys, ecological surveys, and installation of environmental monitoring equipment (including surface water).

² **Limited petroleum activities** mean any low impact petroleum activity and single well leases (includes observation, pilot, injection and production wells) and associated infrastructure (water pumps and generators, sumps, flare pits or dams) located on the well lease; multi-well leases and associated infrastructure (water pumps and generators, sumps, flare pits, dams or tanks) located on the well leases; construction of new access tracks that are required as part of the construction or servicing a petroleum activity; upgrading or maintenance of existing roads or tracks, power and communication lines, gas gathering lines from a well lease to the gas compression facility; water gathering lines from a well lease to water storage; and camps within well lease that may involve sewage treatment works that are a no release works.

³ **Petroleum activities** include low impact petroleum activities, limited petroleum activities, and all other GFD Project activities including major facilities such as permanent accommodation camps, gas treatment facilities, air strips, gas compression facilities, water management facilities such as water storage and water treatment facilities.

⁴ **Linear infrastructure** means linear infrastructure including (but not limited to) gas and water gathering lines, low and high pressure gas and water transmission pipelines, power lines, communication, roads and access tracks.

5.4.4 Constraints assessment

Initially, a constraints assessment was performed on each individual environmental value in isolation from other values. If multiple constraints overlapped for any particular value, the highest level of constraint prevailed. The environmental values identified for the GFD Project area that have been included in the constraints assessment are as follows:

- Natural environment/ecology
- Surface water
- Land tenure
- Land use
- Cultural heritage (Indigenous and non-indigenous)
- Landscape and visual amenity
- Existing infrastructure such as road and railways.

The levels of constraint applied to the natural environment/ecology, surface water and tenure values are detailed in Table 5-3. These constraints are primarily derived from State and Commonwealth legislation, including the *Nature Conservation Act 1992* (Qld) (NC Act) and the EPBC Act.

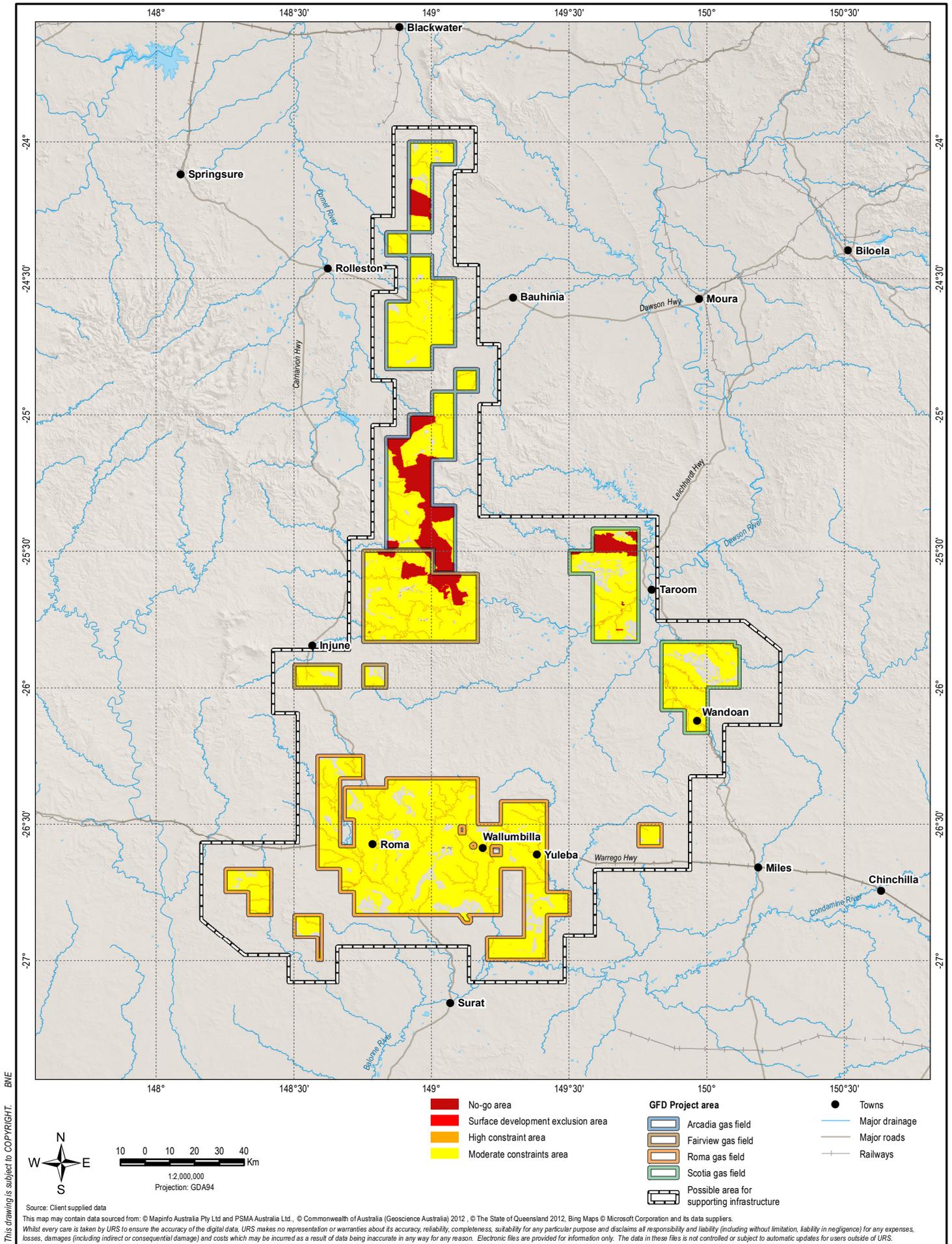
Table 5-3 Constraint layers

Level of constraint	Constraint layer
No-go area	Category A environmentally sensitive areas including national parks, conservation parks, and forest reserves (NC Act).
	EPBC Act-listed spring vents and complexes including primary 200 m buffer.
	Wetlands of national importance including 200 m buffer.
	Wetlands of high ecological significance or high conservation value (<i>Map of Referrable Wetlands</i>).
Surface development exclusion area	Primary 200 m buffer for Category A environmentally sensitive areas.
	The following Category C environmentally sensitive areas: <ul style="list-style-type: none"> • Nature refuges (NC Act) • Koala habitat areas (<i>Nature Conservation (Koala) Conservation Plan 2006</i>) • Declared catchment areas (<i>Water Act 2000 (Qld)</i>).
	The following Category B environmentally sensitive areas: <ul style="list-style-type: none"> • Coordinated conservation areas (NC Act). • State forest park/special forestry areas (<i>Forestry Act 1959 (Qld)</i> (Forestry Act)) • Ramsar sites listed as wetlands of international importance.
High constraint area	Watercourses (stream orders) including 100 m buffer.
	Wetland defined as 'general ecologically significant wetland' or 'wetland of other environmental value' (<i>Map of Referrable Wetlands</i>).
	Spring vents and complexes (not protected under the EPBC Act) including primary 200 m buffer.
Moderate constraint area	Secondary 100 m buffer for Category A environmentally sensitive areas.
	Secondary 100 m buffer for spring vents and complexes (EPBC Act).
	Matters of national environmental significance including habitats (threatened species habitat and migratory species habitat), threatened ecological communities (derived from state regional ecosystem mapping or verified from field surveys), flora species.
	State forests and timber reserves.
	Endangered regional ecosystems including primary 200 m buffer.
	The following Category C environmentally sensitive areas: <ul style="list-style-type: none"> • Essential habitat including primary 200 m buffer (NC Act). • Essential regrowth habitat including primary 200 m buffer (NC Act). • Of concern regional ecosystems including primary 200 m buffer. • Resource reserve (NC Act). • State forests / Timber reserves (Forestry Act).
	Endangered, vulnerable and near-threatened species (NC Act).
Low constraint areas	High value regrowth (endangered and of concern regional ecosystems).
	No concern at present regional ecosystems.
	Type A species (NC Act).
	Existing Santos GLNG infrastructure.
	Existing road, rail, pipeline and other infrastructure.
	Remaining areas once other constraints have been applied.

The levels of constraint applied by the other values are determined as follows:

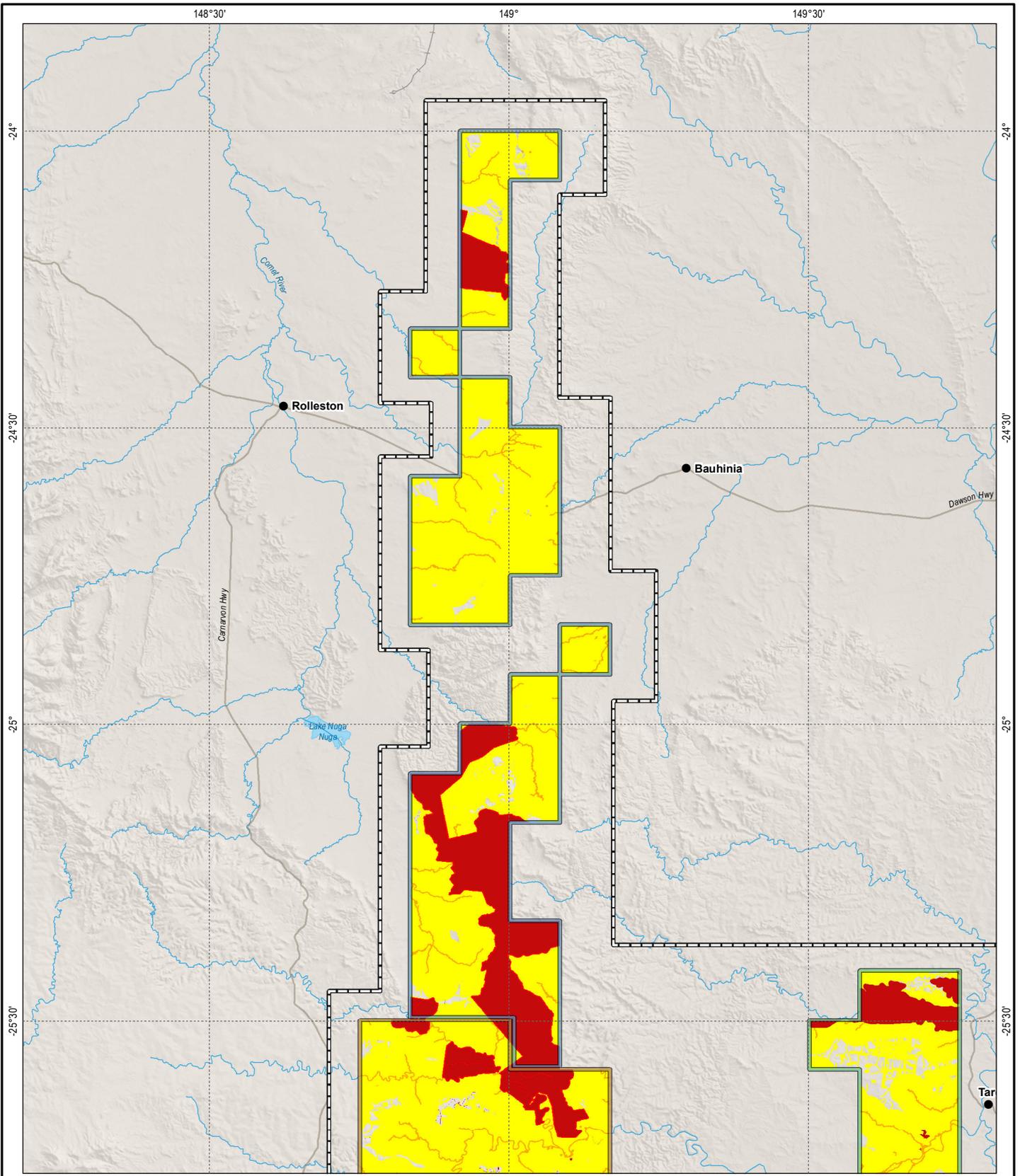
- Land use — by agreements reached through the Santos GLNG landholder engagement process (Figure 5-6), and relevant planning instruments such as regional plans and town planning schemes (outside of petroleum tenures).
- Cultural heritage — by legislation (i.e. *Aboriginal Cultural Heritage Act 2003*, *Australian Heritage Council Act 2003* and *Queensland Heritage Act 1992*), agreed cultural heritage management plans, and corporate policy and standards for cultural heritage management (described in Section 6: Management framework).
- Landscape and visual amenity — by agreements reached through the Santos GLNG landholder engagement process (Figure 5-6).
- Existing infrastructure — by agreements reached through the Santos GLNG landholder engagement process (Figure 5-6) with the relevant infrastructure owners/operators.

A constraints map has been prepared for the GFD Project area, which shows the extent of the no-go and surface development exclusion constraint levels listed in Table 5-3. This map is shown on Figure 5.3.



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- No-go area
 - Surface development exclusion area
 - High constraint area
 - Moderate constraints area
-
- Arcadia gas field
 - Fairview gas field
 - Roma gas field
 - Scotia gas field
 - Possible area for supporting infrastructure
-
- Towns
 - Major drainage
 - Major roads
 - Railways

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GFD PROJECT EIS

CONSTRAINTS APPLICABLE TO GFD PROJECT AREA ARCADIA GAS FIELD



ASSESSMENT FRAMEWORK

Figure: 5-3a

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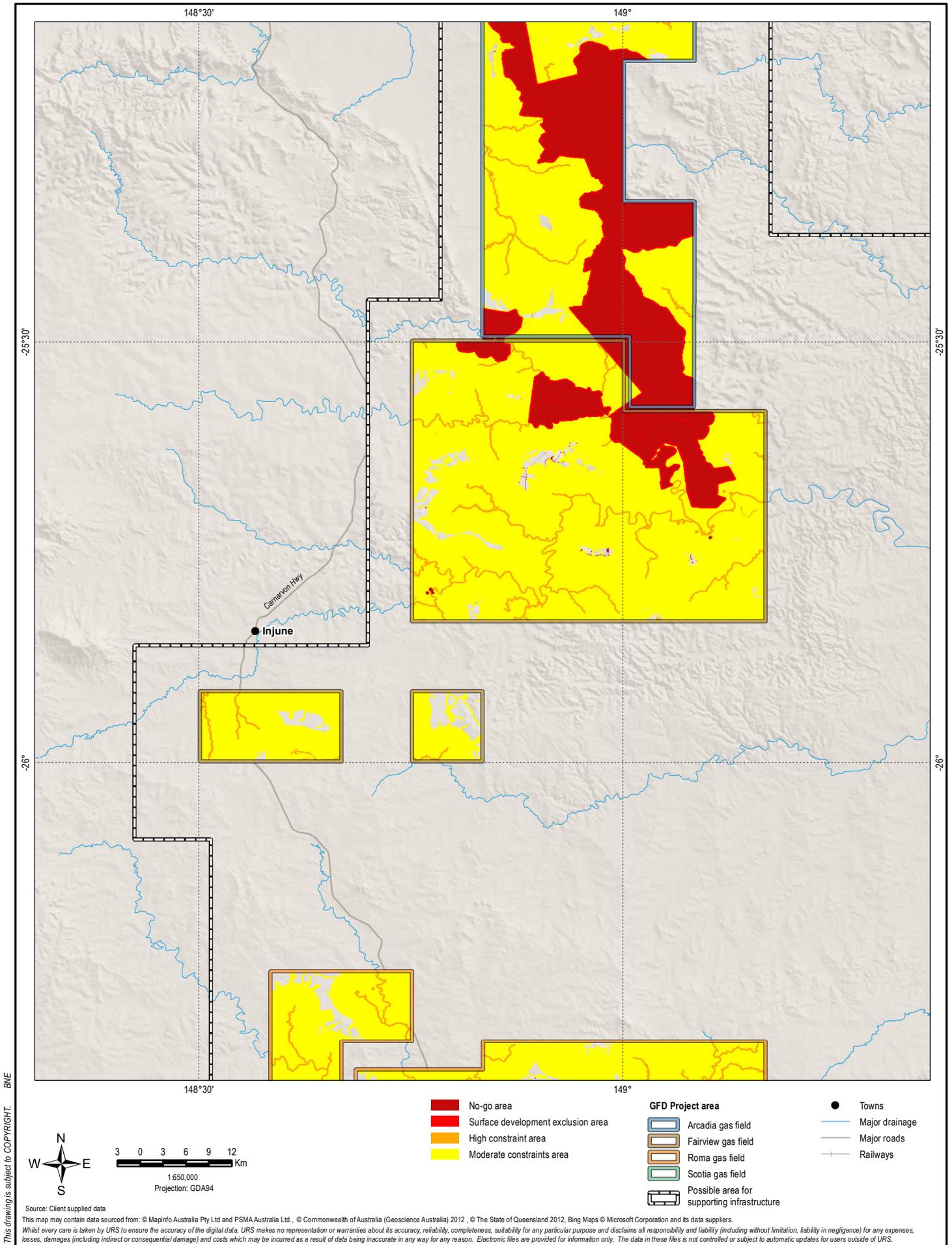
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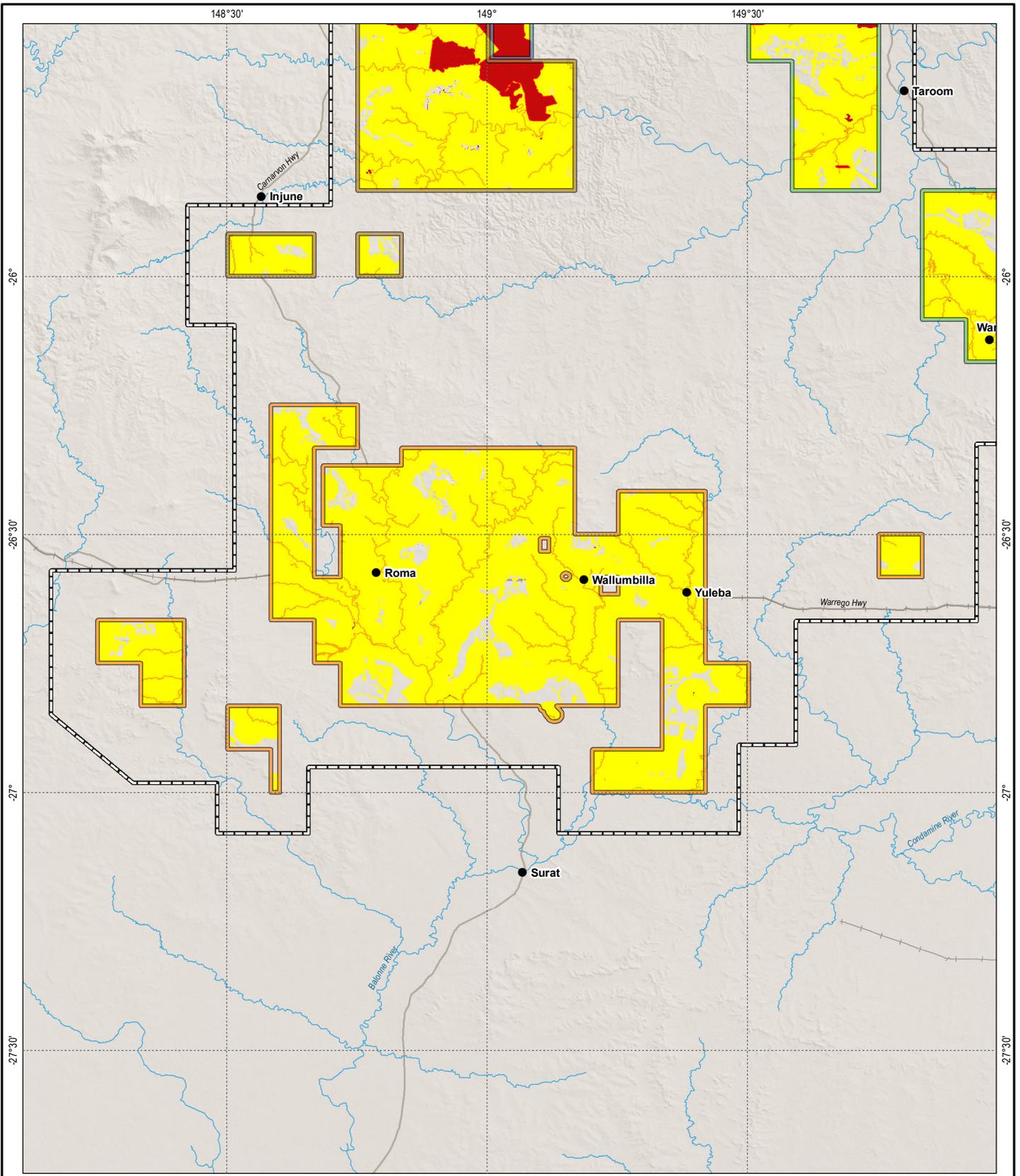
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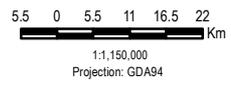


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- No-go area
- Surface development exclusion area
- High constraint area
- Moderate constraints area

- GFD Project area**
- Arcadia gas field
- Fairview gas field
- Roma gas field
- Scotia gas field
- Possible area for supporting infrastructure
- Towns
- Major drainage
- Major roads
- Railways



GFD PROJECT EIS

CONSTRAINTS APPLICABLE TO GFD PROJECT AREA ROMA GAS FIELD



ASSESSMENT FRAMEWORK

Figure: **5-3c**

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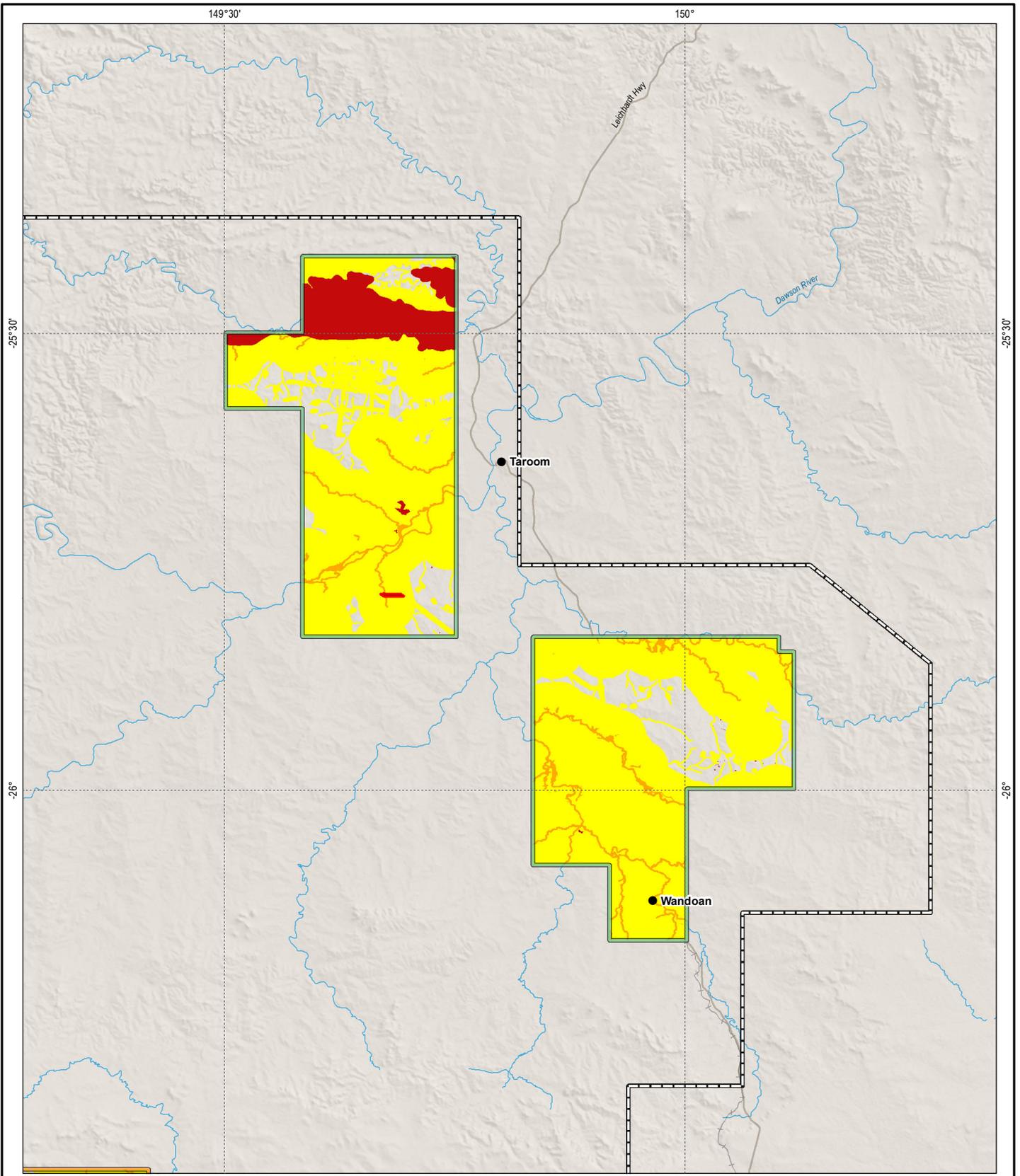
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<p>1:650,000 Projection: GDA94</p> <p>3 0 3 6 9 12 Km</p>	<ul style="list-style-type: none"> No-go area Surface development exclusion area High constraint area Moderate constraints area 	<p>GFD Project area</p> <ul style="list-style-type: none"> Arcadia gas field Fairview gas field Roma gas field Scotia gas field Possible area for supporting infrastructure 	<ul style="list-style-type: none"> Towns Major drainage Major roads Railways
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5.5 Stage 2 – Field planning

5.5.1 Conceptual field development schedule

A conceptual field development schedule was prepared to indicate the likely scale of field development based on the known available gas resources in the GFD Project area and what petroleum activities would be required to extract the gas. The schedule is based on initial estimates of gas resources; however, this schedule will continue to be refined as exploration and appraisal activities are ongoing. The conceptual field development schedule identifies the number and type of the following petroleum activities that could conceptually be developed without consideration of constraints:

- Wells (numbers)
- Gas compression and treatment facilities (numbers, capacities, locations)
- Water management facilities (numbers, capacities, locations)
- Gathering lines and transmission pipelines (locations).

5.5.2 Field development concept process

Santos GLNG understands that planning for the proposed petroleum activities included in the conceptual field development schedule needs to consider relevant environmental (and other) constraints. The field development concept process has been used to indicate how the GFD Project area might develop over the project's life, taking relevant constraints into account. This process will be subject to ongoing refinement as additional resource data are obtained, as more detailed information is gathered on the area's constraints including landholder requirements, and as the GFD Project passes through Phase 1 to Phase 2 as described in section 5.2.

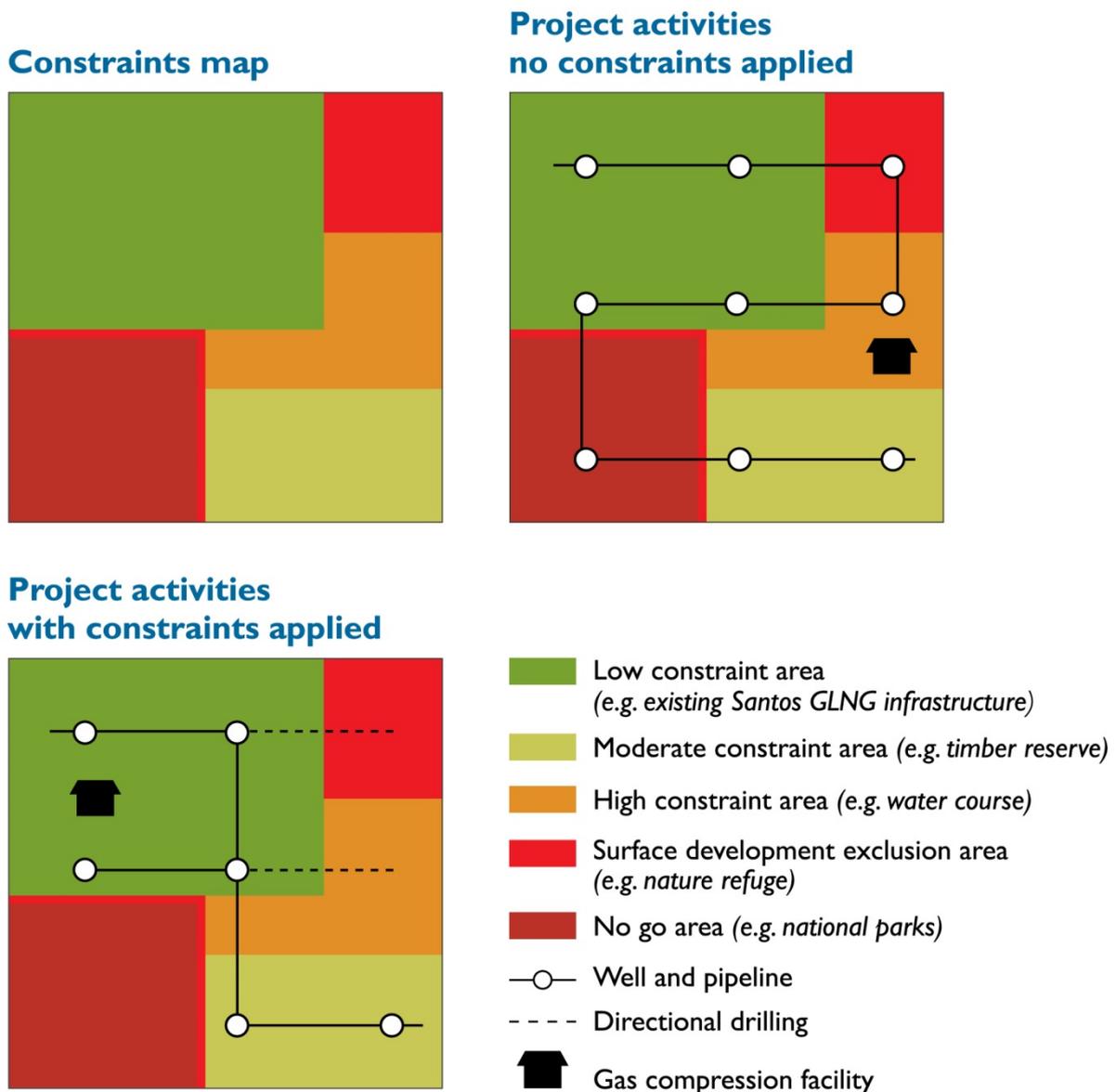
The steps involved in the field development concept process are as follows:

- Identify the various levels of constraint (as defined in Table 5-1) that exist over the subject area
- Superimpose the development envisaged for the subject area by the conceptual field development schedule
- Amend the conceptual field development schedule by considering which project activities are permitted in each of the constraint areas (as listed in Table 5-2).

This process describes how wells, pipelines, gas compression facilities and water management facilities might conceptually be arranged to extract and process gas, taking constraints into account. Based on this, an indicative construction and development program can be developed. This process has been used as the basis for impact assessment in this EIS as it indicates the likely maximum development case in terms of environmental impacts and the GFD Project's maximum disturbance footprint.

Figure 5-4 shows conceptually how the field development concept process will be applied.

Figure 5-4 Field development concept process



5.6 Stage 3 – Environmental impact assessment and mitigation measures

The environmental impact assessment and identification of mitigation measures stage included the following tasks:

- Review existing published and Santos GLNG data (some of the GLNG Project areas already under development have extensive field information that was available for use), and identify data gaps
- Complete targeted fieldwork to confirm broad scale environmental values and constraints
- Impact assessment
- Incorporate existing and (if required) propose additional mitigation and management measures
- Identify residual impacts and develop environmental management plan.

Each of these tasks is discussed in the following sections.

5.6.1 Review of available data

As discussed in section 5.4.2, a substantial amount of data were available from the extensive field investigations already undertaken for the GLNG Project EIS and subsequently as part of the pre-clearance surveys undertaken for approved GLNG Project activities. Relevant information was also obtained from numerous public and project-specific databases. These data were reviewed to identify relevant data gaps that might apply to the GFD Project area.

5.6.2 Fieldwork and confirmation of environmental values and constraints

Based on the data gaps identified in the previous task, fieldwork was undertaken to confirm the existing environmental values and constraints for the GFD Project area. Generally, the fieldwork was required for the following reasons:

- Parts of the GFD Project area extend beyond the boundaries of the GLNG Project area
- Some of the public database information used to support the constraints analysis required confirmation
- More focus was able to be made on possible development areas identified by the field development concept process
- Some of the data from the GLNG Project EIS, which was completed in 2009, required updating.

The fieldwork undertaken for this EIS has been used to verify environmental values in the GFD Project area. It has also been used to confirm the accuracy of certain environmental constraints. Details of the fieldwork undertaken as part of the GFD Project are discussed in the relevant sections of this EIS.

5.6.3 Impact assessment

5.6.3.1 Assessment approach

The approach to impact assessment adopted for this EIS was based on the following process:

- The impact assessment process began with the identification of the impacts that could potentially occur to the particular environmental values being assessed due to the construction, operations, decommissioning and rehabilitation of the GFD Project based on the description given in Section 4: Project description.
- The potential impacts that could occur after the application of the *Environmental protocol for constraints planning and field development* (Constraints protocol) (avoidance principles) were then identified as pre-mitigated impacts. These potential (pre-mitigated) impacts were then assessed using the relevant methodology as described in section 5.6.3.2. This approach is consistent with its environmental management framework which, as described in Section 6: Management framework, has avoidance as the most preferred management practice in the environmental management hierarchy.
- The pre-mitigated impacts were then managed by applying the relevant mitigation and management measures based on the existing plans and strategies contained within the approved environmental management framework that Santos GLNG has already implemented for the GLNG Project (refer to Section 6: Management framework). In this way the mitigated (residual) impacts could be identified. This is consistent with the management practices (subsequent to avoid) in the environmental management framework of mitigate and manage.

5.6.3.2 Assessment methodologies

This EIS has used different impact assessment methodologies for different environmental values. The particular methodology used depended on the nature of the regulatory regime that applied to the particular environmental value, the sensitivity or vulnerability of the environmental value, the nature of the impacts, and how mitigation measures are applied. The relevance of each methodology and the values to which they apply are summarised in Table 5-4.

Table 5-4 Assessment methodologies

Methodology	Relevance	Values
Compliance assessment	Used where compliance with a known guideline or standard (e.g. published limits or thresholds) can be quantitatively assessed	Air quality Greenhouse gases Noise and vibration.
Risk assessment	Used where there are no relevant quantified guidelines an impact may occur and the impact depends on how aspects or materials are managed	Climate Cultural heritage Hazard and risk Land contamination Social Waste.
Significance assessment	Used where there are no quantitative guidelines, an impact will occur and it is the sensitivity or the vulnerability of the environmental value that is important	Ecology Groundwater Land use Soils and geology Surface water Transportation Visual amenity.

A general explanation of how each assessment methodology was applied is given below. In some cases the methodology varied to meet the needs of a particular study. Details of the assessment undertaken for each environmental value are given in the corresponding EIS sections.

Compliance assessment

For the air quality, greenhouse gases and noise and vibration studies, a number of quantified guidelines are set out in environmental protection policies and other regulatory documents developed to protect environmental values. The degree to which the GFD Project complies with these guidelines has been used as a measure of the level of impact.

The compliance assessment methodology has used computer modelling to predict impacts from the proposed GFD Project activities. This enabled an assessment of the extent to which the GFD Project complies with the published limits or thresholds or the extent of mitigation and management measures that need to be applied to comply.

Risk assessment

For the climate, cultural heritage, economics, hazard and risk, land contamination, social and waste studies there are no relevant quantified guidelines to measure impacts and hence the level of impact has been determined by how each particular aspect is to be managed. A qualitative risk assessment was used which was based on *AS/NZS 31000:2009 Risk Management – Principles and Guidelines* and the Santos GLNG standard for hazard identification, risk assessment and control.

Criteria used to rank the likelihood and consequences of potential impacts are set out in Table 5-5 and Table 5-6 respectively.

Table 5-5 Likelihood criteria

Likelihood category	Description
Almost certain Common	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely Has occurred in recent history	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible Could happen, has occurred in the past, but not common	The event could occur. There is likely to be an event on average every five to twenty years.
Unlikely Not likely or uncommon	The event could occur but is not expected. A rare occurrence (once per one hundred years).
Remote Rare or practically impossible	The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as extremely unique.

Table 5-6 Consequence criteria

Consequence category	Description
Critical Severe, widespread long-term effect	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely. Financial loss in excess of \$100 million.
Major Wider spread, moderate to long-term effect	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible. Financial loss from \$50 million to \$100 million.
Moderate Localised, short-term to moderate effect	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern. Financial loss from \$5 million to \$50 million.
Minor Localised short-term effect	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification. Financial loss from \$500,000 to \$5 million.
Negligible Minimal impact or no lasting effect	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols. Financial losses up to \$500,000.

The level of risk of each environmental impact was assessed by combining the likelihood and consequence criteria in a risk assessment process as shown in Table 5-7.

Table 5-7 Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Remote
Critical	Very high	Very high	High	High	Medium
Major	Very high	High	High	Medium	Medium
Moderate	High	Medium	Medium	Medium	Low
Minor	Medium	Medium	Low	Low	Very low
Negligible	Medium	Low	Low	Very low	Very low

Consistent with the requirements of AS/NZS 31000:2009 *Risk Management – Principles and Guidelines* and its companion documents, there were some instances where the technical specialists for particular studies revised the categories and descriptions to better reflect the needs and specific objectives of the studies. Study-specific changes made to the risk assessment methodology are described in the relevant technical assessment reports and EIS sections.

Significance assessment

For the ecology, groundwater, land use, soils and geology, surface water, transportation and visual amenity studies, there are no quantitative guidelines available for assessment – it is the sensitivity or vulnerability of the environmental value and the magnitude of the impact that are important. For these studies, a significance assessment methodology was applied.

The process applied was similar to the risk assessment process described above, but the criteria applied related to sensitivity and magnitude rather than to likelihood and consequence. These criteria are summarised in Table 5-8 and Table 5-9.

Table 5-8 Sensitivity criteria

Sensitivity	Description
High	<p>The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance.</p> <p>The environmental value is intact and retains its intrinsic value.</p> <p>The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region, territory, country or the world.</p> <p>It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value. GFD Project activities would have an adverse effect on the value.</p>
Moderate	<p>The environmental value is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers.</p> <p>The environmental value is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements.</p> <p>It is relatively well represented in the systems/areas in which it occurs but its abundance and distribution are limited by threatening processes.</p> <p>Threatening processes have reduced its resilience to change. Consequently, changes resulting from GFD Project activities may lead to degradation of the prescribed value.</p> <p>Replacement of unavoidable losses is possible due to its abundance and distribution.</p>
Low	<p>The environmental value is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g., historical societies.</p> <p>The environmental value is in a poor to moderate condition as a result of threatening processes, which have degraded its intrinsic value.</p> <p>It is not unique or rare and numerous representative examples exist throughout the system / area.</p> <p>It is abundant and widely distributed throughout the host systems / areas.</p> <p>There is no detectable response to change or change does not result in further degradation of the environmental value.</p> <p>The abundance and wide distribution of the environmental value ensures replacement of unavoidable losses is achievable.</p>

Table 5-9 Magnitude criteria

Magnitude	Description
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the environmental value. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact.
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the GFD Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls.
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.

For some studies the assessment criteria used varied to better reflect the nature of the environmental value being assessed. For example, the sensitivity criteria used for the ecology assessment related to defined sensitivity levels for ESAs. Study-specific changes made to the assessment methodology are described in the relevant technical assessment reports and EIS sections.

The significance of each environmental impact was determined by combining the sensitivity and magnitude criteria in a risk assessment process as shown in Table 5-10.

Table 5-10 Significance matrix

Magnitude	Sensitivity		
	High	Moderate	Low
High	Major	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Negligible

The significance classifications used in Table 5-10 (major, high, moderate, low and negligible) are defined in Table 5-11.

Table 5-11 Significance classifications

Significance	Description
Major	Arises when an impact will potentially cause irreversible or widespread harm to an environmental value that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.
High	Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the environmental value. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status.
Moderate	Results in degradation of the environmental value due to the scale of the impact or its susceptibility to further change even though it may be reasonably resilient to change. The abundance of the environmental value ensures it is adequately represented in the region, and that replacement, if required, is achievable.
Low	Occurs where an environmental value is of local importance and temporary or transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
Negligible	Does not result in any noticeable change and hence the proposed activities will have negligible effect on environmental values. This typically occurs where the activities are located in already disturbed areas.

5.6.3.3 Mitigation and management measures

Mitigation and management measures were applied to reduce the level of impact identified for the pre-mitigated impacts. These measures aim to protect the identified environmental values and to achieve established environmental objectives. Mitigation and management measures will be applied, as appropriate, during the planning and design, construction, operations, decommissioning and rehabilitation phases of the GFD Project.

The mitigation and management measures applied have been based on the existing measures contained within the approved environmental management framework that Santos GLNG has developed and implemented for the GLNG Project as described in Section 6: Management framework. This approach is supported by the corporate environmental, health and safety management system, which is also described in Section 6: Management framework. Applying the same mitigation and measurement measures from the GLNG Project to the GFD Project will ensure a consistent approach by construction and operations personnel and a common understanding for both regulators and the community of the measures to be applied.

Details of the mitigation and management measures to be used to protect the GFD Project area's environmental values are given in the relevant technical reports and EIS sections.

5.6.3.4 Residual impacts and environmental management planning

An assessment of the risk or significance of the residual impacts remaining after application of the mitigation and management measures was undertaken. Comparison of the potential (pre-mitigated) and the residual (mitigated) impacts provided an indication of the effectiveness of such measures.

Details of the residual impacts indicating the effectiveness of the mitigation and management measures to be used to protect the GFD Project area's environmental, social and economic values are given in the relevant technical reports and EIS sections.

To manage the potential residual impacts of the GFD Project, this EIS presents a draft environmental management plan consistent with the requirements of the EIS terms of reference. The environmental management plan provides a framework for continuing management, monitoring, reporting and training. This plan is consistent with the environmental management plans that have been approved and implemented for the GLNG Project. The Draft environmental management plan (Appendix Y) includes details of the following:

- Environmental values likely to be affected by the proposed activities
- Potential adverse and beneficial impacts of the GLNG Project's activities on the environmental values
- Commitments to acceptable levels of environmental performance, including environmental objectives, performance standards and associated measurable indicators, performance monitoring, and reporting
- Impact prevention or mitigation actions to implement the commitments
- Corrective actions to rectify deviations from performance standards.

The environmental management plan is in draft form, pending update after the EIS is completed and prior to the EA application stage in Phase 2.

5.7 Phase 2 – Project implementation

5.7.1 Phased approach

As discussed in section 5.2.2, following approval of the EIS (Phase 1) the GFD Project will require additional approvals before development can commence (Phase 2). During Phase 2, additional documentation, including the provision of more detailed environmental and social impact assessment and management information, will accompany the major approvals applications shown in Figure 5-1. These are discussed in this section.

5.7.2 Environmental authority

It is a requirement of the EP Act that petroleum activities require an EA before they can commence. As discussed in section 5.2.2, the GFD Project will apply for an EA as part of the Phase 2 implementation. Furthermore, as discussed in section 5.7.5, the petroleum tenure required by the GFD Project will not be issued without the EA being granted.

An EA application will be submitted to the Queensland Department of Environment and Heritage Protection in accordance with the requirements of the EP Act. It will include a description of all of the petroleum activities that are proposed, land on which the activities are to be carried out, and it will be supported by the environmental assessment and management measures detailed in this EIS.

The EA, when it has been issued, will include the approval conditions that are to apply to the GFD Project.

5.7.3 Constraints planning and field development protocol

The field development process is a continuation of the field planning process and incorporates the environmental constraints assessment using a combination of existing spatial data and ground-truthed data. This process is already in place for the GLNG Project and will also be used for the GFD Project. Detailed environmental constraints analysis and the field development process will inform the GFD Project's design, together with a range of other factors including technical feasibility, constructability, cost, and risk as required by standards applicable to the design, construction, and operation of gas developments. This information will be used to support the EA application and the plan of operations (see section 5.7.4).

The Constraints protocol (Appendix Y-B) details the approach Santos GLNG takes in identifying, assessing and managing potential impacts to the environment.

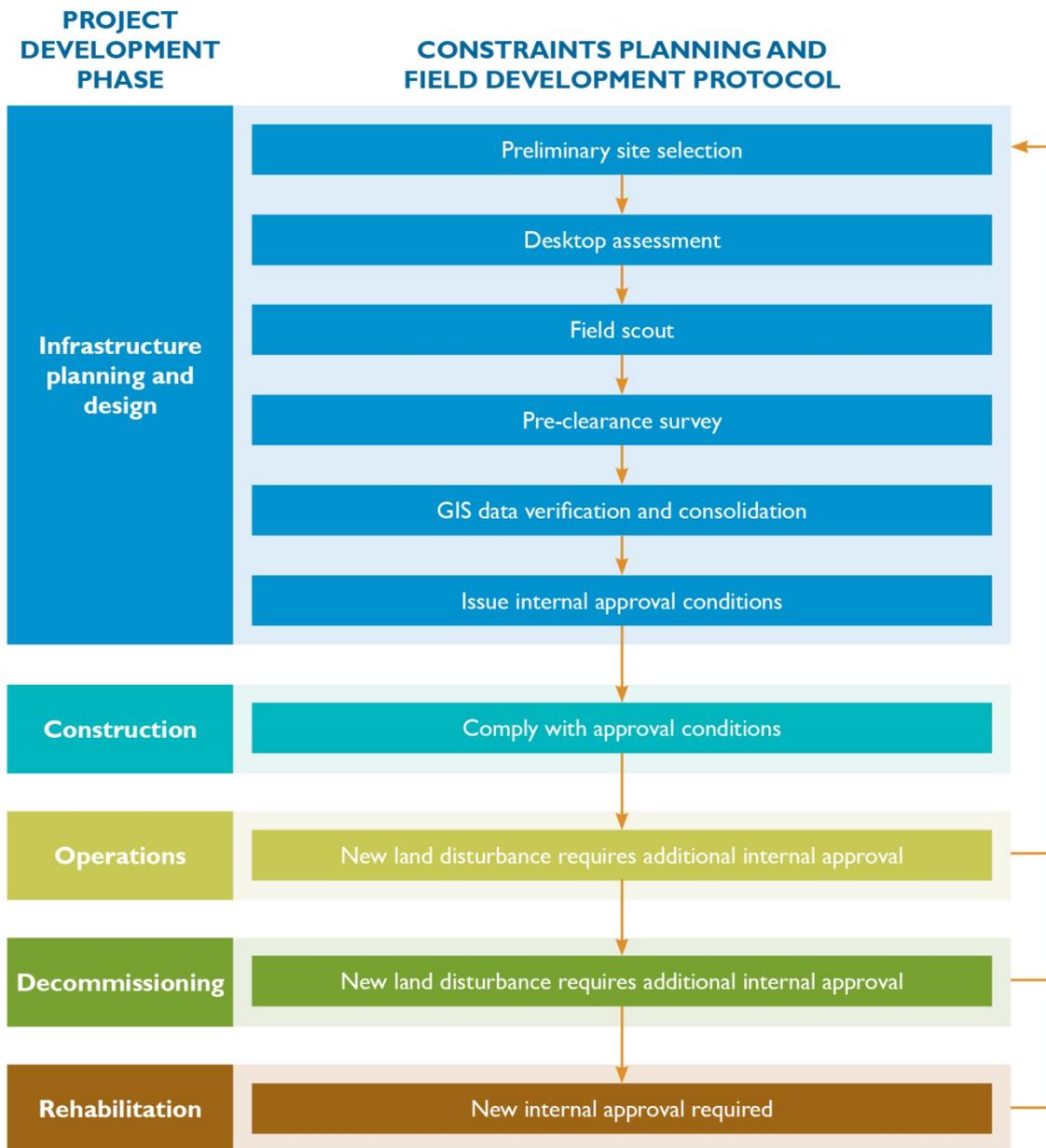
The general principles of the Constraints protocol, in order of preference, are to:

- Avoid — avoid direct and indirect impacts
- Minimise — minimise potential impacts
- Mitigate — implement mitigation and management measures to minimise adverse impacts
- Remediate and rehabilitate — actively remediate and rehabilitate impacted areas
- Offset — offset residual impact in accordance regulatory requirements.

The Constraints protocol primarily deals with ecological constraints; however it also incorporates a decision framework that has been applied to other constraints. The same GIS tools that are used in the Constraints protocol are applied to non-ecological constraints such as regulatory approval conditions, environmental and planning constraints, locations of sensitive receptors, land use and terrain. This assessment process is typically conducted in parallel with the Constraints protocol to ensure that decisions on site selection and linear infrastructure routing provide a balanced assessment that considers relevant impacts.

Application of the Constraints protocol will be an ongoing process throughout the field development process. The tasks involved in this process are summarised in Figure 5-5.

Figure 5-5 Field development process



5.7.4 Plan of operations

As required by the EP Act, Santos GLNG will submit a Plan of operations for the GFD Project that will demonstrate how the environmental approval conditions are going to be met before activities can commence. The plan of operations (which is limited to minimum of one year and a maximum of five years) is required to include the following:

- Description of petroleum activities proposed to be carried out during the period of the plan
- An action program to show how the GFD Project will comply with the environmental approval conditions

- A rehabilitation program for significantly disturbed land during the period of the plan and a statement of the maximum financial assurance for the plan period
- A compliance statement showing the extent to which the plan complies with the environmental approval conditions.

The plan of operations will also be a means of reporting to the administering authority how the Constraints protocol has been effectively applied and that impacts have been avoided, managed, or mitigated.

A plan of operations is currently in place for the GLNG Project's existing operations.

5.7.5 Petroleum tenure

A PL is required before gas can be produced. The PL will not be granted without an approved EA.

Santos GLNG will submit PL applications to the Queensland Department of Natural Resources and Mines in accordance with the requirements of P&G Act and the Petroleum Act. PL applications are required to be accompanied by an initial development plan, which generally would cover a five year period of proposed project activities. At the end of the five year period, it is necessary to lodge a further development plan for the next five years.

The initial development plan will include the following:

- Overview of the activities proposed to be carried during the life of the GFD Project
- Details of the activities proposed for the life of the plan, including the number and type of wells, pipelines, gas compression and treatment facilities, water management facilities, and associated infrastructure
- Map showing the locations of proposed activities
- Resource map showing the extent of each underground reservoir, well locations, geophysical survey locations, and relationship to any mining infrastructure
- Estimates and confidence levels for the volume of gas and water to be produced
- Summary of estimated costs
- Identification of any overlapping coal or oil shale tenures.

5.7.6 Conduct and compensation agreement

As required by the P&G Act, Santos GLNG must negotiate a conduct and compensation agreement (CCA) with landholders on whose land the petroleum activities will be carried out. Santos GLNG will engage with landholders before any proposed activity and negotiation of the CCA to provide an opportunity for landholders to raise concerns specific to their property and to reach agreement on where, how, and when development will occur on their property. The locations of wells, gathering lines, and access tracks will be finalised in consultation with the landholder as part of the negotiations. The final locations will also need to comply with relevant approval conditions. Santos GLNG is required to provide detailed information in the CCA about the proposed activities, the locations and timing of activities, impact management, rehabilitation and compensation to the landholder.

The early engagement process with new landholders is summarised in Figure 5-6. Santos GLNG also has existing agreements with landholders in place and processes to adapt them where required.

Figure 5-6 Landholder engagement process

