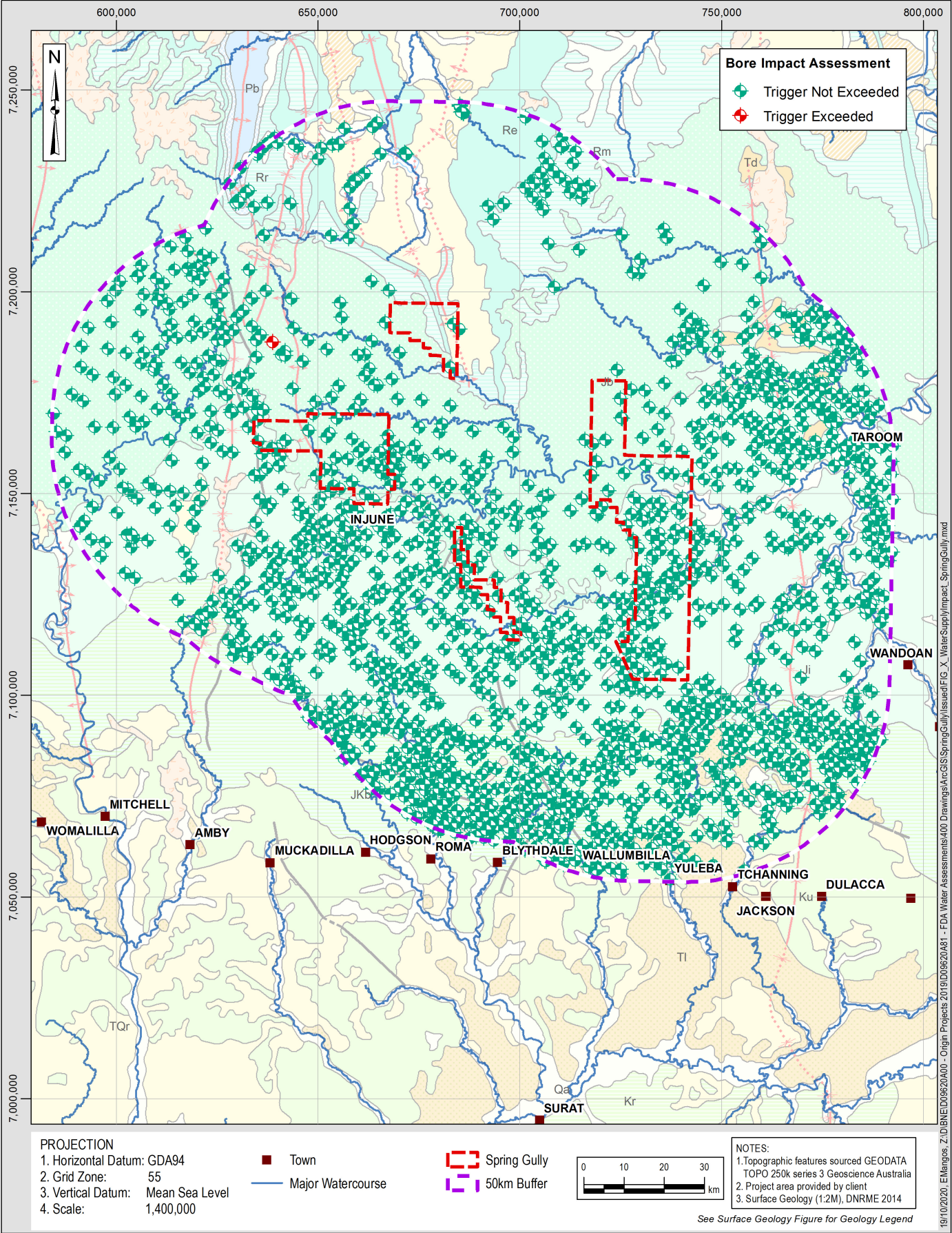


Figure 23 - Predicted Groundwater Bore Trigger Threshold Exceedances: Spring Gully





**Figure 24 - Predicted Groundwater Bore Trigger Threshold Exceedances: Peat**

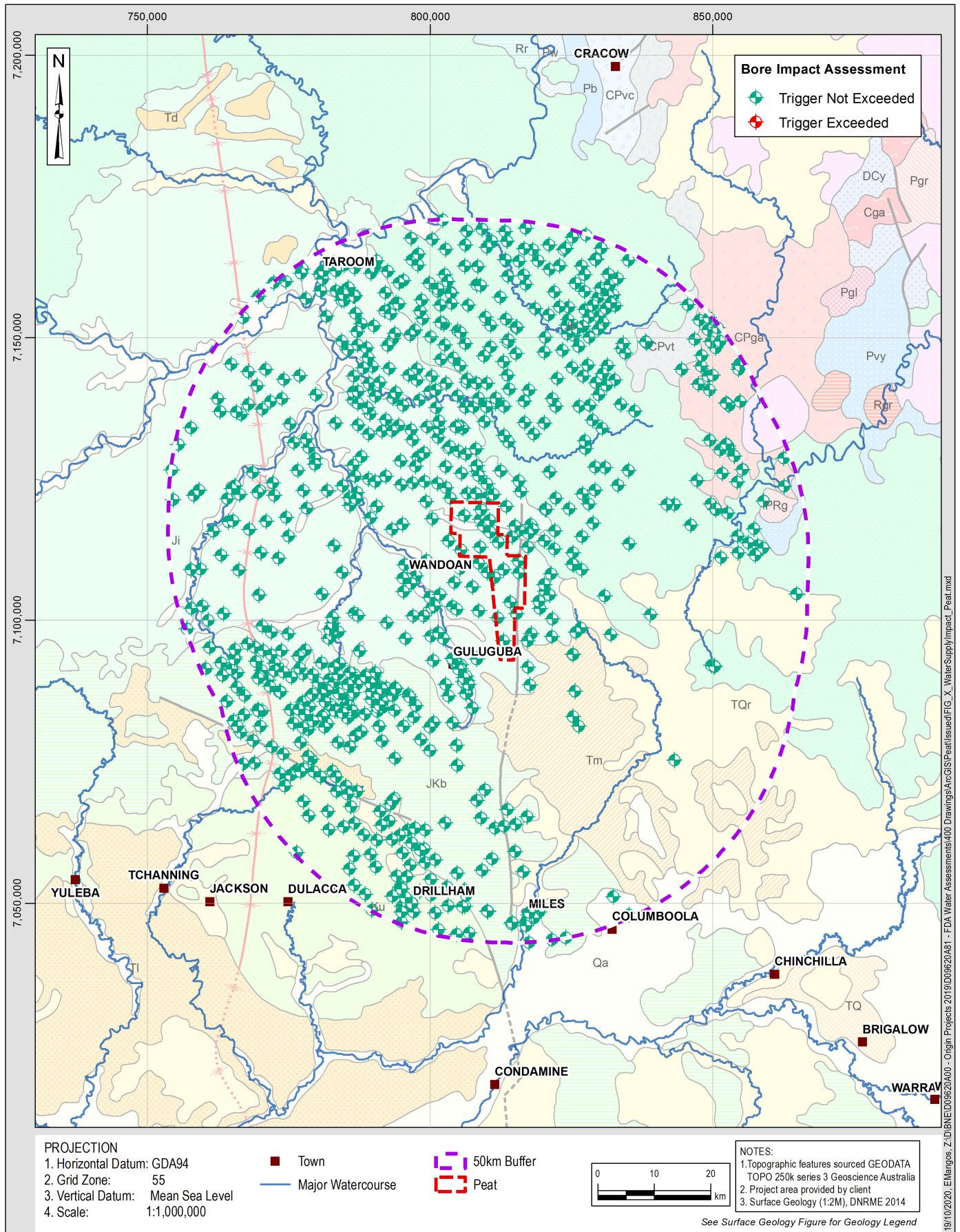
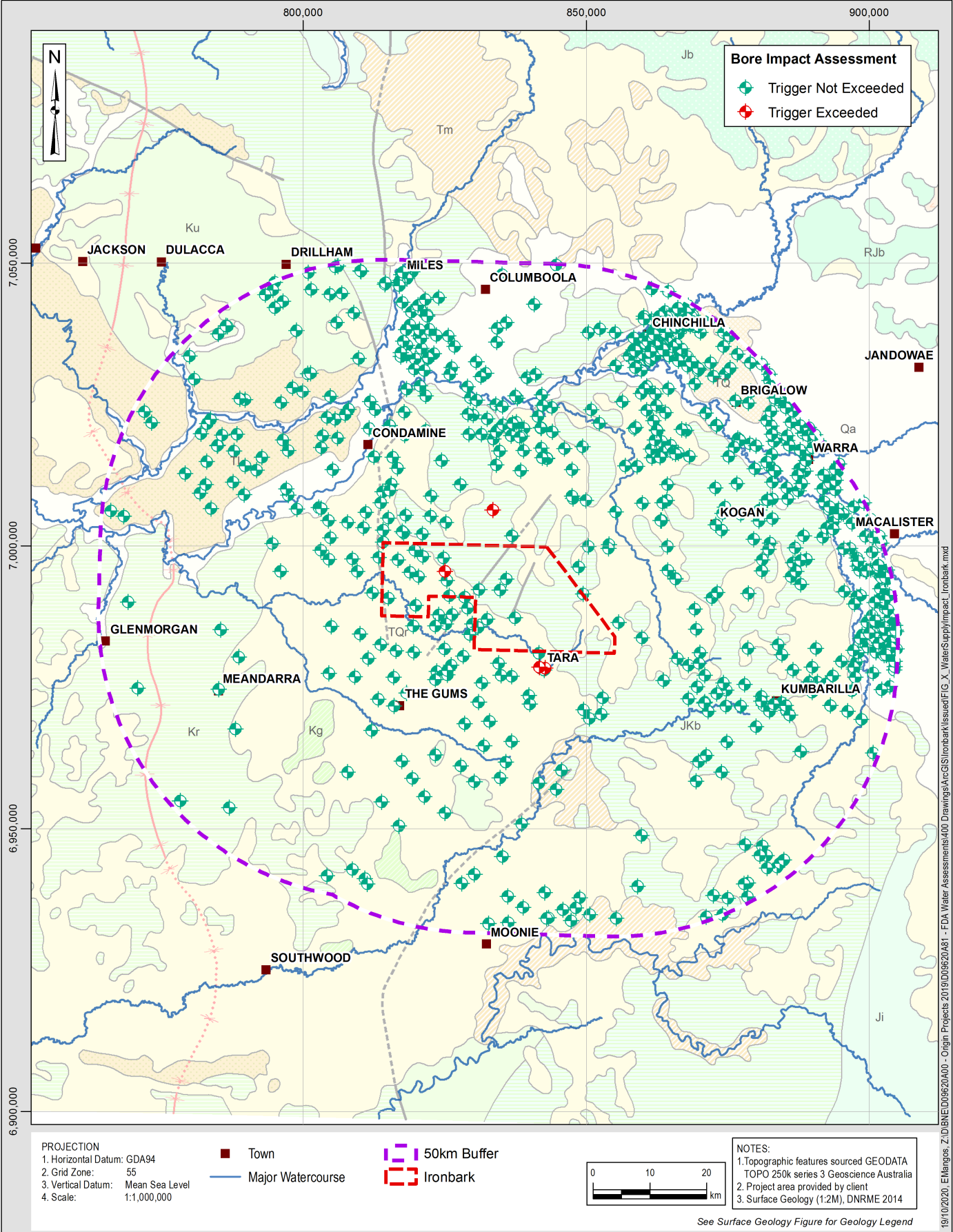


Figure 25 - Predicted Groundwater Bore Trigger Threshold Exceedances: Ironbark



#### 7.4.3.2 EPBC Act-listed springs

There are no EPBC Act-listed springs within the Project Area. Section 4.11 provides the location of the four EPBC Act-listed springs (*the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*) surrounding the Project Area. These EPBC Act-listed springs are not predicted to experience drawdown in exceedance of the 0.2 m Water Act (Qld) spring trigger threshold under the Project only modelling scenario.

Cumulative impacts to EPBC Act-listed springs are assessed in Section 7.5.2.

#### 7.4.3.3 Groundwater dependent ecosystems

For a GDE to be classified as a MNES, the EPBC Act requires that the GDE *contribute to the physical state and environmental value of the water resource*. Despite this relatively restrictive definition under the EPBC Act, GDEs are defined by the IESC (2015) as:

*“Natural ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al., 2011). The broad types of GDE are (Eamus et al., 2006):*

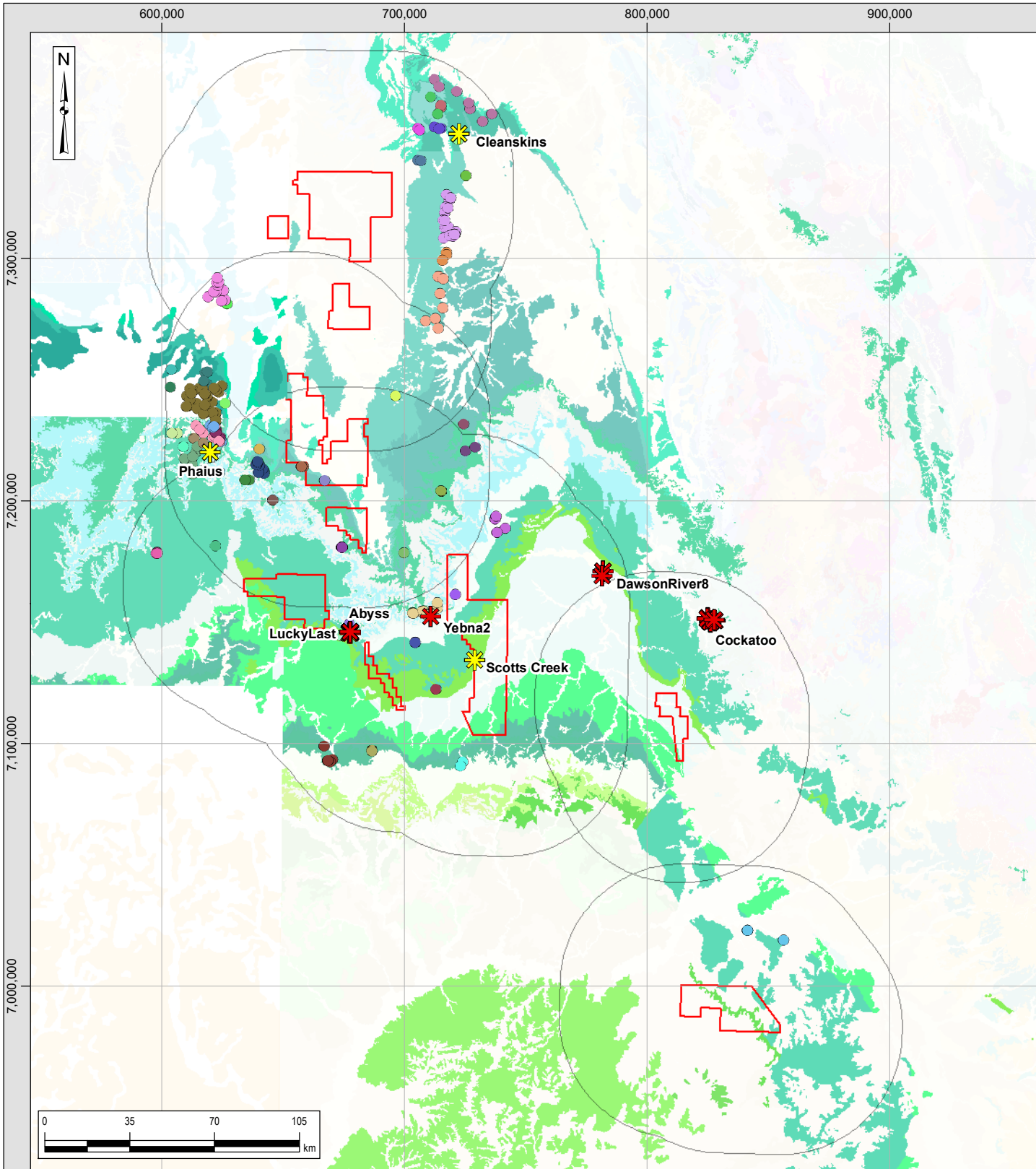
- *ecosystems dependent on surface expression of groundwater*
- *ecosystems dependent on subsurface presence of groundwater*
- *subterranean ecosystems.”*

These three classifications of GDEs are known as surface expressions GDEs, terrestrial GDEs, and subterranean GDEs as described below.

##### 7.4.3.3.1 Surface expression GDEs

Figure 26 provides the location of potential surface expression GDEs (spring vents and watercourse springs) within 50 kms of the Project Area. Drawdown at these potential surface expression GDEs is not predicted to exceed the 0.2 m Water Act (Qld) spring trigger threshold under the Project only modelling scenario.





### Legend

- EPBC Act Listed Spring
- Potential GDE Providing Habitat for EPBC Act Listed Species
- 311
- 561
- 911
- Abyss
- Aldinga
- Anchovies
- Ardurad
- Barton
- Bedourie
- Boxvale
- Carnarvon Gorge (Evergreen Formation)
- Carnarvon Gorge (Hutton Sandstone)
- Carnarvon Gorge (Precipice Sandstone)
- Carnassier
- Cleanskins
- Cockatoo
- Conom
- Crusoe
- CrystalBall
- DawsonRiver8
- Deep Earth
- Eden Vale
- Elgin
- Emailsent
- Flickit
- Gubberamunda
- Horror
- Injury

- Ital
- Kullanda
- Lonely Eddie
- LuckyLast
- Merlin
- Mimosa
- Moffat
- Moffat Basalt
- Moolayember
- Morella
- Murder
- Mussel
- Mutinery
- Newton
- Notonly
- Nugget
- Nyanda
- Phaius
- Ponies
- Rainbow Spring
- Robin
- Scotts Creek
- Sleepy
- Spring Ridge
- Springwood
- Tucker
- Wambo
- White Soaks
- Yebna
- Yebna2

### Surface Geology

- Adori Sandstone (Jia)
- Boxvale Sandstone Member (Jev/b)
- Bungil Formation (Ky)
- Clematis Group (Re)
- Eurombah Formation (Jie)
- Eurombah Formation>Tib-QLD (Jie>Tib)
- Expedition Sandstone (Ree)
- Glenidal Formation (Pbi)
- Griman Creek Formation (Kg)
- Gubberamunda Sandstone (JKig)
- Hooray Sandstone (JKyh)
- Hutton Sandstone (Jh)
- Kumbarilla Beds (JKk)
- Mooga Sandstone (Kym)
- Moolayember Formation (Rm)
- Nullawurt Sandstone Member (Kybn)
- Precipice Sandstone (Jp)
- Rewan Group (Rr)
- Springbok Sandstone (Jis)
- Surat Siltstone, Wallumbilla Formation(w)
- Westbourne Formation (Jiw)
- Project Area
- 50km Buffer

PROJECTION  
1. Horizontal Datum: GDA94  
2. Grid Zone: 55  
3. Vertical Datum: Mean Sea Level  
4. Scale: 1:2,250,000

Figure 26: Surface expression GDEs within 50 kms of the Project Area

NOTES:  
1. Topographic features sourced GEODATA  
TOPO 250k series 3 Geoscience Australia  
2. Project area provided by client  
3. Surface Geology (1:2M), DNRME 2014  
4. Detailed Surface Geology (1:250K), DNRME 2018

#### **7.4.3.3.2 Terrestrial GDEs**

The OGIA's terrestrial GDE (TGDE) risk assessment process has been adopted for the Project and enhanced using TGDE remote sensing data and ecology values applicable to the EPBC Act. This modified TGDE risk assessment process is shown on Figure 27 and includes input from the following site-specific modelling for the Project:

- OGIA Surat CMA groundwater flow model (UWIR model)
- TGDE remote sensing; and
- predictive habitat modelling.

##### ***OGIA Surat CMA Groundwater Flow Model***

In accordance with the OGIA's TGDE risk assessment process, predicted long-term drawdown of more than 1 m within layer 1 of the UWIR model (alluvium and basalt) (shown in Table 65), or aquifer outcrop areas, represents a medium or high risk of impacts to potential TGDEs accessing groundwater from these units. Rulesets for Queensland Government GDE mapping and data from the Australian Government's GDE Atlas were used to identify potential GDEs accessing groundwater from these areas of predicted drawdown. The application of these rulesets determined that the Mahalo development area is the only area containing basalt outcrop areas in the Project Area, shown on Figure 28.

##### ***TGDE remote sensing***

The IESC Explanatory Note *Assessing groundwater-dependent ecosystems* (IESC, 2019) details the process for using remote sensing data to determine the level of groundwater dependence of vegetation associated with potential TGDEs. This process involves spatial analysis of Landsat imagery taken during historically wet (2015-2016) and dry (end-2019) periods to identify vegetation change during these climatically diverse intervals.

Multi-spectral indices such as Normalised Difference Vegetation Index (NDVI) and Normalised Difference Wetness Index (NDWI) were used to track changes in vegetation greenness and wetness, respectively. TGDEs are expected to maintain higher greenness over extended dry periods as well as higher surface water content related to increased water availability in comparison to dryland, rainfall-dependent xeric vegetation.

This process was used to determine the location of possible and probable TGDEs within basalt outcrops of the Mahalo development area. As shown on Figure 28, there are no possible or potential TGDEs within the basalt outcrop areas predicted to experience more than 1 m drawdown. Accordingly, there are no TGDEs with a medium or high risk of impacts from the Project.



Figure 27: TGDE risk assessment

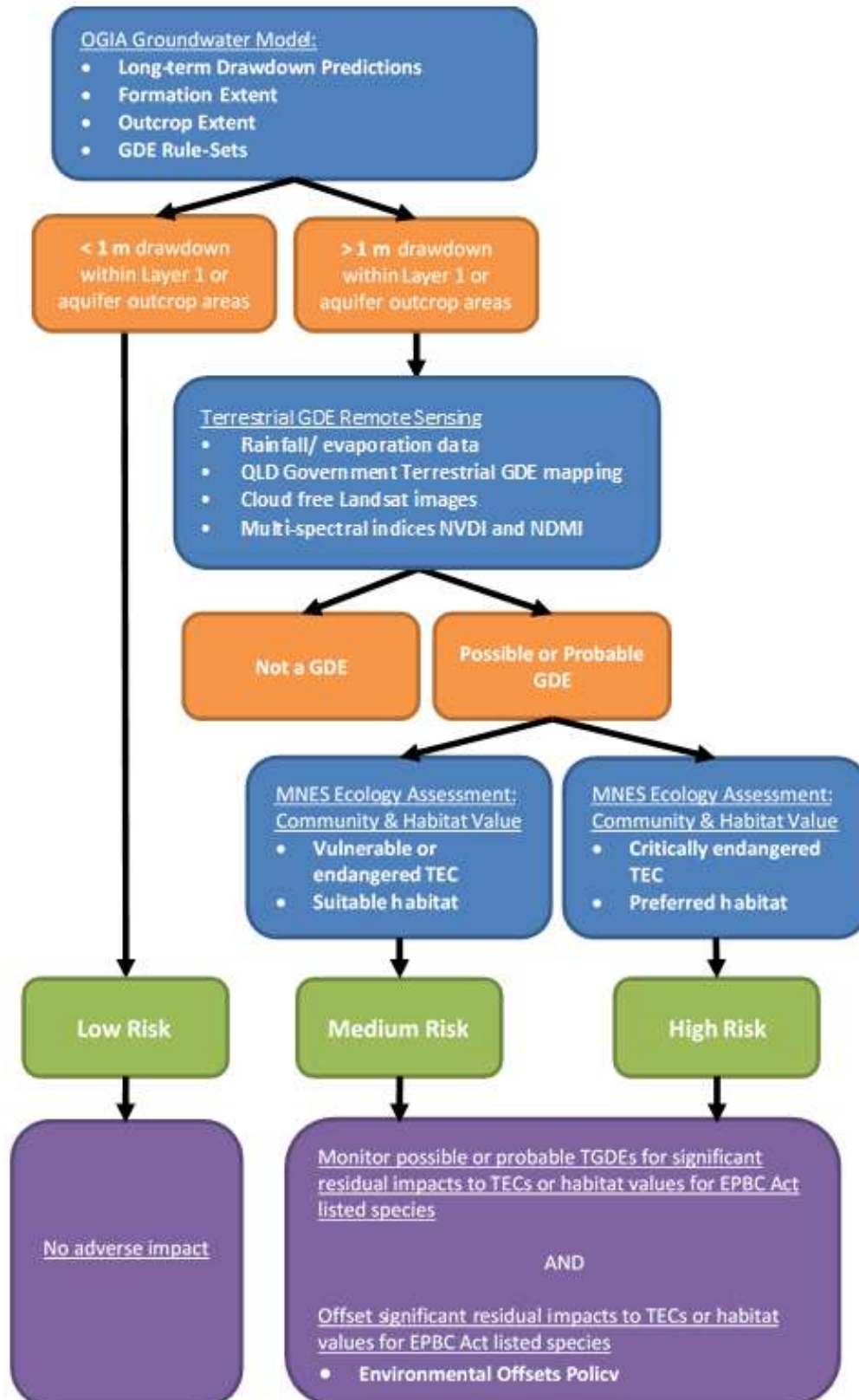
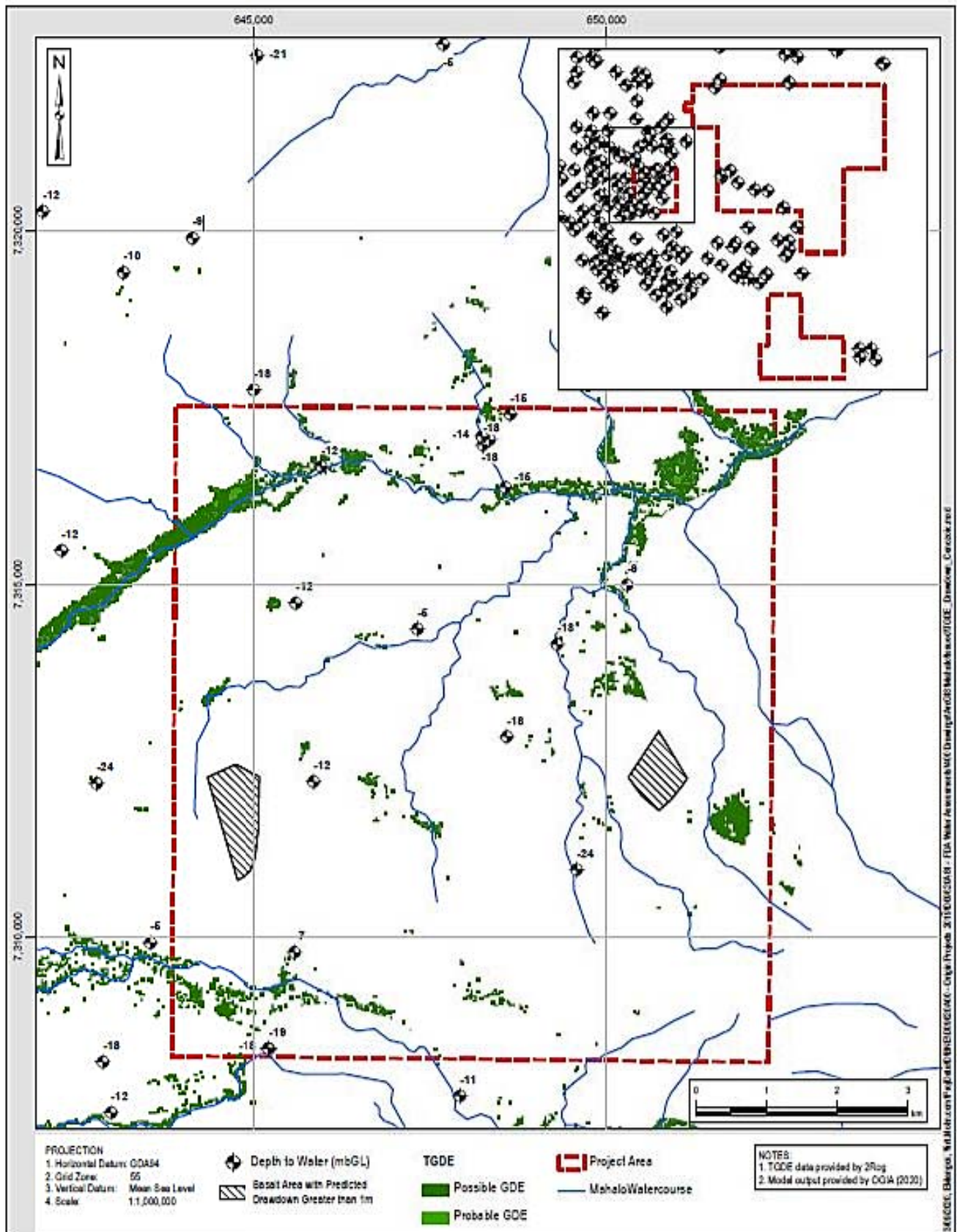


Figure 28: Potential Mahalo development area TGDEs





#### 7.4.3.3.3 Subterranean fauna

Appendix F of the IESC Explanatory Note *Assessing groundwater-dependent ecosystems* (IESC, 2019) (the Explanatory Note) provides a framework for assessing the suitability of subterranean fauna habitat based on water chemistry and aquifer conditions. The Explanatory Note identifies aquifers with shallow water tables (e.g. typically less than 20 to 30 metres below ground level [mbgl]) as providing potential habitat for subterranean fauna (stygo fauna) due to higher concentrations of organic matter and dissolved oxygen. Therefore, areas of predicted groundwater drawdown greater than 0.2 m within layer 1 of the UWIR model and aquifer outcrop areas were subject to a subterranean fauna habitat assessment.

Table 66 provides a summary of the subterranean fauna habitat assessment for layer 1 of the UWIR model and aquifer outcrop areas predicted to experience drawdown greater than 0.2 m, limited to the Mahalo, Denison and Spring Gully development areas.

**Table 66: Subterranean fauna habitat suitability assessment**

Parameter	Unit	Favourable conditions for stygo fauna habitat	Development area						
			Spring Gully/ Denison	Denison	Mahalo				
Aquifer type	-	alluvium, karst, fractured rock	Rewan Group	Lower Bowen 1	Alluvium	Cenozoic Sediments	Basalt	Rewan Group	Lower Bowen 1
Water table depth	mbGL	typically less than 20 to 30	9 to 44	n/a	9 to 26	6 to 42	5 to 26	9 to 50	3 to 57
Hydraulic conductivity/ aquifer porosity	m/day	must be greater than $8.6 \times 10^{-2}$	$5.4 \times 10^{-7}$ to $3.0 \times 10^{-2}$	$3.2 \times 10^{-6}$ to $1.2 \times 10^{-3}$	2.4 to 116	$4.6 \times 10^{-3}$ to 5.1	$1.3 \times 10^{-1}$ to 8.2	$5.4 \times 10^{-7}$ to $3.0 \times 10^{-2}$	$3.2 \times 10^{-6}$ to $1.2 \times 10^{-3}$
Salinity	$\mu\text{S/cm}$	typically less than 5,000	1,536 to 26,375	<5,000	850 to 1,500	2,028 to 8,245	810 to 1,333	1,950 to 15,500	1,040 to 1,360
Favourable conditions for stygo fauna habitat			low	low	high	moderate	high	low	low

Notes: n/a = data not available  
Dark to light colours = favourable to moderately favourable to unfavourable conditions

As shown in Table 66, highly or moderately favourable conditions for stygo fauna habitat are present in the alluvium, basalt, and cenozoic sediments within the Mahalo development area. Two distinct areas of drawdown are predicted within these units:

- Predominately cenozoic sediments with localised alluvium and basalt: maximum predicted drawdown of up to 0.6 m.
- Predominantly basalt: maximum predicted drawdown of up to 1.2 m.

The saturated thicknesses of each unit within the Project Area are approximately:

- Alluvium: 5 m to 12 m
- Cenozoic sediments: 30 m
- Basalt: 26 m to 74 m.

Given the relatively minor and temporary nature of the predicted reduction in saturated thicknesses of between 2% and 12%, the Project is not predicted to have a significant impact on subterranean fauna habitat availability.

#### 7.4.3.4 Significant impact guidelines

Table 67 and Table 68 provide an assessment of potential impacts against the significant impact criteria listed in the *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources* (DoE, 2013b).

**Table 67: Significant impact assessment: changes to hydrological characteristics**

Parameter	Comments
Flow regime (volume, timing, duration, and frequency of surface water flows)	<p>While the Project will utilise existing and approved water management infrastructure authorised under the EPBC Act (e.g. EPBC 2009/4974), the Project does not propose any new or additional authorisations for discharge to, or abstraction from, surface water systems. Notwithstanding minor/ localised erosion and sediment controls, the Project does not include the interception or diversion of surface water flows.</p> <p>Non-linear infrastructure would not be constructed within watercourses in the Project Area. Linear infrastructure (e.g. pipelines and access tracks) would be constructed in accordance with the 'Accepted development requirements for operational work that is constructing or raising waterway barrier works' under the Qld <i>Fisheries Act 1994</i> and <i>Planning Act 2016</i>.</p> <p>No changes to the flow regime have been identified as a result of the Project; therefore, potential impacts to the flow regime are not anticipated.</p>
Recharge rates to groundwater	<p>Some parts of the Project are located in an area where Alluvium, Cenozoic sediments, and Basalts, as well as a number of Surat Basin and Bowen Basin units' outcrop at surface. These outcrop areas are considered to be the location where diffuse rainfall recharge occurs. It is unlikely that recharge rates will be significantly modified as a result of Project activities given the small footprint of infrastructure relative to the recharge area and existing rehabilitation requirements of EAs for the Project.</p>
<p>Aquifer pressure or pressure relationship between aquifers.</p> <p>Groundwater table and potentiometric surface levels</p> <p>Inter-aquifer connectivity</p>	<p>Water production for the Project is predominantly from the coal seams of the Walloon Coal Measures, Bandanna Formation, Baralaba Coal Measures, and Reids Dome Beds. In order to produce gas, the formation pressure must be reduced, which as a result may induce leakage into the formation from overlying or underlying formations.</p> <p>Outputs from the UWIR model simulating gas production from the Project predicted the greatest groundwater pressure declines in the target gas producing Walloon Coal Measures and Bandanna Formation (and equivalent Baralaba Coal Measures). In the Ironbark development area, where the target coal seam is the Walloon Coal Measures, the overlying Westbourne Formation aquitard and the underlying Eurombah Formation aquitard are effective at restricting drawdowns greater than 5 m (consolidated Water Act (Qld) bore trigger threshold) in the surrounding aquifers (i.e. Gubberamunda Sandstone and Hutton Sandstone). In the Peat, Spring Gully (A, B, and C blocks), Denison, and Mahalo development areas, where the target coal seam is the Bandanna Formation (or equivalent Baralaba Coal Measures), the overlying Rewan Group is effective at restricting drawdown greater than 5 m (consolidated Water Act (Qld) bore trigger threshold) in the overlying aquifer (i.e. Clematis Group). Based on the magnitude of drawdown predicted, there is limited potential for a significant change in the pressure relationship between the target coal seams and the overlying and underlying aquifers.</p> <p>The UWIR model was not used to simulate gas production from the Reids Dome Beds in the Spring Gully (Block D) development area; however, potential drawdown in surrounding formations are anticipated to be minimal due to the low interpreted permeabilities of the Back Creek Group and lack of continuity between the water bearing units.</p> <p>All production wells will be designed, constructed, operated and decommissioned in accordance with the <i>Code of Practice for the construction and abandonment of petroleum wells and associated bores in Queensland</i>. This code outlines the mandatory requirements to reduce the risk of environmental harm throughout the drilling process from overlying aquifers.</p>



Parameter	Comments
	Therefore, potential impacts from the Project to inter-aquifer connectivity are not considered significant.
Surface water-groundwater interactions  River-floodplain connectivity	Groundwater and surface water interactions are unlikely to be affected given that most watercourses in the Project Area are ephemeral and streamflow only occurs following rainfall events.  Modelling outputs from the UWIR did not predict drawdown greater than 0.2 m at any of the watercourse springs.  Water production for the Project is limited to the coal seams of the Walloon Coal Measures, Baralaba Coal Measures, Bandanna Formation, and Reids Dome Beds. While the Project will utilise existing and approved water management infrastructure authorised under the EPBC Act (e.g. EPBC 2009/4974), the Project does not propose any new or additional abstraction from, or discharge to, surface water systems. Groundwater abstracted as a result of gas production from the Project will be managed in accordance with the Produced Water Management Plan (Appendix G).
Coastal processes	The Project is located in central Queensland. Given the distance to the coast and minimal potential impacts to surface water from the Project, changes to coastal processes will not occur.

**Table 68: Significant impact assessment: changes to water quality**

Parameter	Comments
Create risks to human or animal health or to the condition of the natural environment as a result of the change in water quality	Changes to groundwater or surface water quality as a result of water production associated with the Project are not anticipated.  Produced water will be stored in tanks or dams, which will be designed, constructed, and operated in accordance with the conditions of EAs for the Project and relevant guidelines such as the <i>Manual for assessing consequence categories and hydraulic performance of structures</i> (Department of Environment and Science, 2016a) and <i>Structures which are dams or levees constructed as part of environmentally relevant activities</i> (Department of Environment and Science, 2019c).  Produced water for beneficial use will be fit for purpose and in compliance with existing Queensland regulatory requirements, including the conditions of the EAs for the Project and end of waste codes under the WRR Act. Conditions of these approvals provide water management requirements including compliance with ANZECC water quality limits for stock and irrigation uses.  Wells will be designed, constructed, operated and decommissioned in accordance with the <i>Code of Practice for the construction and abandonment of coal seam gas and petroleum wells and associated bores in Queensland</i> (DNRME, 2019). This code outlines the mandatory requirements to reduce the risk of environmental harm throughout the drilling process from overlying aquifers.  Given predicted impacts from the Project and implementation of management measures, it is not likely that the Project would result in a risk to human or animal health, or to the condition of the environment as a result of a change in water quality.
Substantially reduces the amount of water available for human consumptive uses	Groundwater within the vicinity of the Project is utilised by a number of third-party users, with stock and domestic use being the most commonly recorded purpose. Drawdown of a significant magnitude is limited to the gas

Parameter	Comments
or for other uses, including environmental uses which are dependent on water of the appropriate quality	<p>targets of the Walloon Coal Measures and Bandanna Formation (and equivalent Baralaba Coal Measures). There are three groundwater bores potentially accessing the Walloon Coal Measures and five groundwater bores potentially accessing the Bandanna Formation that have been predicted to experience a water level decline greater than the trigger threshold of 5 m.</p> <p>There are also two bores attributed to the Rewan Group and one bore attributed to the Springbok Sandstone that are predicted to exceed this threshold. Baseline assessments (including determining groundwater source) will be undertaken at these bores and a make good agreement will be implemented in accordance with the Water Act (Qld) as required. Therefore, impacts to existing groundwater users are considered unlikely. Impacts to EPBC Act-listed springs as well as other potential surface expression GDEs as a result of gas production from the Project are considered unlikely based on the predicted magnitude and extent of drawdown in the hydrostratigraphic units that potentially provide groundwater to the springs.</p> <p>No possible or probable TGDEs were identified in areas predicted to experience drawdown greater than 1 m within layer 1 of the UWIR model (alluvium and basalt) or aquifer outcrop areas. Therefore, TGDEs have a low risk of impact from potential groundwater drawdown for the Project.</p> <p>Water supply for surface expression GDEs is not anticipated to be significantly impacted as groundwater drawdown as a result of gas production from the Project is not predicted to be greater than 0.2 m at any of the watercourse springs (i.e. baseflow-fed sections of watercourses).</p> <p>The peak produced water rate for the Project of approximately 6 GL/year represents approximately 10% of the annual amount of groundwater produced by the petroleum industry in the Surat CMA (60 GL/year as calculated by OGIA in the 2019 UWIR and approximately 4% of the annual amount of groundwater produced by non-petroleum groundwater use (largely non stock and domestic uses such as irrigation)) in the Surat CMA (164 GL/year as calculated by OGIA in the 2019 UWIR). It is therefore not anticipated that the Project would substantially reduce the amount of water available or impact the water quality.</p>
Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment	<p>Produced water and water management by-products will be stored in tanks or dams, which will be designed, constructed, and operated in accordance with the conditions of EAs for the Project and relevant guidelines such as the <i>Manual for assessing consequence categories and hydraulic performance of structures</i> (Department of Environment and Science, 2016a) and <i>Structures which are dams or levees constructed as part of environmentally relevant activities</i> (Department of Environment and Science, 2019c).</p> <p>Produced water for beneficial use will be fit for purpose and comply with existing Queensland regulatory requirements, including the conditions of the EAs for the Project and end of waste codes under the WRR Act. Conditions of these approvals provide water management requirements including compliance with ANZECC water quality limits for stock and irrigation uses.</p> <p>Water management by-products will be disposed offsite at a regulated waste facility authorised under the EP Act.</p> <p>Fuel and chemicals used during construction and operation will be stored and handled in accordance with the relevant Australian Standards (e.g. AS 3780:2008, AS 1940:2004, AS 3833:2007) and regulatory requirements, including EAs for the Project.</p> <p>Hydraulic stimulation and drilling fluids comprise typically low toxicity and inert substances that are broadly used throughout the petroleum and gas industry in Australia, with many also utilised for the drilling of water bores.</p>



Parameter	Comments
	<p>Potential risks of exposure to these fluids is considered unlikely given implementation of existing legislative and approval requirements.</p> <p>All wells will be designed, constructed, operated and decommissioned in accordance with <i>Code of Practice for the construction and abandonment of coal seam gas and petroleum wells and associated bores in Queensland</i>. This code outlines the mandatory requirements to reduce the risk of environmental harm. Wells will be designed to prevent any interconnection between target hydrocarbon bearing formations and aquifers, ensure that gas is contained within the well and associated pipework and equipment without leakage, ensure zonal isolation between different aquifers is achieved, and not introduce substances that may cause environmental harm.</p> <p>Given existing regulatory requirements and proposed management measures, the Project is unlikely to introduce organic chemicals, heavy metals, salt, or other potentially harmful substances to the environment.</p>
Seriously affects the habitat or lifecycle of a native species dependent on a water resource	<p>Surface water availability for native species is not anticipated to be significantly impacted, as the majority of watercourses in the Project Area are ephemeral and streamflow typically only occurs following rainfall events. In addition, groundwater drawdown for the Project is not predicted to be greater than 0.2 m at any of the watercourse springs (i.e. baseflow-fed sections of watercourses).</p> <p>No significant changes to groundwater or surface water quality are expected as a result of the Project given implementation of regulatory requirements and management measures. Therefore, no significant changes to habitat or lifecycle of a native species dependent on a water resource are expected.</p>
Causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource	<p>No significant changes to groundwater and surface water quality are expected as a result of the Project. Therefore, the Project is unlikely to cause the establishment of an invasive species (or the spread of an existing invasive species) given implementation of regulatory requirements such as weed, pest, and hygiene controls in accordance with obligations under the Queensland <i>Biosecurity Act 2014</i>, including meeting the risk minimisation requirements of the DAF Queensland Biosecurity Manual (Department of Agriculture and Fisheries, 2019).</p>
There is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives)	<p>Groundwater quality data indicates that groundwater in the Project Area generally has a distinct sodium-bicarbonate, sodium-magnesium-bicarbonate, or sodium-chloride signature water type, irrespective of the hydrostratigraphic unit.</p> <p>While the Project will utilise existing and approved water management infrastructure authorised under the EPBC Act (e.g. EPBC 2009/4974), the Project does not propose any new or additional abstraction from, or discharge to, surface water systems.</p> <p>No significant changes to groundwater or surface water quality are expected as a result of the Project given the implementation of management measures. Therefore, no significant worsening of local water quality is anticipated as a result of the Project.</p>
High quality water is released into an ecosystem which is adapted to a lower quality of water	<p>Produced water will be stored in tanks or dams, which will be designed, constructed, and operated in accordance with EA conditions for each development area and relevant guidelines such as the <i>Manual for assessing consequence categories and hydraulic performance of structures</i> (Department of Environment and Science, 2016a) and <i>Structures which are dams or levees constructed as part of environmentally relevant activities</i> (Department of Environment and Science, 2019c).</p>

Parameter	Comments
	<p>Produced water for beneficial use will be fit for purpose and comply with existing Queensland regulatory requirements, including EA conditions and EoW codes under the WRR Act. Conditions of these approvals provide water management requirements including compliance with ANZECC water quality limits for stock and irrigation uses.</p> <p>While the Project will utilise existing and approved water management infrastructure authorised under the EPBC Act (e.g. EPBC 2009/4974), the Project does not propose any new or additional authorisations for discharge to, or abstraction from, surface water systems. As such no changes to ecosystem water qualities are anticipated.</p>

## 7.5 Cumulative impacts

### 7.5.1 Threatened species and TECs

As described in Section 7.2.1, vegetation and habitat clearing are key impact pathways via which threatened species and TECs may be adversely impacted by the Project. Other impacts are possible and will be addressed in line with best practise management and mitigation measures and as required by EA conditions and other relevant permits. Similarly, threatened species and TECs in the region of the Project may also be affected by other projects - primarily via loss of vegetation and habitat as a result of construction activities. In this way, the combined suite of projects has the potential to result in cumulative impacts to values that are more significant than when projects are considered individually.

This chapter provides a cumulative impact assessment (CIA) of impacts from the Project in the context of other gas projects in the region. Cumulative impacts in the region of the Project have been previously assessed in detail in a number of prior project assessments. These provide a baseline of information on cumulative impacts to ecological values that can be further built upon as part of this assessment. Key 'baseline' resources include:

- Santos Limited Gas Field Development Project EIS CIA (Santos GLNG, 2014)
- Australia Pacific LNG EIS CIA (Australia Pacific LNG, 2010)
- Senex Western Surat Gas Project Public Environment Report (PER) (Senex Energy Limited, 2018).

The approach of these assessments was to consider a range of projects that could be considered 'reasonably foreseeable' in that they were under assessment at the time of the CIA. Only projects of an appropriate size for which publicly available information is available was included in the CIA, this involved projects that are subject to assessment under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) (Qld) or the EP Act (Qld).

For consistency, this assessment has utilised previous CIAs as a baseline, updated for any new projects and then contextualised the potential impacts from the Project against the cumulative totals. In order to further account for habitat loss since previous studies were undertaken, a suite of new spatial analysis has been undertaken to determine the extent of ecological values remaining in the CIA study area. This included using the latest version of RE and MSES mapping to determine the extent of vegetation and essential habitat currently mapped as present by the Queensland Government. Recent versions of these spatial data will have included habitat lost since the original CIAs were undertaken.

Projects included in the CIA baseline included 26 major projects including the major gas field developments that lie in closest proximity to the Project; i.e. Gladstone LNG Project, Australia Pacific LNG Project and Queensland Curtis LNG (refer Santos GLNG (2014)), as well as five other projects that have been assessed primarily under the EPBC Act (refer Senex Energy Limited (2018)).

A contemporary review of the relevant Queensland Government major projects and EPBC Act referrals that have been assessed since 2018 or are currently under assessment was undertaken. There were no new major projects being assessed by EIS under Queensland legislation and only three relevant EPBC Act referrals, including:

- EPBC2019/8276 Surat North CSG Project - controlled action
- EPBC2019/8581 Derrillo Irrigation Project near Springsure - controlled action with potential impact to Grasslands TEC
- EPBC2019/8534 Mahalo Development Area CSG Project - not a controlled action.

Importantly, a number of the projects included in the baseline assessment have not commenced construction. This results in a conservative estimate of the potential cumulative vegetation/habitat loss. Similarly, a number of projects have not completed construction and nevertheless continue to be accounted for in the cumulative totals. This provides a robust understanding of the recent historical clearing within the CIA study area over the previous decade.

In order to apply a consistent approach across the baseline to the present, the assessment of values has focused on:

- vegetation, as represented by endangered and of concern REs
- essential habitat, as represented on the Queensland regulated vegetation mapping
- wetlands of general ecological significance (GES), as mapped under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (Qld)
- TECs, as listed under the EPBC Act.

Using this approach, the cumulative impacts to vegetation, mapped essential habitat and GES wetlands have been used as a proxy to understand the potential cumulative impacts on threatened flora and fauna, which may use these areas as habitat. This assessment only takes account of known and foreseeable actions and does not account for ongoing activities that are not readily reported such as forestry and agriculture activities that are responsible for the majority of clearing within the bioregion.

The potential impact calculations for the Project were determined using a randomly selected static gas field design, and as such are considered indicative but within an order of magnitude to the likely final impact and therefore are appropriate to be used in a cumulative calculation.

It should be noted that cumulative impacts to two TECs that may be impacted by the Project were not included in the CIA:

- Poplar Box TEC was listed in mid-2019 and therefore was not addressed in the baseline cumulative assessment.
- Weeping Myall TEC was also omitted from the CIA as there appears to be inconsistency in the area calculations of this TEC. The baseline cumulative analysis reports a higher potential cumulative impact of ~36,000 ha compared to the extent both the bioregional analysis undertaken for this Project (~21,000 ha) and the 2009 TEC listing advice (~31,000 ha) suggests currently exists in the Brigalow Belt.

Results of the CIA are provided in Table 69. Overall, the results demonstrate a cumulative impact of major project development in the Brigalow Belt Bioregion of <5% for most values. Importantly, the contribution of the Project to that cumulative total is consistently small, with the Project contributing <1.5% of the total cumulative impact for all values, with the exception of Brigalow TEC, where the value is just below 3%.



Table 69: Terrestrial MNES cumulative impact summary

Environmental value	Total at baseline - 2014 (ha)	Additional impacts from projects post-2014 (ha)*	Additional impacts from Project (ha)	Available in bioregion (ha)	Total cumulative impact (ha)	Total cumulative as % of bioregion	Project contribution to cumulative (%)
<b>Environmental values - proxy for threatened species habitats</b>							
Endangered REs	21,300	ND	526	1,222,646	21,826	1.79%	2.41%
Of concern REs	61,652	ND	809	3,271,839	62,461	1.91%	1.30%
Essential habitat	9,798	ND	347	1,269,345	10,145	0.80%	3.42%
GES wetlands	8,308	ND	133	628,449	8,441	1.34%	1.58%
<b>TECs</b>							
Brigalow TEC	20,646	28	189	576,963	20,863	3.62%	0.91%
Coolabah TEC	7,696	0	133	172,854	7,829	4.53%	1.70%
Natural Grassland TEC	14,354	92	47	231,045	14,493	6.27%	0.32%
SEVT	11,656	5	44	81,498	11,705	14.36%	0.38%

\* Includes all projects listed in Senex Energy Limited (2018) and those listed above

ND - no data available, however given the scale of projects and mitigation measures implemented, values are expected to be low and therefore make minimal contribution to the cumulative total

### 7.5.2 Water resources

Operational and proposed gas projects are located adjacent to the Denison, Spring Gully, Peat and Ironbark development areas. Groundwater production from these surrounding resource projects may result in varying degrees of cumulative drawdown. The Water Act (Qld) obliges the OGIA to model the cumulative impacts on water level drawdown associated with resource tenure holders exercising their underground water rights within the Surat CMA.

A cumulative drawdown scenario, inclusive of proposed production for the Project, has been simulated by the OGIA using the regional groundwater flow model for the Surat CMA.

#### Groundwater Bores

Cumulative drawdown from the Project and surrounding resource projects results in 13 bores predicted to exceed the Water Act (Qld) bore trigger thresholds that were not predicted to exceed the trigger thresholds based on the 2019 Surat CMA UWIR. The two additional bores (compared to the Project only modelling predictions) are located proximal to the Spring Gully and Denison development areas and are recorded as sourcing water from the typically unproductive Rewan Group aquitard.

### ***EPBC Act-listed Springs***

Modelled cumulative groundwater level drawdown is predicted to exceed 0.2 m threshold at the following EPBC Act-listed spring complexes surrounding the Project Area:

- Cockatoo
- LuckyLast
- Yebna2

OGIA has previously predicted cumulative groundwater drawdown at these EPBC Act listed springs in exceedance of the Water Act (Qld) spring trigger of 0.2m in the absence of the Project as documented in the 2019 UWIR. OGIA have allocated responsible tenure holder obligations for these EPBC Act listed springs as detailed below.

#### **Cockatoo**

The Cockatoo spring complex is located 19 km northeast of the Scotia gas field (Santos Limited) and 32 km northeast of the Peat development area. While predicted Project-only drawdown at the Cockatoo spring complex was -0.02 m, cumulative drawdown of -0.4 m was predicted.

This cumulative drawdown is similar to what was predicted in the 2019 UWIR (0.3 m to 0.5 m), with drawdown greater than 0.2 m expected in approximately 8 to 12 years. OGIA noted that pressure responses from reinjection activities by Origin are expected to delay predicted drawdown at this location.

The Project is predicted to contribute approximately 4% to the cumulative drawdown at the Cockatoo spring complex. In the 2019 UWIR (OGIA, 2019b), Santos is listed as the responsible tenure holder for this complex and is therefore required to prepare a mitigation plan. In addition, OGIA intend to undertake further hydrogeological studies to improve understanding of impact propagation at the Cockatoo spring complex.

#### **LuckyLast**

The LuckyLast spring complex is located within the Fairview gas field (Santos Limited). Predicted Project-only drawdown at this spring complex is 0.03 m; however, the cumulative drawdown was predicted to be 0.3 m. The UWIR model predicted a similar cumulative drawdown of 0.2 m to 0.4 m, with drawdowns greater than 0.2 m in less than 4 years. OGIA (2019a) noted that pressure responses from reinjection activities by Origin are expected to delay predicted drawdown at this location.

The Project is predicted to contribute approximately 8% to the cumulative drawdown at the LuckyLast spring complex. In the 2019 UWIR (OGIA, 2019b), Santos is listed as the responsible tenure holder for this complex and is therefore required to prepare a mitigation plan.

#### **Yebna2**

The Yebna2 complex is located in the Fairview gas field (Santos Limited). While predicted Project-only drawdown at the Yebna2 spring complex is -0.01 m, cumulative drawdown of -0.6 m was predicted. This cumulative drawdown is similar to what was predicted in the 2019 UWIR (0.5 m to 0.7 m), with drawdowns greater than 0.2 m expected in approximately 1 to 3 years. OGIA noted that pressure responses from reinjection activities by Origin are expected to delay predicted drawdown at this location.

The Project is predicted to contribute approximately 3% to the cumulative drawdown at the Yebna2 spring complex. In the 2019 UWIR (OGIA, 2019b), Santos is listed as the responsible tenure holder for this complex and is therefore required to prepare a mitigation plan.

### ***Potential Surface Expression GDEs***

Cumulative drawdown at some potential surface expression GDEs is predicted to exceed the 0.2 m Water Act (Qld) threshold. Table 70 shows the Project's contribution to predicted cumulative groundwater drawdown at these potential surface expression GDEs.

**Table 70: Predicted cumulative drawdown at potential surface expression GDEs**

Potential surface expression GDEs	Project contribution to cumulative drawdown
311	3%
Spring Rock Creek	4%
Barton	0%
Lonely Eddie	9%
Wambo	1%
Blyth Creek (W10)	0%
Barton Creek (W166)	0%
Boyd Creek (W179)	3%
Cave Gully (W185)	12%
Christmas Creek (W187)	4%
Dogwood Creek (W203)	0%
Horse Creek (W215)	0%
Hutton Creek (W217)	3%
L Tree Creek (W224)	0%
North Branch (W239)	13%
Robinson Creek (W251)	0%
Sardine Creek (W261)	15%
Spring Creek (W265)	3%
Sugarloaf Creek (W267)	0%
Unnamed Creek (W274)	2%
Cockatoo Creek (W28)	4%
Dawson River (W40)	3%
Horse Creek (East Branch) (W77)	0%
Horse Creek (East Branch) Tributary (W78)	0%
Horse Creek (East Branch) Tributary (W79)	0%
Hutton Creek (W81)	3%



Given the relatively minor Project contribution to predicted cumulative groundwater drawdown at these surface expression GDEs of 0% to 9% for spring complexes and 0% to 15% for watercourse springs, and the Water Act (Qld) framework for assigning responsible tenure holder obligations via the Surat CMA UWIR, these surface expression GDEs would not be significantly impacted by the Project.

### ***Terrestrial GDEs***

Cumulative drawdown modelling does not result in medium or high risk of impacts to potential TGDEs. As described in Section 1.1.1.1.1, potential TGDEs accessing groundwater from areas of predicted drawdown greater than 1 m are limited to basalt outcrop areas within the Mahalo development area, with minimal cumulative drawdown predicted from other resource projects.

### ***Subterranean GDEs***

Cumulative drawdown modelling does not result in a significant change to the habitat suitability assessment provided in Section 7.4.3.3.3. Areas of medium or high habitat suitability for subterranean fauna area limited to the Mahalo development area with minimal cumulative drawdown predicted from other resource projects.

## **7.6 Greenhouse gas emissions**

### **7.6.1 Description of the environment**

Greenhouse gases (GHGs) such as water vapour, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and ozone (O<sub>3</sub>) are naturally present in the Earth's atmosphere. Anthropogenic activities such as combustion of fossil fuels and agricultural activity add GHGs to the atmosphere.

The Project is located in a predominantly rural, agricultural and sparsely populated areas, with GHG emissions occurring in the region as a result of:

- emissions from resource activities and infrastructure
- emissions from agricultural activities such as livestock or burning of crop residues; and
- natural seepage of methane from gas reservoirs to the surface.

There are three categories for defining GHG emissions:

- Scope 1 - emissions released to the atmosphere as a direct result of an activity
- Scope 2 - emissions released to the atmosphere from the indirect consumption of electricity
- Scope 3 - indirect emissions other than Scope 2 that occur because of the activity but not from sources owned or controlled by that business.

Under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) (Commonwealth), the Project will be required to report on Scope 1 (direct) and Scope 2 (indirect) emissions in tonnes of carbon dioxide- equivalent (CO<sub>2</sub>-e). The GHG emissions inventory for the Project is provided in Appendix J.

### **7.6.2 Impact assessment**

#### **7.6.2.1 Direct (Scope 1) greenhouse gas emissions**

During construction, the main sources of GHG emissions include fuel use associated with power generation and vehicles, land clearing, drilling of wells and flaring during well completion. Sources of GHG emissions associated with the operational phase include fuel use associated with power generation and vehicles, flaring and venting of gas during well operation and fugitive emissions from wells.

For Scope 1 emission sources during 20 years of construction of the Project, well drilling accounts for 44.0% of GHG emissions, with land clearing and flaring during well completions contributing 28.2% and 16.4%, respectively. For Scope 1 emission sources for operations, the highest emission sources are diesel and gas combustion used to generate power for operation of the combined facilities.

Total Scope 1 GHG emissions for the Project (construction and operation) are estimated to be 42.0 Mt CO<sub>2</sub>-e over the anticipated lifetime of the Project. Of this total, predominant Scope 1 emission sources (representing 91.8% of Scope 1 emissions) are:

- combustion of diesel to power combined gas processing and water management facilities (36.6%)
- combustion of gas to power combined gas processing and water management facilities (26.9%)
- combustion of gas to power wellheads (16.2%)
- flaring during operation (12.1%).

GHG emissions will be further reduced by sequestration following re-establishment of vegetation within cleared areas following construction and at decommissioning in later years of the Project's lifetime.

The GHG emissions inventory for the Project is provided in Appendix J.

### **7.6.2.2 Indirect (Scope 2) greenhouse gas emissions**

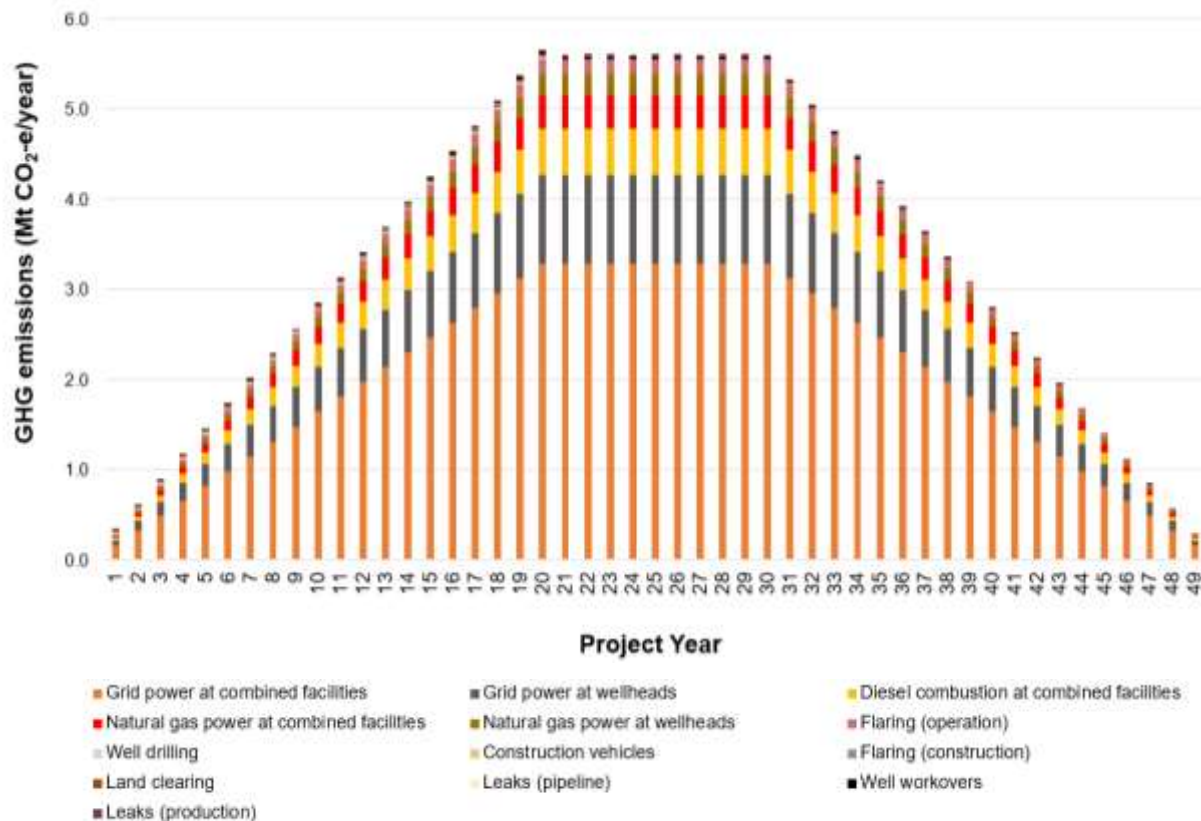
Total Scope 2 GHG emissions for the Project are calculated to be 128.1 Mt CO<sub>2</sub>-e over the anticipated lifetime of the Project. Grid power used for the operation of combined facilities is the highest emission source, representing 76.9% (98.6 Mt CO<sub>2</sub>-e) of Scope 2 emissions. Grid power for the operation of well heads represents 23.1% (29.6 Mt CO<sub>2</sub>-e) of Scope 2 emissions.

Scope 2 emissions are expected to be greater than Scope 1 emissions. With a likely increase in renewable energy sources in the Queensland energy supply sector, Scope 2 emissions are expected to decrease in future years, which would in turn decrease the estimated future Scope 2 GHG emissions from the Project.

### **7.6.2.3 Project life greenhouse gas emissions**

GHG emissions are estimated to increase until end of construction (Project year 20) when emissions stabilise. Emissions then decline from Project year 30 onwards with decommissioning of wells at the end of their production life. The corresponding GHG emissions profile for the anticipated construction and operation of the Project is illustrated in Figure 29.

**Figure 29: Annual cumulative (Scope 1 and Scope 2) greenhouse gas emissions**



The largest GHG emission source is grid electricity consumption to power combined facilities and wellheads estimated to account for 58.2% and 17.5% respectively of GHG emissions over the estimated operational life of the Project as shown in Table 71. A significant reduction in GHG emissions will be realised through improvement in electricity grid emissions intensity and sequestration of CO<sub>2</sub> as a result of revegetation of cleared areas following construction and at decommissioning, although the latter is not currently captured in the GHG inventory and reporting. Further reduction in GHG emissions will be realised through Origin's Objectives for Action on Climate Change (refer to section 7.6.2.5)

**Table 71: Estimated total GHG emissions for the Project**

Emissions scope	Source	Operational Life of Project		Peak year (Project year 20)	
		GHG emissions (Mt CO <sub>2</sub> -e)	Percentage contribution	GHG emissions (Mt CO <sub>2</sub> -e)	Percentage contribution
Scope 1	Construction vehicles	0.125	0.1%	0.006	0.1%
	Well drilling	0.287	0.2%	0.014	0.3%
	Flaring (construction)	0.253	0.1%	0.013	0.2%
	Land clearing	0.435	0.3%	0.022	0.4%



Emissions scope	Source	Operational Life of Project		Peak year (Project year 20)	
		GHG emissions (Mt CO <sub>2</sub> -e)	Percentage contribution	GHG emissions (Mt CO <sub>2</sub> -e)	Percentage contribution
	Gas power at wellheads	6.784	4.0%	0.226	4.0%
	Gas power at combined facilities	11.307	6.7%	0.377	6.7%
	Diesel combustion at combined facilities	15.374	9.1%	0.512	9.1%
	Flaring (operation)	5.061	3.0%	0.169	3.0%
	Well workovers	0.614	0.4%	0.020	0.4%
	Leaks from production and processing	0.783	0.5%	0.026	0.5%
	Leaks from high-pressure pipeline	0.164	0.1%	0.005	0.1%
Scope 2	Grid power at wellheads	29.565	17.5%	0.986	17.4%
	Grid power at combined facilities	98.550	58.2%	3.285	58.0%
Total		169.302		5.661	

#### 7.6.2.4 Assessment of potential impacts of greenhouse gas emissions on MNES

The potential for the Project to influence global mean temperature change is measured against the transient climate response to cumulative carbon emissions (TCRE) metric reported in the Intergovernmental Panel on Climate Change (IPCC) Climate Change 2014 Synthesis Report (2015). This indicates the global mean peak surface temperature change per trillion tonnes of carbon (1000 GtC) emitted as CO<sub>2</sub> is likely in the range of 0.8°C to 2.5°C. On this basis, total GHG emissions over the life of the Project will result in practically immeasurable temperature changes beyond natural climatic variability with no significant impacts to MNES.

#### 7.6.2.5 Origin's Objectives for Action on Climate Change

Origin is committed to reducing greenhouse gas emissions and helping lead the transition to a low-carbon future. To enable this transition Origin had targets set in 2017 (approved by independent Science Based Targets initiative). Origin have also set the following business-wide objectives:

- reduce Scope 1 and Scope 2 emissions by 50%, and Scope 3 emissions by 25% by 2032
- new short-term target to reduce Scope 1 emissions by 10 per cent on average over FY2021-FY 2023
- commitment to update Origin's targets to a 1.5°C pathway
- commitment to achieve net zero emissions across business by 2050
- establish a five-pillar climate change strategy to underpin actions.

### 7.7 Chemical use

A Chemical Risk Assessment (Appendix I) was undertaken for the Project using information on the forecast development program and all chemicals used during well construction (make up water/drilling fluids), hydraulic stimulation, and water management.

The primary aim of the chemical risk assessment is to evaluate the potential risks to MNES, and effects of chemicals used during well construction and water management activities. The assessment evaluates the potential risks posed by the combined mixture of:

- chemical additives
- anthropogenic chemicals
- geo-genic constituents (from analytical data).

The CSG Risk Assessment Guidance Manual (Department of the Environment and Energy, 2017a) references the United States Environmental Protection Agency (USEPA) and the Organisation for Economic Co-operation and Development (OECD) toolboxes in developing their chemical risk assessment framework and their tools to guide best practice for human health and environmental risk assessment. Methods and tools are selected that are appropriate for the chemical, its functional toxicity, and the exposure pathway being used for assessment. A hierarchy is applied in the use and assessment of data on exposure point concentrations (EPCs) and toxicity, with direct measurements and toxicity values provided by epidemiological studies providing the least uncertainty in the risk assessment process.

In addition to enHealth and National Environment Protection Measure (NEPM) guidance, the USEPA ExpoBox and the OECD Environmental Risk Assessment Toolkit were used in the risk assessment to provide a compendium of risk assessment tools that links to guidance, databases, models, key references and related resources. These tools provided input throughout the risk assessment process and uncertainty in the risk assessment is minimised.

The chemical risk assessment demonstrated that potential risks have been eliminated or reduced as much as is reasonably practicable to potentially exposed MNES, through exposure pathways, including water resources and soils.

The risk assessment has demonstrated that regulatory controls and other management and mitigation strategies are effective at ensuring that unacceptable risks to MNES are minimised. Operational inspections, monitoring and auditing of compliance with these processes will be conducted to ensure that risks are effectively managed through the life of the Project.

Detailed risk assessment and mitigation and management measures are provided in Appendix I.

## 8.0 ENVIRONMENTAL OFFSETS

The Offsets Plan (Appendix E) describes how Origin, on behalf of Australia Pacific LNG, will secure and manage offsets required for the Project. The Offsets Plan describes how:

- SRI to MNES will be determined as per the EPBC Act Environmental Offset Policy (Department of Sustainability Environment Water Population and Communities, 2012)
- the Offsets Bank will operate, details of properties included and the associated MNES values
- offset obligations will be acquitted over the life of the Project

The EPBC Act does not have specific provisions for the delivery of offsets. However, the Minister can attach conditions to the approval of an action (under s138 of the EPBC Act) that are necessary for protecting and/or repairing or mitigating damage to a protected matter. In this way, offsets are often used in conditions of approval to address SRI to MNES.

The EPBC Act Environmental Offsets Policy (Department of Sustainability Environment Water Population and Communities, 2012) describes the current approach to environmental offsets for protected matters under the EPBC Act. The policy states that offsets are required if an 'action' is going to have a 'significant residual impact' to a protected matter (i.e. only where residual, unavoidable, impacts are considered to be significant). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and the intensity, duration, magnitude and geographic extent of the impacts.

Impacts from the Project have been assessed with regard to their level of significance. The Project will result in vegetation clearing and associated habitat loss and some, but not all, of this is considered likely to result in an SRI. A set of rules were established to consider the circumstances in which habitat loss is likely to constitute an SRI, considering cumulative loss from the Project in the region, ecological functionality and connectivity. It is therefore only when the Project exceeds a threshold under these criteria that the impact is considered significant and therefore a corresponding offset required.

The purpose of the Offsets Plan is to:

1. Commit to the delivery of offsets consistent with the requirements of the EPBC Act Environmental Offsets Policy (DSEWPC, 2012a)
2. Establish an Offsets Bank for the delivery of offsets
3. Describe the process for ensuring offsets are acquitted for SRI over the life of the Project.

### 8.1 Overview of offset approach

Under the EPBC Act Environmental Offsets Policy, offsets can comprise direct offsets and other compensatory measures. In addition, the proponent may also choose to provide advanced direct offsets for future use. Direct offsets are those that provide a measurable 'conservation gain' for an impacted protected matter. A conservation gain is a benefit which maintains or increases the viability of a protected matter or reduces any threats of damage, destruction or extinction.

Direct offsets will be secured as the preferred mechanism to address SRI to threatened species and TECs from Project activities. Direct are likely to include:

- procuring good or better-quality land for continuing protection through inclusion in the conservation estate (including covenanting arrangement on private land)
- maintenance or improvement of land targeted toward the impacted value, such as the improvement and creation of new habitat through regeneration and rehabilitation activities across a landscape
- protection of regrowth vegetation.

By providing a primarily direct offsets-based package, a conservation gain will be provided for those threatened species and TECs that are significantly impacted by the Project. It is also anticipated



there will be additional benefits for threatened species and TECs that do not experience SRI but are also located within offset areas and will experience an associated conservation gain.

The conservation gain for threatened species and TECs will be delivered in a number of ways including via the establishment of an offset bank, management of offset areas and on ground protection and management, outlined in the Offsets Plan (Appendix E). Within a particular offset area, a conservation gain will be achieved by activities including:

- improving existing habitat for the protected matter
- creating new habitat for the protected matter
- reducing threats to the protected matter
- averting an area of threatened species and/or TEC habitat that is currently under threat.

### 8.2 Offset procedure

Origin commits to providing offsets for all SRI to MNES that result from the Project.

The development of the gas fields is iterative and occurs incrementally over the life of the Project as gas resources are further defined. For the purposes of this assessment, the potential impacts to threatened species and TECs for the Project have been calculated based on a maximum disturbance scenario and a predicted SRI. These values provide the basis of this overarching offsets framework. However, it is considered unlikely that a development of the predicted scale and intensity will occur given that:

- gas resources are unlikely to occur uniformly across the entirety of the Project area resulting in less infrastructure
- existing approved infrastructure will be leveraged
- the conservative nature of mapped habitat
- the opportunities to avoid and reduce impacts (refer to section 6.3).

The process for accurately determining actual SRI and the associated offsets will be implemented as the Project progresses; this process is described below.

Origin is proposing to establish an Offsets Bank made up of appropriate offset areas to ensure that offsets are available and provided for SRI as they occur over the life of the Project. The Offsets Bank will be managed to maintain sufficient offset values to acquit SRI. Additional areas will be added to the Offsets Bank as required depending on accurate SRI. This approach is consistent with section 5.2 of the EPBC Act Environmental Offsets Policy, whereby, in order to determine if an offset is necessary, the impacts of proposed activities need to be fully understood.

An overview of the process which will be undertaken to deliver offsets in a progressive manner during Project implementation is summarised below. These steps are summarised visually in Figure 30.

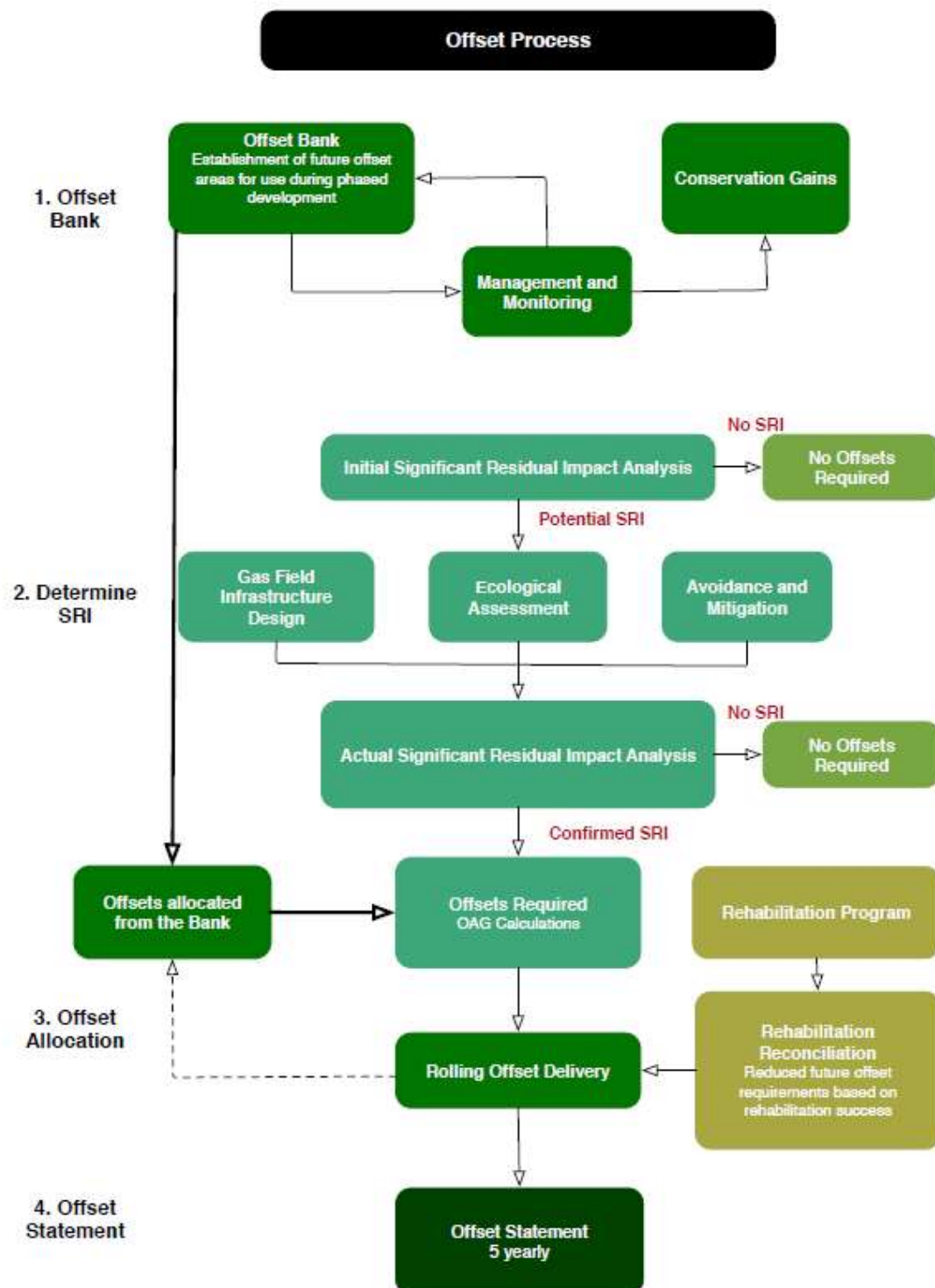
The offsets procedure for the Project involves the following steps:

#### 1. Establishment of an Offset Bank

- This Plan establishes an Offset Bank that will utilise properties that provide sufficient offsets to acquit the predicted SRI for all initial development activities
- Additional locations will be added to the Offset Bank as needed during the life of the Project
- Future offsets will be identified for relevant offset values including determination of MNES and habitat quality

- Once offset locations are determined to be suitable (i.e. required habitat values are present), a formal process to secure the offset will be undertaken (usually via a landholder agreement or property purchase)
  - Ecological assessments documenting values, their condition and actions required to achieve performance targets and completion criteria will be undertaken and reported in the Offset Statement every 5 years.
2. Determination of actual SRI
- Using final gas field infrastructure design and MNES value assessments
  - Includes application of avoidance and mitigation measures to reduce impact levels
  - May identify threatened species and TECs which will not be significantly impacted and therefore do not require offsets; and
  - Identifies threatened species and TECs with confirmed SRI that require offsets.
3. Offset allocation
- Undertaken for values with SRI and commensurate with level of impact
  - Uses agreed inputs to OAG to determine specific quantum of offset for each relevant threatened species and TEC
  - Offset area to come from within Offset Bank and will be appropriately secured using a binding legal mechanism
  - Includes ongoing management and monitoring of offset areas to achieve desired environmental outcomes.
4. Offset Statement
- Offsets will be aligned with Project development activities, with an acquittal process for reporting at project intervals (5 yearly) and final overall accounting at the end of the Project
  - Ongoing assessment of offset areas, prediction of future impacts and likely offset requirements to ensure offset values are available for delivery during the relevant phase (i.e. no lags or shortfalls)
  - Details of additional areas added to the Offset Bank during the preceding 5 years
  - Rehabilitation program will feed back into offset acquittal as credits to ensure offsets reflect actual SRI.

Figure 30: Offset process





### 8.3 Final offset delivery

As discussed above the offsets obligation for development will be allocated prior to any actual SRI to threatened species and TECs. Post impact, a further review will be undertaken to ensure offsets have met the final SRI that was realised during development.

For all disturbances relating to threatened species and TECs the following details will be recorded:

- extent of the disturbance and the relevant effect on authorised MNES disturbance limits
- calculation of SRI and determination of offset liability
- location and area of corresponding offset areas.

The information will be recorded and maintained for incorporation into the offset statement. Disturbances will be frequently updated in the Origin GIS so that predicted disturbances can be analysed with actual disturbances and records updated to accurately reflect cumulative disturbances levels. Where an actual disturbance has been identified as having an SRI on a threatened species or TEC, the disturbance will require offsetting.

Across the life of the Project the Offset Bank will be managed to ensure offset values are available to acquit the required offset relative to the actual extent of on-ground impact. Information on the progress of the offset reconciliation will be provided in offset statements.

During the course of Project, Origin will rehabilitate areas no longer needed for construction, access or operation. This includes lay down areas and construction areas around well pads and pipeline alignments. As rehabilitation occurs an assessment will be undertaken to determine when the rehabilitation has re-established threatened species habitat or TEC (based on habitat definitions and guideline thresholds). Where rehabilitation has been successful the area rehabilitated will be applied as a credit to the offset obligations of future impacts.

Once the final phase of the Project has been through the reconciliation and accounting process and there is no outstanding offset obligation, offsets for the Project will be deemed to be finalised.

## 9.0 CONSULTATION

Origin will continue to maintain the Australia Pacific LNG Project's existing landholder access protocols and stakeholder communication and consultation mechanisms. Origin has relationships with stakeholders in the vicinity of the Project Area due to the Australia Pacific LNG Project, and will continue to apply the following engagement strategies for the Project:

- consultation and engagement programs with stakeholders to ensure their views are understood and considered throughout the operations and ongoing development phase of the business
- participation with government in local and regional planning processes and provision of timely information about the business to inform discussion and decision making
- practical partnerships to achieve mutually beneficial outcomes in the Project Area
- working to mitigate business impacts on local landholders throughout the Project life by:
  - engaging with each landholder within the development area prior to any development activity on their land
  - where possible, working towards mutually beneficial outcomes
  - assigning a dedicated liaison officer to each landholder in the development area
  - locating and scheduling business activities to reduce impacts on landholder activities where practicable.

### 9.1 Proposed consultation about relevant impacts of the action

The Project will comply with the Land Access Code established under the MERCPA including:

- guidelines for communication between the holders of resource authorities and owners and occupiers of private land
- mandatory conditions concerning the conduct of authorised resource activities on land, including using the land in a way that minimises disturbance to people, livestock and property
- general principles for negotiations and guidelines for communication.

Further details of the regulatory controls prescribed by the Land Access Code are listed in Table 14.

The Project will benefit from existing community and stakeholder engagement conducted for Australia Pacific LNG Project operations. For example, Origin's recent engagement with local communities has included:

- for the eastern part of the gas fields, regular engagement with the Chinchilla Chamber of Commerce, Miles Chamber of Commerce, and the Tara Futures Group, which has encompassed a range of shared initiatives
- for the western part of the gas fields, regular engagement with Commerce Roma, Wandoan Chamber of Commerce, Advance Injune, Yuleba Development Group and Wallumbilla Town Improvement project group
- engagement with local schools through workshops and demonstrations
- involvement in key local events, career days, business information sessions, community information nights and 'Meet the Buyer' events
- tours of the Australia Pacific LNG Project operations and facilities
- communication channels including regional offices, Australia Pacific LNG and Origin websites, email enquiry channels and an information hotline.

## 9.2 Identification of affected parties

### 9.2.1 Community

The Project Area is within the Western Downs, Maranoa, Banana and Central Highlands local government areas (LGAs) which have been considered as the social catchment area. The Banana and Central Highlands LGAs are within the Central Queensland Statistical Area 4 (SA4), and the Western Downs and Maranoa LGAs are within the Darling Downs-Maranoa SA4.

The nearest regional towns to the Project (within 20 km) and considered in this report include:

- Rolleston within the Central Highlands LGA
- Injune within the Maranoa LGA
- Wandoan and Tara within the Western Downs LGA.

The nearest regional centres include Emerald within the Central Highlands LGA, Roma within the Maranoa LGA, and Dalby within the Western Downs LGA.

Local and regional communities within or adjacent to the Project Area are summarised in Table 72.

**Table 72: Local and regional communities**

Development area	Proximity to rural towns	Proximity to regional centres	LGA
Mahalo	North and east of Rolleston, with the nearest Block approximately 9 km to the east to Rolleston	Approximately 70 km south of Emerald	Central Highlands
Denison	Approximately 35 km south of Rolleston and approximately 50 km north of Injune	Approximately 130 km south of Emerald	Central Highlands
Spring Gully	North and east of Injune, with the nearest Block located approximately 8 km north of Injune and 40 km west of Taroom	Approximately 250 north west of Dalby and 70 km north of Roma	Maranoa, Banana and Western Downs
Peat	Approximately 10 km east of Wandoan	Approximately 200 km north west of Dalby	Western Downs
Ironbark	Approximately 4 km north and north west of Tara	Approximately 80 km west of Dalby	Western Downs

The Gas Industry Social and Environmental Research Alliance (GISERA) undertook independent research on environmental, social and economic factors impacted by gas field operation in the Surat and Bowen Basins. GISERA's most recent (2018) survey of community views on gas within the Eastern Maranoa, Western Downs and Tara regions identified a spectrum of views about gas development which had remained consistent since 2014. In 2018:

- 9% of people rejected gas development
- 34% tolerated gas development
- 31% accepted gas development
- 16% approved gas development
- 10% of people embraced gas development.

These results indicate that a total of 57% of survey participants accepted, approved or embraced gas development. More information is provided in the Social Assessment (Appendix K).

### 9.2.2 Landowners and occupiers

The Project Area intersects mostly with privately-owned freehold land associated with larger agricultural properties, with smaller 'lifestyle' properties located in the Tara area. The remainder of the land tenure is a combination of lands lease, road reserves, easements and unallocated state land. Key land uses include:

- residential and community purposes
- agricultural production (cropping and cattle grazing)
- resource extraction, including petroleum activities
- protected areas with conservation and recreation values.

Origin works closely and cooperatively with landowners who are hosting gas exploration and production activities. Landowners have access to a dedicated Origin contact who works with them from the commencement to the completion of activities, and relationships are generally positive. Origin's negotiates individual conduct and compensation agreements (CCAs) with landowners, that as a minimum meet the Land Access Code but typically go beyond these requirements to facilitate coexistence.

Origin currently supplies produced water to landholders to maximise the beneficial use of produced water from the Australia Pacific LNG Project. The irrigation schemes were developed after close engagement with landholders to deliver a positive outcome for participating landholders. In FY19/20 approximately 12,300 ML of water was provided to landholders via the following schemes:

- the purpose-built Fairymead Road Irrigation Pipeline, which started delivering produced water to participating landholders in April 2014
- the Spring Gully irrigation scheme, which was expanded in FY2019 to a larger landholder-run irrigation scheme to further enhance beneficial use for produced water.

### 9.2.3 Indigenous groups

Origin is committed to engaging with Indigenous Australians in a respectful and culturally appropriate way. Various cultural heritage places, reflective of Indigenous settlement and early European exploration and settlement are present within the Project Area. The Project Area also contains active claims or determinations as well as state land where Native Title rights have not been extinguished and can still be made.

Native title agreements are an essential requirement under the Commonwealth *Native Title Act 1993* to enable resource developers to validly carry out activities that impact on native title. They fall into two categories:

- Indigenous Land Use Agreements (ILUAs) negotiated with native title parties and registered with the National Native title Tribunal
- Agreements under section 31 of the *Native Title Act 1993* arising out of the Right to Negotiate (RTN) provisions of the legislation.

Origin have negotiated both ILUAs and section 31 agreements within the Project Area with native title groups including the Mandandanji People and Iman People.

As shown in , the Project Area is overlapped by the following native title claims or determinations (Figure 31):

- Iman People #2 - Determination



- Iman People #4 - Claim
- Gaangalu Nation People - Claim.

Origin will seek to negotiate further agreements with relevant Native Title parties if any further forms of regulatory approvals are required within the Project Area.

Origin has existing Cultural Heritage Management Plans (CHMPs) with relevant Traditional Owner groups across the Project Area. As part of implementing these CHMPs, Traditional Owners are involved with scouting activities to determine infrastructure locations and monitoring of construction activities where necessary, which enables Traditional Owners to work on Country.

Field development planning will apply a proactive approach to identifying, assessing and managing potential impacts on cultural heritage values. Activities will be carried out in accordance with existing approved CHMPs that will ensure the protection of cultural heritage values and compliance with regulatory requirements.

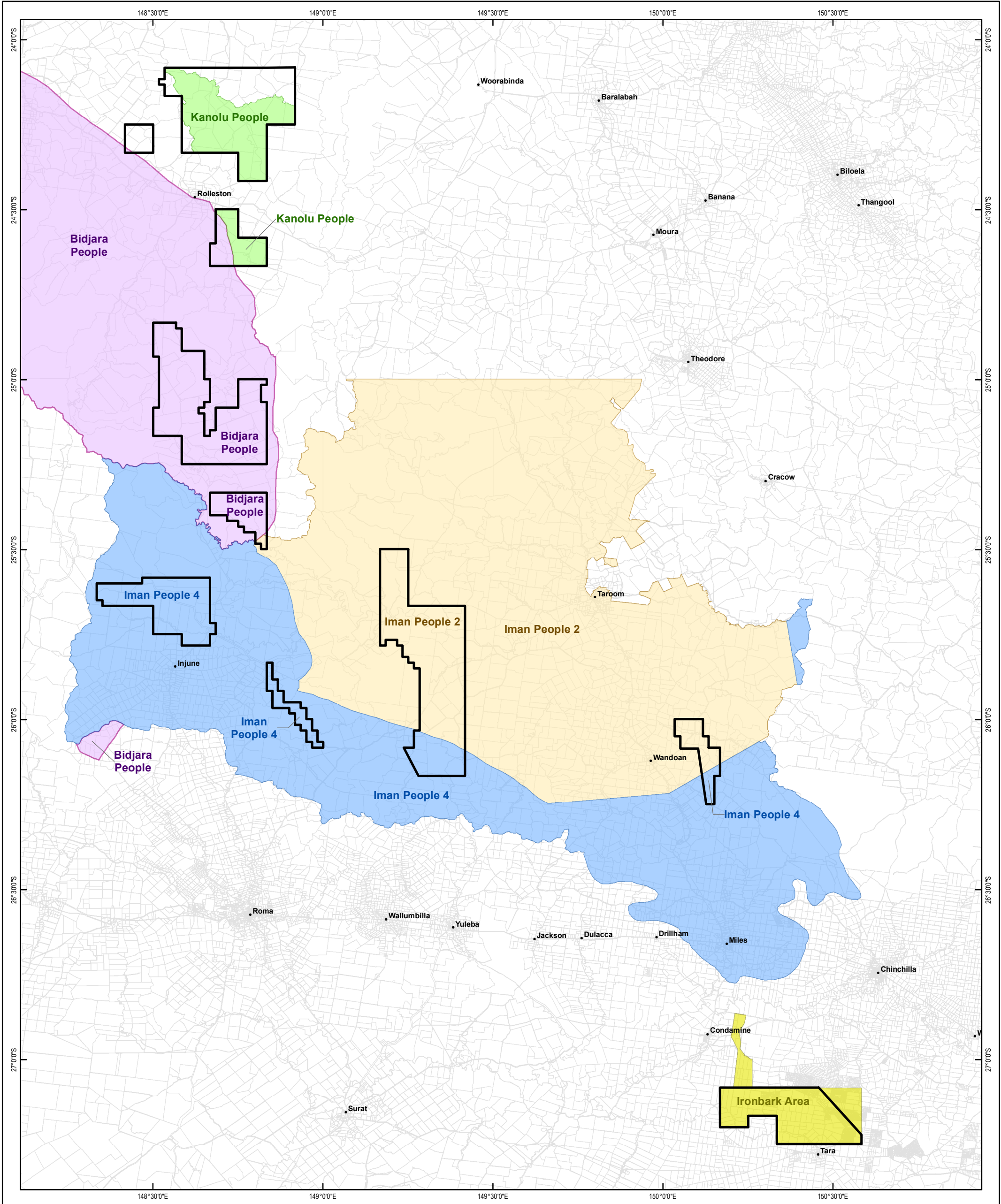
Origin has five existing CHMPs that overlap the Project Area (Figure 32):

- Kanolu People
- Bidjara People
- Ironbark Area
- Iman People #4
- Iman People #2.

The remainder of the Project Area does not have an existing overlapping CHMP. Origin will continue to work with Indigenous stakeholders on cultural heritage management, caring for Country initiatives, and the continuation of cultural awareness programs, with respect to development of the Project.







**Legend**

- Town
- Gas Supply Security Project (GSSP)
- Cadastral Parcels

**Overlapping CHMPs**

- Iman People 2
- Iman People 4
- Ironbark Area

Bidjara People

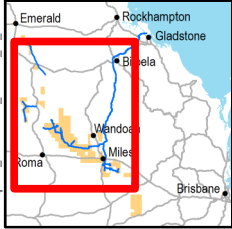
Kanolu People

Scale 1:1,160,000 (at A3)

0 10 20 40 Kilometres

Coordinate System: GCS GDA 1994

Source Information:  
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	Rev	Description	JM	GL	GH	06/07/2020	
			Drawn	Check	QA	Approved	Date



Gas Supply Security Project (GSSP) Overlapping CHMPs		
Figure 30	Doc No	Rev
	Map ID RITM_133248	

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#### **9.2.4 Local businesses**

Origin supports local, regional and Indigenous suppliers, with a focus on suppliers based in the Maranoa, Western Downs and Banana Shire LGAs. The local procurement program includes (Australia Pacific LNG, 2019a):

- increasing the percentage of regional and local procurement spend for FY 2020
- inclusion of regional participation plans for all major tenders and contracts where work is conducted locally
- facilitating ‘meet the buyer’ events to enable local communities to understand employment and subcontracting opportunities with major contractors; and
- engaging with local industry groups to share learnings and identify opportunities for collaboration.

Origin has strategies to ensure opportunities for Aboriginal and Torres Strait Islander people and businesses continue to be realised, with a focus on employment, supply chain and training opportunities, education and community investment.

During FY18 to FY20, Origin’s supply chain involved a total of 16 businesses in the Banana LGA, two businesses in the Central Highlands LGA, 99 businesses in the Maranoa LGA and 132 businesses in the Western Downs LGA. The value of Origin’s expenditure with businesses within the four LGAs during the three years was approximately \$187 million.

The National Institute of Economic and Industry Research reports on contribution to economic output within each LGA by industry sector. The data shows that the oil and gas industry contribution is representative of the maturity of gas field development in the region. Over FY19, the contribution of the oil and gas industry to economic output was 38% (\$1,310 million) in Maranoa LGA and 30% (\$2,908 million) in Western Downs LGA. Oil and gas industry contribution to economic output in Central Highlands (15.6%) and Banana (1.2%) LGAs has potential to rise as operations progress in these areas.

#### **9.2.5 Regional councils**

Origin has constructive and cooperative relationships with the Councils where its assets operate, meeting regularly with representatives of the Western Downs and Maranoa Regional Councils.

Local employment, the number of Origin personnel living locally and local business opportunities are issues of interest for Western Downs Regional Council.

Issues of interest to Maranoa Regional Council relate to increasing local employment to address population decline, economic diversification, and emergency response support in relation to droughts and floods.

With limited operations in the Central Highlands and Banana LGAs to date, Origin’s relationships with these Councils is now developing.

## 10.0 ECONOMIC AND SOCIAL MATTERS

### 10.1 Regional socio-economic context

The Project Area is within LGAs that primarily include agriculture including sheep and beef production, horticulture, and broadacre cropping.

Gas was first discovered and produced in Australia on the outskirts of Roma in 1900 (Towler *et al.*, 2016) and by 1968, the Roma area's conventional gas fields supported the development of the Roma (Wallumbilla) to Brisbane gas pipeline (Ibid.).

Between 2010 and 2015 there was significant gas development across the Surat and Bowen basins. This resulted in significantly increased employment and business opportunities in the Surat Basin and also inflation of housing prices, disruption to communities' character and additional stresses on social and health infrastructure.

The cessation of construction of major gas fields in the Surat Basin from around 2015 saw a reduction in employment and business supply options, but also a return to more affordable housing, and less pressure on social and health infrastructure. Communities in the LGAs which form the Project's broader social catchment have experienced extended drought conditions during the past decade. Flooding and bushfires also affected some areas in recent years, which has required an extended period of community response and recovery.

Coexistence between gas and agriculture is a key goal for Councils, resource companies, landowners and Government planning frameworks.

### 10.2 Impacts and benefits

Origin's field-based workforce is typically involved in construction of new infrastructure, drilling and connecting new wells (construction) or operating and maintaining assets (operational employees). The workforce profile across the gas fields can vary significantly depending on the phase of work, the drill programs in place, activities in other areas, seasonality, weather, and other internal and external factors.

Origin works with stakeholders, including landholders, Traditional Owners, Councils and Government departments, to understand the potential for impacts on stakeholders' interests, values and assets, and avoid impacts wherever possible.

Origin has established management systems and procedures to minimise the risk of economic and social impacts and ensure local communities' benefit from gas field developments, including:

- the HSE Assurance Management Plan
- compliance with International Finance Corporation performance standards and the Equator Principles
- dedicated staff implementing community and stakeholder engagement initiatives
- ILUAs, CHMPs and partnership agreements with Traditional Owners
- workforce recruitment and development strategies, including a focus on locally based personnel
- regular engagement and partnerships with Councils and groups such as the Chinchilla Chamber of Commerce, Miles Chamber of Commerce and Tara Futures Group, Commerce Roma, Wandoan Chamber of Commerce, Advance Injune, Yuleba Development Group and Wallumbilla Town Improvement project group
- a Complaints and Grievance policy and procedure which enable resolution of operational issues affecting stakeholders.

More information is provided in the Economic Assessment (Appendix L) and the Social Assessment (Appendix K).



Potential economic and social impacts and benefits relating to the construction and operation of gas field activities are listed in Table 73, along with an estimation of the probability of impacts resulting from the Project, and a rationale for the probability rating. The probability is estimated for each benefit and impact and is rated between 'low' and 'high,' as follows:

- High (probability of 81-100%)
- Medium (probability of 31-80%)
- Low (probability of 0-30%).

**Table 73: Potential economic and social benefits and impacts**

Potential impacts/ benefits	Phase	Probability	Rationale
<b>Potential Benefits</b>			
Construction employment	Development	High	Construction of GPFs and WMFs is likely to require a construction workforce drawing on established regional strengths in major facility construction, supported by specialist construction trades from other regions.
Continuity of operational employment	Development and operation	High	The Project would extend employment opportunities for existing personnel and new entrants to the gas industry and would support the vitality of local businesses that supply the Project, supporting their employees' employment security.
Opportunity to increase labour force participation and local skills capacity	Development and operation	Medium	There is existing labour force capacity for gas field development and operation within the social catchment's labour force. Project recruitment will include a focus on recruitment from communities within the social catchment. The Project would support labour force participation rates and continue opportunities to develop relevant skills within the social catchment.
Employment and training opportunities for Indigenous people	Development and operation	Medium	Australia Pacific LNG employs Indigenous people as managers, cultural heritage monitors (part-time casuals), clerical/administrative staff and machine operators. Traditional owner community members are also involved in cultural heritage management practices such as scouting and surveys, enabling them to work on Country. Origin's Stretch Reconciliation Plan aims to increase Indigenous people's involvement in Project employment and business supply opportunities.

Continuity of population	Operation	Medium	<p>The Project would maintain the availability of local employment, supporting the retention of people of working age in local communities and potentially attracting new households, in the context of low to no population growth projected for the four hosting LGAs.</p> <p>There is potential for an incremental increase in the number of personnel moving to local towns in the social catchment as a result of Australia Pacific LNG's 'Live Local' policy. New residents would either purchase or rent housing in nearby communities, which is likely to be welcomed by local residents and Councils. The rate of inflow of new residents is not expected to result in sudden or excessive demands which would affect access to housing for existing residents.</p>
Opportunities for local and regional businesses to supply goods and services to the Project	Development and operation	Medium	<p>There is established capacity within local and regional businesses to supply the Project, which will help to maintain their trading levels and the availability of employment in local businesses.</p>
Community investment	Operation	High	<p>Local communities near the Project would have access to Origin's community investment program including donations and the benefits of Origin's community partnerships.</p>
Government royalties	Operation	High	<p>The State Government is set to receive royalties based on the volume of gas produced from the Project.</p>
Landholder agreements and payments	Development and operation	High	<p>Dependent on the proposed resource activities and potential for impacts on property and/or residents' lifestyles, landholders may be entitled to make arrangements for compensation and infrastructure developed on their land.</p>
Supply of water for beneficial use	Development and operation	Medium	<p>There is potential for the Project to contribute to Origin's current program for supply of water for beneficial use which may include irrigation, aquifer injection, construction uses and potable water for camps.</p>
Gas supply	Operation	High	<p>The Project will contribute to the provision of natural gas for the domestic market, contributing to gas security and cost management.</p>

Potential Impacts			
Changes to Indigenous people's access to traditional Country or connection to cultural landscapes	Development and operation	Low	Access to Country which is not held in freehold may be disrupted, commencing during construction and continuing during operations. The appearance of gas field infrastructure may also change feelings of connection to the landscape.
Impacts on private land use or amenity	Development and operation	Medium	The Project will require use of private landholdings (by agreement with landholders) which may result in changes to land use or amenity. Land access agreements are supported by compensation to landholders and Origin's established protocols for land access management and landowner engagement.
Potential to impact on important agricultural land	Development and operation	Unknown, potentially low	A regional interests development approval is likely to be required under the RPI Act if gas field development is intended within these areas, unless exemption applies and the administering authority does not require an approval.
Impact on community amenity	Development and operation	Medium	Notwithstanding compliance with EA conditions unplanned events during operation of gas field infrastructure near local communities has potential to trigger complaints regarding nuisance (dust, light pollution, noise or traffic) issues that may affect the amenity of nearby residents. Origin's established stakeholder engagement processes and environmental management systems are expected to minimise the potential for impacts on amenity, but specific consideration of Tara's amenity will be required as part of field development planning.
Effects on transport facilities	Development and operation	Low	The Tara Aerodrome is located within the Ironbark development area, requiring consideration of any safety issues regarding flightpaths or proposed use of land within or near the aerodrome site. Project use of land within the aerodrome site is not expected.
Changes to the population or housing conditions relating to the Project workforce	Development and operation	Low-Medium	No significant change to the size or local/non-local personnel proportions of the operational workforce is anticipated as a result of the Project.  The Project will utilise the existing Australia Pacific LNG Project workforce continuing the availability of employment options and job security for current personnel. The Project workforce will

			<p>remain relatively constant There is a possibility of incremental increases in residential employees over time, but little potential for negative impacts on population characteristics or housing demand.</p> <p>Local personnel will use their own accommodation, whilst some non-local personnel will also use rental accommodation in local towns. Non-local personnel will otherwise be accommodated in existing workers' accommodation facilities.</p> <p>Temporary workforce accommodation facilities may be required to accommodate non-local construction workers for GPFs and WMFs being constructed in more remote locations.</p>
Increased cost of living due to inflationary pressure from higher incomes	Operation	Low	The Project would not result in a significant change to the incomes earned by gas field or other personnel.
Impact to local and regional businesses losing employees to the Project	Development and operation	Low	The Project would not result in a significant increase to the workforce, with little potential to increase the draw of labour away from other businesses or industries.
Increase in road movements impacting road safety	Development and operation	Low	Project traffic would be governed by a Traffic Management Plan and the established workforce conduct policies implemented by Australia Pacific LNG.
Concerns that workers accommodation facilities will foster anti-social behaviour and impact host communities	Development and operation	Low	<p>Additional workforce accommodation facilities are not envisaged as part of the Project, but temporary facilities may be required to accommodate non-resident construction workers. Any additional camps are likely to be located in more remote locations where safe daily travel between work sites and existing accommodation sites is not possible.</p> <p>The Project workforce will include local and non-local residents, all of whom will be subject to the Australia Pacific LNG Workforce Code of Conduct.</p>
Increased demand for medical, health or emergency services	Development and operation	Low-Medium	Origin's commitment to local employment may contribute to incremental increases in the populations of local communities over time. This is unlikely to result in sudden changes to population sizes or composition, so additional demands on social and health infrastructure are not

			<p>expected to diminish local access to services.</p> <p>The requirement for a construction workforce on a regular or continual basis for the construction of GPFs and WMFs may increase demands on health or emergency services in the social catchment. This is unlikely to result in any change to service access for local residents, however prior notice of construction workforce numbers and their location will assist Council and State agencies to plan for any increases in demand.</p> <p>The Project would not result in a significant increase to the operational workforce, with little potential to increase demands on social infrastructure.</p>
Increased demand for community services and facilities (e.g. childcare and family support services)	Operation	Low	The Project would not result in a significant increase to the workforce, with little potential to increase demand for community support services
Reduced access to recreational areas	Development and operation	Low	The Project avoids impacts on the Carnarvon Gorge National Park (southwest of Rolleston and northwest of Injune), the Albinia Conservation Park Area (west of Rolleston), the Nuga National Park between Rolleston and Injune, and the Isla Gorge National Park south of Wandoan. Other parks or recreational reserves were not identified within the Project Area.
Reduced amenity of recreation reserves	Construction and operation	Low	The Tara Golf Course, Racecourse and Showground are within the Tara PLA, north of the town centre, and may require consideration with respect to the location of major facilities within the Ironbark development area.
Disruption of community events	Construction and operation	Low	The sites of community events would require specific consideration and consultation as part of field development planning to avoid impacts on their amenity or sustainability.



## 11.0 ENVIRONMENTAL RECORD OF PERSON(S) PROPOSING TO TAKE THE ACTION

Origin is committed to responsible environmental management and have Health Safety and Environment (HSE) Management Systems which help to govern all activities and ensure continual improvement in managing environmental risks.

As the upstream operator for Australia Pacific LNG, Origin is committed to protecting the environment and consequently manages HSE matters as critical business activities. Origin has developed corporate environmental policies that provide a public statement of the corporate commitment to protecting the environment during operations.

The HSE Management System ensures that environmental risks associated with Origin's operations are either avoided or kept to as low as reasonably practicable. In addition, the HSE Management System drives continuous improvement in the company's environmental performance and assists to demonstrate to regulators, commercial partners and stakeholders that Origin is managing its operations in an environmentally responsible way. Origin aims to comply with all environmental regulations and conditions attached to approvals to operate, and promptly reports any non-compliance to relevant authorities. Employees and contractors to Origin are encouraged to report on environmental performance associated with activities. To increase an understanding and improve company-wide performance, a register of all environmental incidents, observations and good practices is maintained.

Australia Pacific LNG and Origin have not been subject to court proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

## 12.0 CONCLUSIONS

Origin Energy, as the upstream operator for Australia Pacific LNG Pty Ltd, propose to continue to progress the Australia Pacific LNG Project (EPBC 2009/4974) by developing gas field infrastructure in existing petroleum tenures within the Surat and Bowen basins, not covered by the previous Australia Pacific LNG Pty Ltd EPBC Act approvals. The Project extends the commercial production area of existing, previously approved Australia Pacific LNG Project gas fields into adjacent development areas.

The AEMO report (AEMO, 2020) illustrates a projected shortfall in gas supply from 2024 based on the expected production forecast for existing and committed gas projects. The indicative schedule for commencement of the Project's development activities coincides with the predicted gas shortfall starting from 2024. With the advantage of existing capability and capacity of Australia Pacific LNG Project infrastructure and management systems, the Project will continue to provide long-term gas supply to the east coast domestic and export markets.

A maximum development scenario (section 7.2.2.5) was used to provide a conservative assessment of potential environmental impacts from the Project. The assessment assumes minimal avoidance of environmental constraints and minimal use of third-party infrastructure. The final size of the Project will be smaller than the maximum development scenario as it will be influenced by:

- the quality of gas resources identified through ongoing exploration and appraisal activities;
- the application of constraints planning incorporating environmental, land access, and cultural heritage values, as detailed in the Environmental Constraints Planning and Field Development Protocol (the Protocol) (Appendix A); and
- optimising the use of existing infrastructure such as roads, accommodation camps, gas compression and water management facilities.

Presence or likely presence of MNES in the Project Area have been assessed for each MNES listed under the EPBC Act (section 7.0). The assessment identified the following MNES relevant to the Project:

- listed threatened species and ecological communities
- migratory species
- a water resource, in relation to coal seam gas development and large coal mining development.

The Project is not predicted to have a significant impact to migratory species or a water resource, in relation to coal seam gas development and large coal mining development; these MNES do not constitute controlling provisions for the Project.

### Avoidance and mitigation

The environmental management framework for the Project has been developed, refined, and successfully implemented over a period of approximately 10 years for the Australia Pacific LNG Project. The framework adopts a hierarchy of environmental management practices that will be implemented through planning, development and operation of the Project. This framework has proven to effectively manage potential impacts on relevant MNES values from gas field development and operational activities and complies with regulatory requirements for petroleum projects.

The Protocol (Appendix A) describes how petroleum infrastructure is located and constructed to preferentially avoid, minimise and mitigate significant impacts to MNES. A hierarchy of environmental management practices will be adopted to minimise potential impacts to MNES through:

- **Avoidance** - avoid disturbance to MNES

- **Minimisation** - minimise disturbance to MNES where disturbance cannot reasonably and practicably be avoided
- **Mitigation** - implement mitigation and management measures to minimise impacts to MNES
- **Rehabilitation** - actively rehabilitate disturbance to MNES in accordance with the Rehabilitation Management Plan and relevant EA conditions
- **Offset** - where required, provide offsets for activities that result in an SRI to MNES.

The Project is authorised to conduct petroleum activities within petroleum tenures subject to conditions of those regulatory controls such as conditions of existing EAs (Appendix N). The Project includes implementation of the key regulatory controls required by existing authorisations and the Project-specific controls (section 5.0).

The proposed EPBC Act approval conditions (Appendix M) are designed to manage potential significant impacts to MNES based on the Australia Government's Outcomes-Based Conditions Policy and Outcomes-Based Conditions Guidance. The proposed conditions have also been informed by contemporary conditions for similar EPBC Act approvals.

### 12.1 MNES assessment

#### Listed threatened species and ecological communities

The Project is likely to have a significant impact to listed threatened species and ecological communities (section 7.2.3.3).

Following the application of management and mitigation measures, potential significant impacts from the Project are only likely as a result of habitat loss from vegetation clearing/removal. SRI criteria have been developed based on an understanding of the circumstances in which vegetation clearing and habitat loss may result in significant impacts to MNES biodiversity values (Appendix B5). The underlying assumption is that threatened species and TECs can tolerate some degree of habitat loss, provided three key parameters are maintained:

- a minimum total extent of habitat
- habitat functionality at a more localised scale; and
- retention of connectivity between habitat areas.

Using the SRI criteria, the maximum development scenario and habitat mapping, the SRI for each threatened species and TEC has been calculated. The result of this analysis is shown in the Table 29. Not all TECs and threatened species potentially occurring within the Project Area will be impacted.

Both the habitat and the probabilistic modelling methods have resulted in a conservative (over) estimate of maximum disturbance associated with the Project activities. In reality it is expected that these numbers will reduce, particularly as the mapped extent of habitat is often overestimated due to the GIS modelling methods being unable to distinguish micro habitat features (e.g. fallen timber that may be an essential habitat requirement for many species such as the Yakka skink and Dunmall's snake). As a result, the assessment has taken a conservative approach and all potential areas of habitat are included in the species map to minimise scientific uncertainty.

In addition, once an ecological assessment is undertaken during design and execution further reductions in habitat disturbance is likely from application of the Protocol which includes detailed guidance as to how land disturbance to MNES will be firstly avoided where possible, and then minimised or mitigated (Appendix A).

The proposed maximum disturbance numbers are an upper limit as a result of conservative habitat model assumptions derived from a conservative pre-mitigation scenario based on the maximum development scenario.

Table 29 provides an overview of the outcomes of the detailed impact analysis for all threatened species and TECs addressed in this report.

#### Listed migratory species

No significant impacts to migratory species are likely to result from the Project. Migratory species have the potential to occur in the Project Area, however migratory species are either common throughout their range and/or opportunistic visitors to wetland environments. As disturbance to wetland environments will be avoided by the Project (Figure 17), impacts have been considered based on the likelihood of population level effects.

Habitat in central Queensland in general, and within the Project Area more specifically, is unlikely to be considered important habitat for migratory species. There is no evidence to suggest that the Project Area provides habitat that is of critical importance to migratory species at particular life-cycle stages or that ecologically significant proportions of migratory bird species are present within the Project Area. Accordingly, it is not expected that significant impacts to migratory species will result from the Project.

Therefore, migratory species does not qualify as a controlling provision for the action.

#### A water resource, in relation to coal seam gas development and large coal mining development

Through implementation of the following regulatory controls, the Project would have no significant or adverse impacts to water resources including groundwater bores, EPBC Act-listed springs or GDEs:

- Surat CMA UWIR process (OGIA) under the Water Act (Qld)
- Produced water management under the *Environmental Protection Act 1994* (Qld) and *Waste Reduction and Recycling Act 2011* (Qld)
- Chemical storage and handling and stimulation risk assessments under the *Environmental Protection Act 1994* (Qld)
- Code of Practice for the construction and abandonment of petroleum wells and associated bores in Queensland under the *Petroleum and Gas (Production and Safety) Act 2004* (Qld).

Consistent with Section 75 of the EPBC Act, relevant controlling provisions do not apply to an action if there are no adverse impacts in the absence of beneficial impacts. Offsets are not required as it has been identified that there are no significant or adverse impacts to water resources as a result of the Project. Therefore, a water resource from coal seam gas development and large coal mining development does not qualify as a controlling provision for the action.

Table 64 provides an overview of the outcomes of the detailed analysis for all water resources addressed in this report.

## **12.2 Environmental Outcomes**

Consistent with Section 74B of the EPBC Act, the Minister must be satisfied that the action would have an acceptable impact. Following extensive study and analysis, the scientific outcomes for the project clearly demonstrate that impacts will be acceptable.

Through detailed design, avoidance and management (as outlined in the proposed conditions for approval (Appendix M) impacts will be sufficiently controlled to avoid significant impacts to migratory species and water resources.

Some residual significant impacts may occur to threatened species and TECs. At a regional scale impacts to listed threatened species habitat and TECs will range from zero to a maximum of 0.33% of regional extent. Accordingly, a change in the conservation status or sustainability of listed threatened species and TECs will not occur as a result of the Project.

Through the application of environmental offsets, the resulting outcomes will deliver improved conservation areas for those threatened species and TECs significantly impacted. Existing offset

areas have been secured for the Project and will be managed consistently from the outset of the Project to provide improved threat reduction and protection. In the long-term offset areas combined with rehabilitation of impacted sites will deliver an overall environmental benefit.



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Appendix A: Environmental Constraints Planning and Field Development Protocol

Appendix B1: MNES Likelihood of Occurrence Assessments and PMST Reports

Appendix B2: Habitat Modelling Methods

Appendix B3: Land Disturbance Probabilistic Calculations Method

Appendix B4: Species Profiles and Mapping

Appendix B5: Significant Impact Assessments

Appendix C: Environmental Management Plan

Appendix D: Rehabilitation Management Plan

Appendix E: Offsets Plan

Appendix F: Water Assessment Report

Appendix G: Produced Water Management Plan

Appendix H: Groundwater Monitoring and Management Plan

Appendix I: Chemical Risk Assessment

Appendix J: Greenhouse Gas Emissions Inventory

Appendix K: Social Assessment

Appendix L: Economic Assessment

Appendix M: Proposed EPBC Act Approval Conditions

Appendix N: Environmental Authorities