Santos

Attachment 2
Supporting Information for an Environmental Authority Amendment Application

Fairview Arcadia Project Area (EPPG00928713)

Low Point Drains

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Abbreviations and Units

Acronym	Description
ATP	Authority to Prospect
CSG	Coal Seam Gas
DES	Department of Environment and Science, Queensland
EA	Environmental Authority
EO Act	*Environmental Offsets Act 2014*
EO Reg	*Environmental Offsets Regulation 2014*
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment, Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally sensitive area
ESC	Erosion and sediment controls
FAPA	Fairview Arcadia Project Area
LPD	Low Point Drain
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
PL	Petroleum Lease
PPZ	Primary Protection Zone
RE	Regional Ecosystem
SPZ	Secondary Protection Zone
TEC	Threatened Ecological Community

1.0 Introduction

Santos TOGA Pty Ltd (Santos), on behalf of the Santos GLNG joint venture partners (Santos TPY CSG Corp, Santos TPY Corp, Santos Queensland Corp, Bronco Energy Pty Ltd, PAPL (Upstream) Pty Limited, Total E&P Australia, Total E&P Australia II & KGLNG E&P Pty Ltd) is seeking to amend the Fairview Arcadia Project Area (FAPA) Environmental Authority (EA) (EPPG00928713). EA EPPG00928713 authorises the carrying out of petroleum exploration and production activities.

This application is in response to correspondence received from the Department of Environment and Science (DES) requiring Santos to apply for an amendment to EPPG00928713 to address an alleged non-compliance with condition D2 and D4 of the EA.

This application seeks the inclusion of a new condition into the FAPA EA to explicitly authorise the release of water from low point drains to 'waters' (as defined under the EA) as part of ongoing field operations. This condition will complement existing EA conditions D2 and D4, which authorise releases of this water to 'land'.

Pursuant to Section 224 of the *Environmental Protection Act 1994* (EP Act), the holder of an EA may, at any time make an application to the assessing authority seeking an amendment to an EA.

Santos has prepared this document in accordance with Sections 226 and 227 of the EP Act and considered the '*Guideline – Application requirements for petroleum activities'* (DEHP, 2013).

Santos considers the proposed amendment satisfies all requirements of the definition of a minor amendment (threshold) (in accordance with Section 223 of the EP Act – refer to Sectio 6.1.4).

2.0 Application Description

This amendment application seeks to amend the FAPA EA (EPPG00928713) to include new conditions that explicitly authorise the release of water from low point drains (LPDs) to areas defined, by the EA as 'waters'. This change is sought to provide clarity and remove any ambiguity, regarding the controlled release(s) of water from LPDs to land and to waters.

The need for change has resulted from an alleged non-compliance identified during a compliance inspection in Fairview by Department of Environment and Science (DES) personnel in August 2019. DES alleged the release of water from a LPD was in contravention of the following EA conditions:

> *(D4) Contaminants that are hydrostatic test water from pipelines and contaminants from low point drains may be released to land in accordance with condition (D2).*
>
> *(D2) The release of contaminants to land must be carried out in a manner such that:*
>
> *(c) There is no surface ponding or runoff to waters[1].*

In response to the alleged non-compliance, DES required Santos to apply to amend the conditions of the FAPA EA to address the issue of LPDs releasing to waters (as identified by the compliance inspection). The proposed amendment does not propose to alter existing activities or introduce additional activities. Rather, it seeks to provide clarity through the addition of new conditions authorising where, and how, the release of water from LPDs to 'waters' is undertaken. This is discussed in further detail throughout the following sections.

2.1 Background

In 2013, Santos undertook a comprehensive EA amendment process with the Department of Environment and Heritage Protection (DEHP, now DES) to seek the amendment of project EA conditions, including those relating to LPD releases in the Fairview and Arcadia Project Areas. The LPD amendments sought to authorise more sustainable and cost-effective methodologies for managing water released from LPDs whilst minimising the potential for harm to the receiving environment.

The condition controlling the release of water from LPDs prior to the 2013 EA amendment is provided below at B39. Condition B39 required the testing of water from LPDs prior to its release to the environment to demonstrate compliance with prescribed water quality parameters:

Low Point Drains

(B39) Water extracted from low point drains may be released to land providing that the water quality does not exceed the water quality limits set in Schedule B, Table 1 – Limits for the disposal of hydrostatic test water and low point drains to land and that the release is carried out in a manner that ensures that:

(a) vegetation is not damaged;
(b) soil erosion and soil structure damage is avoided;
(c) the quality of groundwater is not adversely affected;
(d) discharge of low point drain water will be controlled so that there is no water run-off from the nominated discharge areas; and

[1] This condition was amended in March 2020 as a result of an unrelated EA amendment process. The condition now states "*there is no surface ponding or runoff beyond the designated release area'*.

*(e) there are no releases of low point drain water to any **surface waters**.*

Table 1: *Schedule B, Table 1 – Limits for the disposal of hydrostatic test water and low point drains to land.*

Parameter	Water Quality Limits (maximum value unless stated otherwise)
pH	6.5-8.5 (range)
Arsenic (mg/L)	2.0
Cadmium (mg/L)	0.05
Chromium (mg/L)	1
Copper (mg/L)	5
Iron (mg/L)	10
Lead (mg/L)	5
Manganese	10
Zinc (mg/L)	5
Nitrogen (mg/L)	35
Phosphorus (mg/L)	10
Electrical Conductivity (µS/cm)	2000

To ensure compliance with the abovementioned conditions, the management practices, in addition to routine maintenance and inspection, included the installation of tanks and infrastructure at each LPD. Tanks were designed to capture and store water from LPDs prior to its release or removal 'off-site'. The installation and maintenance of this infrastructure created many challenges within the operational field, including:

- damage to tanks and other infrastructure designed to store and then manage the release of water from LPDs due to being located in areas subject to flash flooding under extreme climatic conditions;
- accessing (and associated disturbances at) LPD locations for maintenance, testing and monitoring in remote / difficult to access areas, including 'waters';
- significant vehicle and trucking movements, often into remote and / or sensitive areas; and
- compliance with other EA conditions that preclude disturbances and establishment of certain infrastructure and disturbance types within and immediately adjacent to drainage features including watercourses.

As part of the amendment process, Santos demonstrated that water released from LPDs could be released and managed so that it did not pose a risk of harm. Outcome based conditions were considered appropriate to ensure that the required environmental outcomes were achieved, and for which compliance could be demonstrated.

Under normal operations, water generated from LPDs is considered condensate water, which has similar properties to distilled water. Condensate water is formed as water saturated gas flows from the gas / water separator through gas gathering lines to compressor facilities. As pressures and temperatures drop along the gas gathering line, water vapour condenses and forms liquid droplets (condensate water) (refer to sections 2.2 and 2.5 for further information).

In addition, it was concluded that on the basis of the assessments undertaken as part of the amendment process, as well as ongoing modifications to system design and operations, that both the chemistry of the water and volumes released from the LPD network have limited to no potential for harm to the environment. Further, based on the challenges associated with access to existing LPDs and the potential for additional disturbance of watercourse beds and banks, and associated vegetation and habitats, there were no net environmental benefits for sampling (and then truck removal of liquids) compared to a strategy of a direct managed release.

Based on the above, the prescribed water quality limits governing the disposal of water from LPDs (and hydrostatic test water) to land were removed from the FAPA EA in 2013. Specific conditions relating to the development and implementation of a Land Release Management Plan were also removed, placing greater emphasis on outcomes focused condition requirements for authorised releases to land consistent with DES's regulatory strategy (i.e. condition (D2)).

These amendments were undertaken during extensive consultation with DEHP as part of an enduring *Amendment by Agreement* process between Santos and DEHP throughout 2012 and 2013. The *Amendment by Agreement* process involved multiple site inspections to Fairview and Roma by representatives of DEHP and included LPDs. As part of this *Amendment by Agreement*, changes were initially made to the Roma East Project Area East (RSGPAE) EA (EPPG00898213), with subsequent amendments to the Fairview Project Area (FPA) EA, and former Arcadia Valley (AV) EA (EPPG00984113).

The changes to conditions relating to LPDs made during the *Amendment by Agreement* centred on several key areas including:

- demonstrable water quality and volume information, and the ability to achieve the required environmental outcomes;
- a net environment benefit assessment comparing potential impacts associated with the release(s) of water form LPDs against impacts associated with ongoing monitoring and maintenance; and
- applicability assessment of the prescribed water quality limits in the existing EAs.

At the time of the 2013 amendment, the prescribed limits in both Santos' existing EAs as well as the Level 1 Chapter 5A draft model conditions were the ANZECC short-term trigger values (STVs) for irrigation waters (ANZECC Table 4.210). Santos demonstrated and reached agreement with DEHP that these guideline values should not be used as mandatory standards as there is significant uncertainty associated with the derivation and application of water quality guidelines.

The uncertainty in use of the STVs for LPD releases was based on the premise that STVs are the maximum concentration (mg/L) of contaminant in irrigation water which can be tolerated for a shorter period of time (20 years), assuming an annual application rate of 1,000 mm of irrigation water. These circumstances are simply not applicable to water releases from LPDs.

The amendments made during the *Amendment by Agreement* led to substantial changes in how Santos managed the collection and release of water from LPDs, including significant redesign and re-engineering of suitable and fit for purpose release mechanisms and protocols. Whereby, water from LPDs was previously and onerously captured, tested and typically removed and disposed 'off-site', and/or otherwise released to land. Where released to land, Santos implemented innovative changes that allowed for the release of water from LPDs (at low points) in a managed and controlled manner that ensured the outcomes required by the EA (including but not limited to no damage to vegetation, no surface ponding, or runoff to surface waters) were met and that no harm would result.

Furthermore, at the time of the EA amendment(s) it was estimated that the redesign(s) had an economic benefit to Santos of an estimated $250M in combined CAPEX and OPEX related costs. These savings were identified through:

- significant cost reductions to be had through the re-engineering and removal of the tanks and pumps from future LPD reticulation designs;
- substantial reductions in the ongoing associated operations and maintenance cost in managing the water from LPDs;
- reductions in ongoing environmental compliance monitoring; and
- reductions in the construction and maintenance of access tracks.

These changes were implemented based on the premise that such controlled and managed releases were being made to land and to typically dry ephemeral drainage lines and watercourses, but not to 'surface waters'. This was consistent with the previous condition, and the locations of LPDs discussed throughout the amendment process.

The change in use of the term 'surface waters' to 'waters' in condition (D2)(c) of the 2013 EA amendment resulted in the adverse consequence of directly linking the authorised release of water from LPDs to the definition of 'waters' under the EA.

By design LPDs must be installed at the low point of a gathering line. It was not in Santos' interest to engage and negotiate with DEHP in 2013 on an amendment to a condition that would result in the location and operation of an essential piece of infrastructure to be non-compliant (both existing and future) with EA conditions. The inclusion of the term 'waters' into condition D2(c) resulted in unintended and inadvertent consequences.

2.2 Gas / Water Separation and Low Point Drains

In the process of gas production activities, a combined gas / water stream is extracted from the well through the process of pumping associated (formation) water which facilitates the depressurisation of the coal sequences, and allows gas to flow into the well and up to the surface.

In addition to the associated water being pumped from the well, a residual amount of associated water remains entrained in the gas flowing from the wellhead i.e. the gas flowing from the wellhead is often water saturated and at or near reservoir temperature.

Water and gas are separated by gas / water separation equipment located at the well or at key piping manifold locations (see Figure 1). Gas / water separation can be achieved through a range of methods, but essentially the water and gas are split into two separate streams and then conveyed through dedicated gas and water gathering lines.

Associated water removed by gas / water separation is managed as produced water. Produced water is conveyed through dedicated water gathering lines, which run to storage and management facilities prior to beneficial use.

A simplified process diagram of gas / water generation and processing is shown on Figure 2.

Figure 1 – Example Gas / Water Separation Equipment

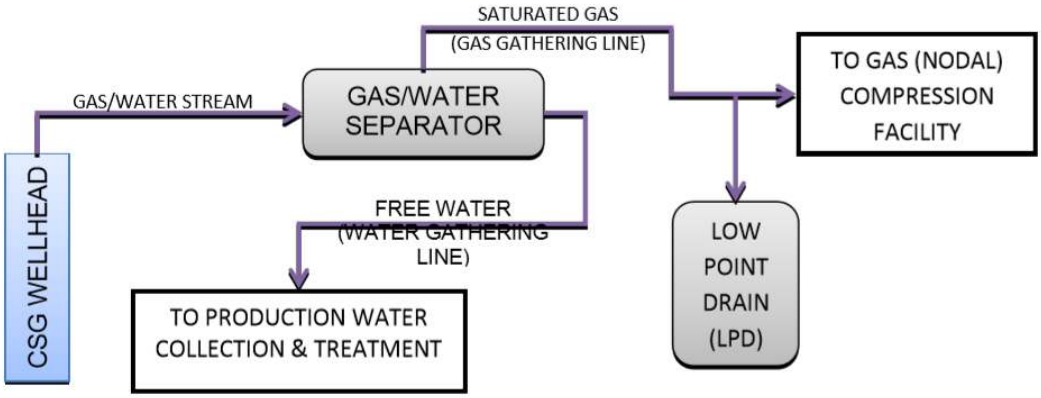

Figure 2 – Simplified Process Flow Diagram for CSG Gas / Water Generation and Processing

The gas / water separation equipment is specifically designed as a water knock-out system to remove residual associated water prior to gas entering the gas gathering lines. An extensive program of design and operational maintenance is implemented to ensure gas / water separation equipment operates efficiently to limit the potential for associated water to enter the gas gathering network.

Following separation, the gas stream still retains some entrained moisture. This water is not able to be removed through gas / water separation as it is entrained in the gas. This condensate water 'drops out' of the gas as the gas moves through the gas gathering network (and associated pipelines, risers and manifolds) and is exposed to temperature and pressure changes between the subsurface and the surface. That is, as the gas moves through the gathering line network, pressures and temperatures reduce, causing water vapour to condense and form liquid droplets (condensate) in the gas gathering network. This water naturally accumulates at low points along gathering lines via gravity.

Condensate formation in gas gathering lines from gas operations is expected as a part of normal operations. Free water and condensate which accumulate in the gas gathering network causes

excessive pressure drops in the gas lines and creates potential for water locks, which reduce the efficiency of gas production and transfer to compression facilities. Furthermore, when significant volumes of condensate are present in the gas gathering network, gas flow can cease altogether. Such issues can be further compounded by the inherently lower pressures and gas flow rates associated with coal seam gas production, as gas gathering lines are typically designed with a low allowable pressure drop per unit length, and are oversized to accommodate future development.

Therefore, when significant volumes of condensate are present within the gas gathering network, gas flow can cease altogether, and as such it is critical to remove any water that accumulates within the gathering line.

During normal operating conditions, associated water is removed and separated from produced gas by the gas / water separation however, occasional process upsets in the gas / water separation process and can result in small volumes of associated water being 'carried over' into gas gathering lines (this water is commonly referred to as "carry over water"). Upsets can be a result of maintenance and calibration issues, blockages caused by sediments, or changes in gas velocity, and is more likely to occur in the period following commissioning of a well. Operational controls are in place to minimise the occurrence of these events.

2.3 Low Point Drain Location and Placement

As discussed above, gas gathering lines must be designed with LPDs to ensure the efficient collection and removal of water from the gas gathering network. By design and in order to be effective, these drains must be located at points of lower elevation along the gas gathering network. Typically there are four LDPs for every gas well in a field.

The number of LPDs located within Santos' FAPA operations at the time of this application, is presented in Table 2. The number of LPDs in each field is expected to increase in line with development objectives.

Table 2: Low Point Drain Count – Fairview and Arcadia Valley

Field	Low Point Drains
Fairview	964
Arcadia Valley	185

Because LPDs are placed at regular 'low points' along gas gathering lines, a high proportion of Santos' LPDs are located in naturally lower lying topographical areas. Some of these areas may meet the definition of 'waters' in the EA, and are therefore subject to this amendment application. However, some LPDs also exist at naturally occurring low points along the pipeline transect that are not associated with areas defined as waters in the EA.

By way of example, Figure 3 presents a portion of the Fairview field displaying LPD locations (red triangles) along the existing gas gathering network (red lines), together with ordered drainage (dashed blue lines).

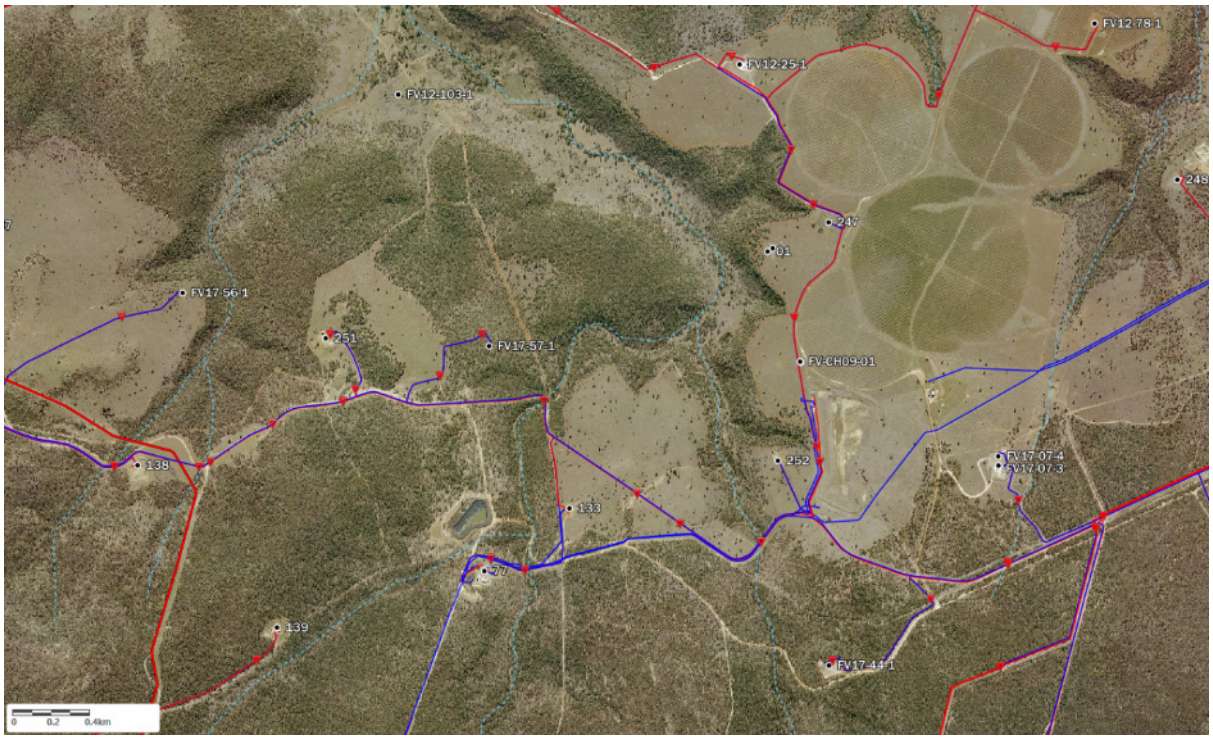

Figure 3 – Example LPD locations (Fairview Field)

As can be seen, the majority of LPDs are located away from ordered drainage features, and areas that would otherwise be defined as 'waters'.

Based on a review of LPDs at the time of this application, of the ~1149 LPDs present within the FAPA, approximately 16% are located within 10 m of a mapped drainage feature / watercourse, and 95% (of the 16%) of these LPDs are located within 10 m of Stream Order (SO) 1, SO2 or SO3 feature. Given the proximity of these LPDs to mapped features, it has been assumed for the purpose of this application that there is some potential for a release to 'waters' to occur .

The FAPA is located within the upper most section of the Upper Dawson River Catchment and Comet River catchment. SOs 1, 2 and 3 are therefore typically highly ephemeral drainage features occurring high in the catchments. These ephemeral drainage features do not typically contain discernible watercourse features i.e. distinct bed or banks, evidence of extended flows and / or riparian vegetation. Instead, these drainage features are often depressions in the landscape that will naturally collect and flow water only during heavy periods of rainfall and for a very short duration.

There are only limited examples of LPDs being located close to higher order streams in FAPA (i.e. SO 4, 5 and 6). Of the ~1149 LPDs located in FAPA, only 9 are located within 10 m of a SO4 or greater watercourse. Santos avoids placing LPDs within the "bed and banks" of pipeline crossings of high order creeks or rivers (e.g. the Dawson River) where standing or permanent surface waters are known to exist, and/or where there is high potential for water from LPDs to interact with surface water. High velocity flows in these locations also present risks to infrastructure integrity.

LPD installation occurs during the construction and installation of gas gathering lines. As such LPDs are located within the existing disturbance footprint created for the pipeline right of way (RoW), and pipeline construction and installation.

A key requirement of the outcome based conditions negotiated in 2013 was to ensure the discharge of water from LPDs was managed in a controlled manner so it would not cause runoff from the discharge area, and that no releases of LPD water to 'surface waters' occurred. The agreed intent of the outcome

based conditions was to prevent the release of LPD water directly to surface water bodies, while permitting LPDs to release water to land located near or on the edge of drainage features and watercourses. LPDs by their very design must be located in these areas to function correctly.

As discussed in Section 2.1, the 2013 *Amendment by Agreement* led to substantial changes in how Santos managed the collection and release of water from LPDs. The change in EA conditions allowed Santos to modify future LPD design, with water from LPDs being directed to a shallow, subsurface pit filled with rocks or gravel (as opposed to being directed to a tank for collection) (refer to Figure 4 and Figure 5) to achieve the required environmental outcomes. This design was considered appropriate and fit for purpose due to the low volumes of water produced by LPDs; and it would mitigate potential for vegetation damage, impacts to soils, surface ponding or runoff, aerosols or odours (refer to Section 5.0 for further information). LPDs are also fenced to prevent access and potential damage, primarily from livestock (refer to Figure 5).

It should be noted, that as result of varying EA conditions over time, and consequent legacy infrastructure, there are a portion of LPDs located in FAPA, which are not consistent with the current Santos LPD design described above. These LPDs typically discharge water to a rocked or gravelled surface at grade, and they are also fenced (refer to Figure 6).

Figure 4 – Example of Current LPD Discharge Design (Single)

Figure 5 – Example of Current LPD Design with Fence

Figure 6 – Examples of Legacy LPD designs

2.4 Low Point Drain Release Frequency and Volumes

Releases of water from LPDs are variable in nature, but typically low in volume and frequency, especially as a field matures and production rates naturally decrease over time.

Based on the gas production rates for wells within the Fairview Project Area, per well condensate production rates within gas gathering lines during the early stages of well operation are likely to be in the order of 4 to 8 L of water per hour. However these rates are both expected and observed to be significantly lower as an individual well matures and the recovered gas / water profile transitions from high water saturated gas to lower water content gas, and the rate of gas production decreases. These

condensate production rates relate to the typical amount of condensate produced by any one individual well – they do not necessarily relate to the amount of water released from any one individual LPD at one time, however the frequency may reduce. Condensate accumulates in the low points of gas gathering lines, and is released from LPDs automatically when specific pressures are met.

The highest condensate production rates are anticipated to be in the first LPD downstream of the field water / gas separator, where the greatest pressure change and temperature drops are anticipated after separation. However, this is not always the case as subsurface gases (particularly where high-density polyethylene (HDPE) gas gathering lines are used) may take time to cool within the piping system, and the fall within the piping system may result in downstream LPDs being the peak condensate producers.

The size (volume) and distribution of LPD release volumes, based on over 4,000 records for Santos operations in the Fairview and Arcadia Valley Fields, is presented in Figure 7. Analysis of these measured release volumes indicates that over 50% of measured releases are less than 25L, with a further 30% of releases measuring less than 100L. Less than 1% of measured releases reported a volume of between 2,500 and 5,000L at that point in time.

In general, based on over 4,000 records for Santos operations in the Fairview and Arcadia Valley Fields, the frequency and number of measured LPD releases is low (typically <20 per month). More frequent releases were measured during the period from 2H2016 and 1H2017. This increase is attributed to a significant increase in the number of wells brought into production during this period. As discussed above, condensate production rates are greater during the early stages of well operation, and reduce over time as the production well matures. An overall reduction in release frequency from mid-2017 onwards is further attributed to efficiencies gained in the continuous improvement in design and operational maintenance of the gas / water separation systems.

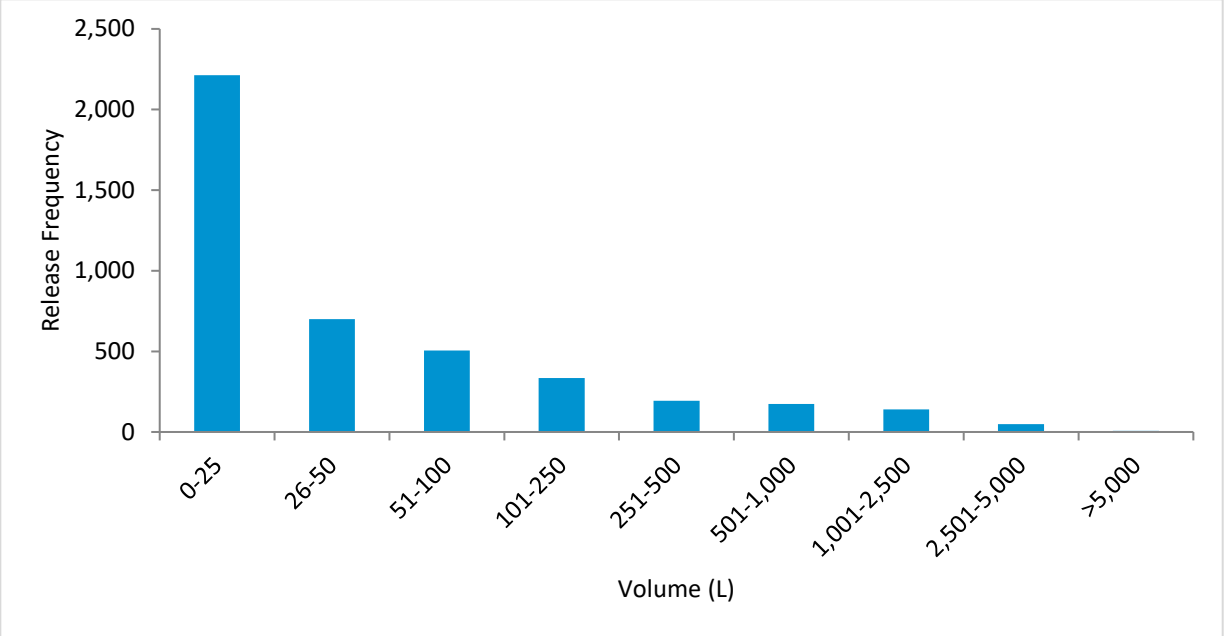

Figure 7 – Measured LPD Release Volumes

2.5 Low Point Drain Release Quality

Prior to December 2013, Fairview EA conditions required LPD water to meet prescribed water quality limits prior to its release to land. Low point drains at the time were fitted with intermediate bulk containers (IBCs) to capture LPD water so it could be tested to confirm water quality prior to its authorised release (see Figure 8). If the fluid met the prescribed water quality limits, the release could occur at that location providing the release would also meet the outcome-based conditions.

Following the change in EA conditions in late 2013, Santos continued to inspect LPDs to ensure that environmental outcomes were being achieved, and randomly sampled water from LPDs in Fairview. Visual inspections were recorded in the form of checklists and photos to ensure compliance with outcome-based conditions.

As discussed in Section 2.1, condensate water in many ways reflects similar properties to distilled water and has low mineral content. Field measurements and laboratory testing of samples confirmed that condensate water under normal operating conditions generally exhibits a low EC and that limited volumes of water are produced from the LPD. Water quality data for samples collected and analysed during recent monitoring of waters released from LPDs is provided in Table 3.

For comparative purposes the ANZECC STVs, as referenced in Section 2.1, and as per Explanatory Note (RML002) within *Guideline - Streamlined model conditions for petroleum activities* (ESR/2016/1989), as well as the *Environmental Protection (Water) Policy 2009 Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part)* (EPP Water) for the Dawson River and Comet River, which references the ANZG (2018) for toxicants (using the 95% level of species protection as recommended for slightly to moderately disturbed ecosystems).

Figure 8 – Example LPD with Collection IBCs

Table 3: LPD Release Quality

Variable	Units	STV[1]	EPP Water[2]	Num Obs	Min	Max	Mean	SD
Electrical Conductivity	µS/cm	650/ 1,300/ 2,900	370-375	154	22	4,280	662.7	1047
pH – Lab	pH Unit	-	-	144	6.38	9.5	7.7	0.736
pH – Field	pH Unit	-	6.5-8.5	127	6.58	9.92	7.6	0.816
Arsenic	mg/L	2	0.013	119	<0.001	0.013	0.00087	0.00139
Cadmium	mg/L	0.05	0.0002	119	<0.0001	0.0002	0.00005	0.00001
Chromium	mg/L	1	0.001	119	<0.001	<0.001	-	-
Copper	mg/L	5	0.0014	119	<0.001	0.014	0.00095	0.00171
Iron	mg/L	10	-	91	0.025	49.7	5.34	9.084
Lead	mg/L	5	0.0034	119	<0.001	0.001	0.00051	0.00006
Manganese	mg/L	10	1.9	119	<0.001	0.76	0.072	0.103
Zinc	mg/L	5	0.008	119	<0.005	2.04	0.0587	0.229

Note - where results are reported <Limit of Reporting (LOR), 0.5 x LOR has been used in statistical analysis.
[1] – ANZECC short-term trigger values (STVs), Table 4.2.10
[2] – Environmental Protection (Water) Policy 2009 Comet and Dawson River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), which references the ANZG (2018) for toxicants (using the 95% level of species protection as recommended for slightly to moderately disturbed ecosystems).

Analysis of the water quality data, as summarised in Table 3, indicates:

- for the majority of constituents the mean concentrations are less than both the STV, and EPP Water / ANZG 2018 guideline values;
- 70% of reported EC concentrations were < 370 µS/cm (EPP Water);
- 93% of reported EC concentrations were <2,900 µS/Cm (ANZG 2018);
- 90% of reported copper concentrations were < 0.0014 mg/L (ANZG 2018); and
- 74% of reported zinc concentrations were <0.008 mg/L (ANZG, 2018).

The distribution and cumulative % of electrical conductivity for reported water quality samples collected and analysed (summarised in Table 3) is presented in Figure 9.

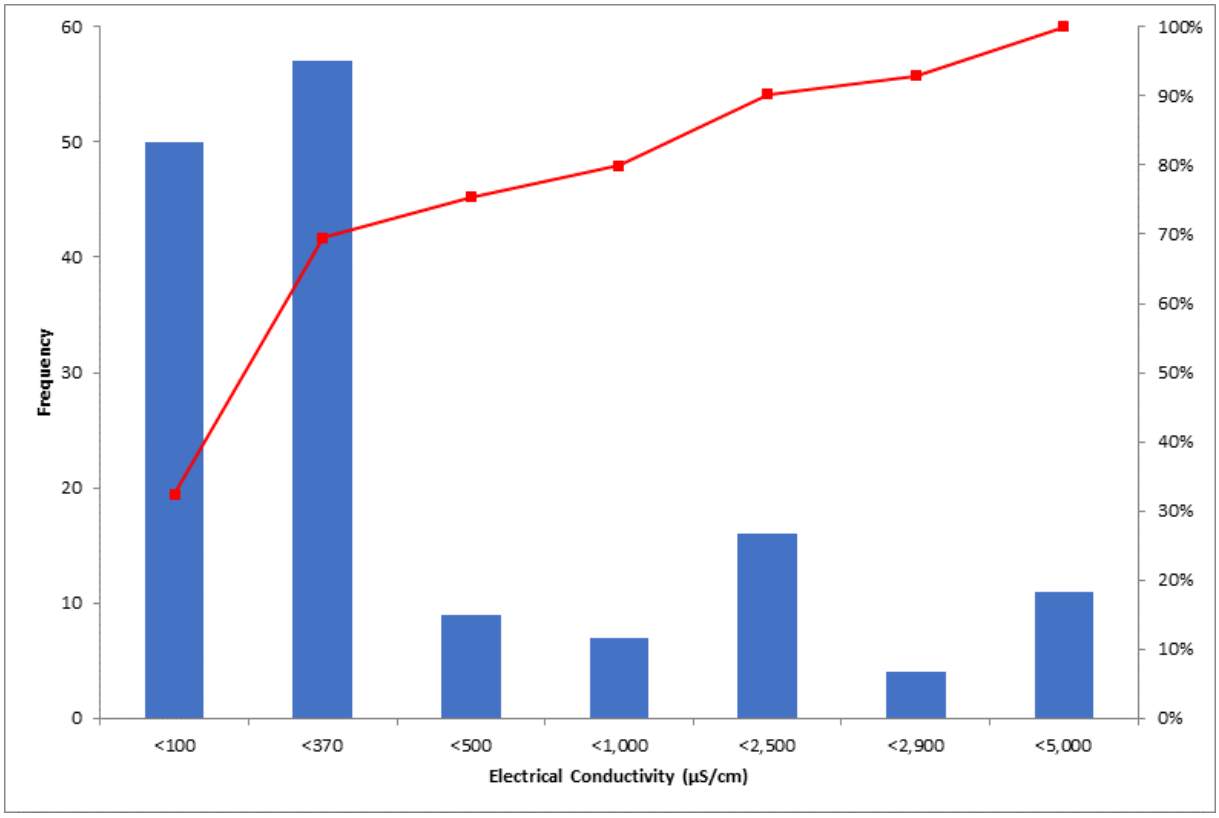

Figure 9 – Frequency Distribution of Reported Electrical Conductivity (count 154)

The above analysis supports the conclusions made in 2013 i.e. the chemistry of water released from LPDs within the gas gathering system has very low potential to cause harm to the environment. This is further mitigated because the releases typically occur to dry features, and avoid run-off to surface waters, as well as the low (and decreasing) volume and frequency of releases over time.

This conclusion, based on the analytical assessment, is further supported by observations made during field inspections undertaken to ensure compliance with outcome-based conditions (as detailed in Sections 2.1 and 2.5).

When taking into consideration the typical LPD water chemistry and release volumes (as discussed above), as well as the managed and controlled manner of releases (i.e. there is limited potential for erosion, run-off, pooling or ponding), the potential for harm to the environment is significantly reduced to very low risk (as detailed in the Environmental Risk Assessment in Section 5.0). This conclusion is further supported by the highly modified conditions of the ephemeral creeks and drainage features present in the Fairview and Arcadia Fields. These ephemeral creeks and drainage features are 'flashy' (highly episodic and ephemeral) in nature, experiencing high short term flows resulting in significant turbulence and high turbidity of the water.

2.6 Ongoing Monitoring

Santos implemented a fit for purpose monitoring program for the monitoring and assessment of water released from LPDs. The purpose of the monitoring program is to ensure water quality and quantities remain suitable for release, whilst maintaining the desired outcomes, and to ensure no environmental harm occurs.

Following the authorisation to release water from LPDs to land in 2013 as part of the *Amendment by Agreement* process, water sampling of LPDs comprised a representative random sampling set (~10% of LPD's / year), and from 2017 onwards LPD monitoring comprised of visual assessment to demonstrate compliance with outcome based conditions. Frequent operational inspections are also undertaken to ensure the efficient and proper operation of LPDs.

2.7 Alternate Options

As discussed in Section 2.1, Santos has invested considerable effort and expense in redesigning and re-engineering LPDs, including the construction and operation of associated pipeline infrastructure in response to the 2013 *Amendment by Agreement*.

If Santos were required to discard current LPD design and water release conditions, and introduce alternative LPD release conditions, when no harm to the environment has occurred or has limited potential to occur, would be unsustainable and not justified.

Potential new or different technologies may cause complications relating to increased disturbance and environmental compliance issues i.e. any requirements to re-engineer existing LPD and gathering infrastructure in the low points is extremely undesirable.

Despite the above, Santos has assessed various options that would prevent release of water from LPDs to 'waters' as defined by the EA, which are provided in Table 4.

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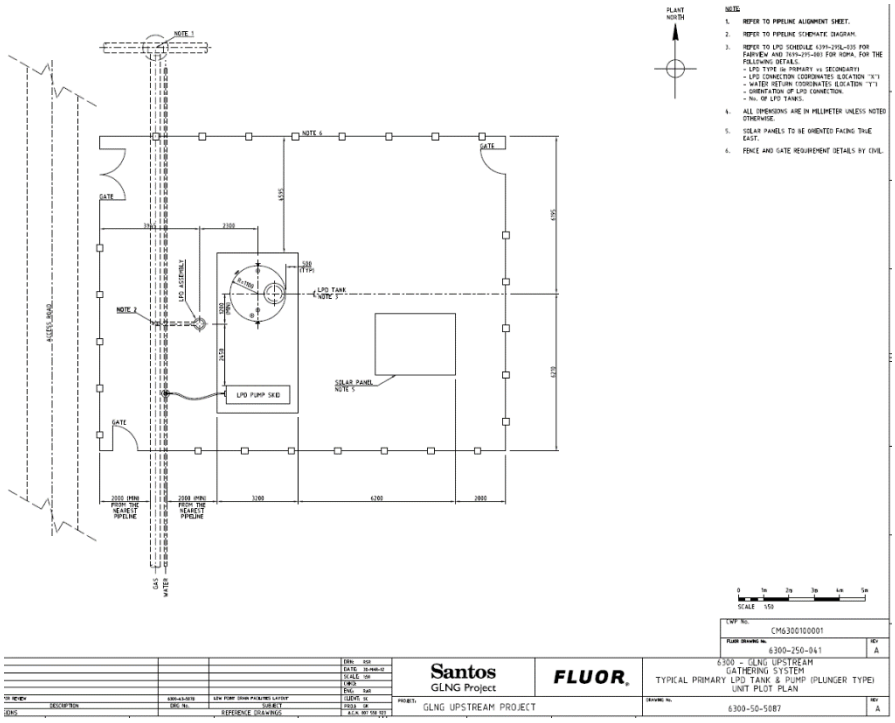
Table 4: Description of Alternate Technologies

Technology	Description and Consideration

Recirculation of water from LPDs into water gathering network	• This process involves the redesign and re-engineering of the existing and proposed LPD infrastructure such that water from LPDs is recirculated into the water gathering line network.
	• This process requires a water gathering line to be co-located with the gas gathering line.
	• Prior to the 2013 amendment this process was reviewed and trialled in Fairview (refer Figures below), however it was not pursued further due to the significant amount of additional disturbance required adjacent to the pipelines to house and facilitate the recirculation equipment (aboveground tank, pumps and power (solar or electrified)).
	• Further, In Fairview, gas and water lines are not always co-located, as water is required to be directed to the centralised treatment facilities
	• Designs and arrangement were as follows:
	  • approximately 90m^2 per LPD would be required outside the existing pipeline right of way (RoW) width within ESA's and ESA primary protection buffers. Differing shapes and sizes outside of RoW based on site conditions – slopes, terrain etc.
	  • Potential conflict with *limited petroleum activity* definition, and is located outside required RoW width in constraint areas (12m, 18m etc.)
	  • Collection systems required with sufficient holding capacity to allow re-injection back into the water gathering and treatment flowlines. Automated system to minimise maintenance.
	 
	• Another major constraint identified in the implementation and maintenance of this technology was, as discussed above, the impact resulting from the 'flashy' flow regimes for the ephemeral streams following rainfall events. Such equipment, as inherently being located at/adjacent to the low point, would invariably get damaged (or in some cases, washed downstream) requiring ongoing maintenance and/or replacement.
	• The timing to implement a recirculation system on the existing LPD network (is estimated to take approximately 5 years at an approximate cost of $155M.

Technology	Description and Consideration
	
Capture, storage and off-site disposal	• This process involves the capture, storage and 'off-site' disposal of water from LPDs. This process was implemented throughout the Fairview Field prior to the 2013 EA Amendment, as described above. • This process involves the redesign and re-engineering of the existing and proposed LPD infrastructure to discharge to a container (e.g. IBC) prior to collection and removal. • A significant amount of additional disturbance would be required to facilitate maintenance and collection of water form storage containers would be required. Access tracks would also be required to be constructed and maintained where they did not coincide with in existing road • As discussed above, a major constraint experienced during previous application of this methodology, was the impact resulting from the 'flashy' flow regimes of the ephemeral streams following rainfall events. Such storage equipment, as inherently being located at/adjacent to the low point, would invariably get damaged or as observed on multiple occasions, be washed downstream requiring ongoing maintenance and/or replacement.  • The timing to implement a recirculation system on the existing LPD network (is estimated to take approximately 4 years at an approximate cost of $30M. • Ongoing costs associated monitoring and disposal have been estimated at approximately $3-4M per annum.

2.8 Discussion

As presented above, Santos does not consider the continued release of water from LPDs, when undertaken in a managed and controlled manner, has very low potential to cause environmental harm to land or 'waters' (as defined by the EA). LPDs have been operating this way across Santos fields since 2013.

Releases of water from LPDs are infrequent, are typically low in volume, and the water quality poses little to no risk of causing environmental harm. Moreover, releases of water from LPDs are undertaken in a managed and controlled manner that prevents damage to vegetation, ensures soil quality is not adversely impacted (other than already disturbed form the construction process), minimises surface pooling or ponding, runoff, erosion or sedimentation beyond the designated release area.

2.9 Proposed Amendments

Santos does not seek to amend any existing conditions. Santos seeks to include, in addition to the existing conditions (at Part A – condition (D4) and Part B – condition (C7)) new conditions that explicitly authorise the release of 'contaminants' from low point drains to 'waters' following the removal of "surface water" from the condition set. In addition, Santos propose the inclusion of additional outcomes based requirements for such releases, similar to those already existing for authorised releases to land.

Based on the outcomes of these assessments the following conditions are proposed.

Part A

(B42) Contaminants from low point drains may be released to waters in accordance with condition (B43).

(B43) The release of contaminants to waters authorised in condition (B42) must be carried out in a manner such that:

a) vegetation is not damaged;
b) soil quality is not adversely impacted;
c) there is no aerosols or odours;
d) it does not result in visible scouring or erosion; or
e) cause a material build up of sediment in such waters.

Part B

(B20*) Contaminants from low point drains may be released to waters in accordance with condition (B21*).

(B21*) The release of contaminants to waters authorised in condition (B20*) must be carried out in a manner such that:

a) vegetation is not damaged;
b) soil quality is not adversely impacted;
c) there is no aerosols or odours;
d) it does not result in visible scouring or erosion; or
e) cause a material build up of sediment in such waters.

3.0 Site Description

3.1 Regional Context

The Fairview Arcadia Project Area (FAPA) covers approximately 341,509 ha. It is located approximately 18 km east of Injune at its southern extent and approximately 30 km north-east of Rolleston at its most northern extent (refer to Figure 10). The project area is comprised of the following Authority to Prospects (ATPs) and Petroleum Leases (PLs) within Maranoa Regional Council, Central Highlands Regional Council and Banana Shire council:

- ATP526/PLA1017
- ATP2012
- PL90
- PL91
- PL92
- PL99
- PL100
- PL232
- PL233
- PL234
- PL235
- PL236
- PL420
- PL421
- PL440

The majority of the project area is freehold with areas of National Park, State Forest, lands lease and resource reserve including Expedition (Limited Depth) National Park, Belington Hut State Forest, Presho State Forest, Expedition Resource Reserve, Beilba State Forest, Hallett State Forest and Stephenton State Forest.

The project area ranges from 190 m AHD to 775 m AHD with notable topographic features including:

- Near-level to strongly undulating plateau surface remnants cut by very steep - sided ravines and terminating in precipitous sandstone escarpments, occurring in the central part of the project area;
- The broad alluvial plains and foot slopes of the Arcadia - Comet valley feature extending northward to the northern limit of the project area; and
- Very steep and in places vertical sandstone escarpments and ravine slopes in the Expedition Range (Expedition (Limited Depth) National Park).

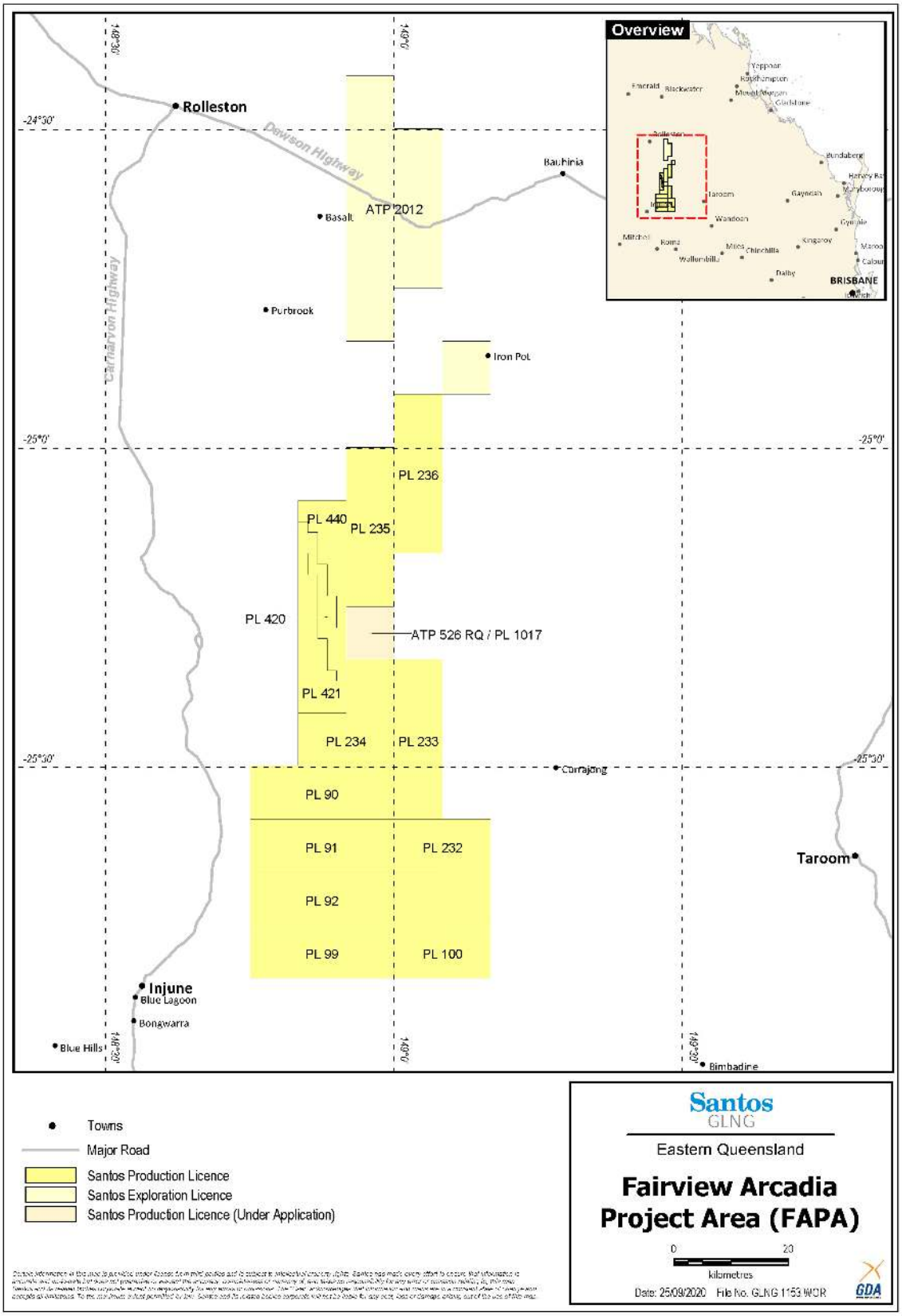


Figure 10 – Regional Location Map - Fairview Arcadia Project Area

4.0 Relevant Environmental Values

This section provides a description of the environmental values present within the project area where relevant to the proposed amendment.

As discussed in Section 2.0, Santos is currently authorised to release water from LPDs (a contaminant) to land in accordance with existing EA conditions located at Part A (condition (D4)) and Part B (condition (C7)). As such, the release of water from LPDs to land is not considered as part of this amendment application. Furthermore, the majority of FAPA LPDs are located outside of areas defined as 'waters' by the EA i.e. the majority of LPDs are located on and release to 'land'.

Specifically, this amendment application is applying for authorisation to release water from LPDs to 'waters' as defined by the EA. As discussed in Section 2.3, the majority of FAPA LPDs located within areas defined as 'waters' under the EA are located near highly ephemeral drainage features that do not typically contain discernible watercourse features, and are dry for extended periods of time. These LPDs typically release to dry land when no surface water is present i.e. the potential risks and impacts of these releases to dry 'waters' are consistent and largely the same as those currently authorised by the EA for releases to land.

It should be noted that LPDs are located within the pipeline right of way (RoW), which is disturbed as part of the pipeline construction process. For reasons of integrity, the RoW is maintained to be free of vegetation (other than grasses and shallow rooted small shrubs), and associated environmental values for its operational life. Flora and fauna values are therefore not considered as important environmental values in the context of this amendment.

Based on the proposed amendment (as detailed in Section 2.0), relevant environmental values include:

- Water
    - Land ((soils) where occurring within an area defined as waters))
    - Surface water; and
    - Groundwater

As mentioned above, flora and fauna values and any associated habitat value are removed from the operational RoW as part of the pipeline construction process. Moreover, the low volumes of water associated with LPD releases, combined with LPD design, mitigate the risk of run-off to environmental values located outside the pre-disturbed pipeline RoW area. However, for completeness, flora and fauna values (including Regional Ecosystems (REs) and Environmentally Sensitive Areas (ESAs)) present within the FAPA have been included in this assessment.

Air and noise values will not be affected by the proposed amendment. Similarly rehabilitation and waste management objectives are not proposed to be impacted and / or changed. The exception only is to clarify and explicitly authorise the release of water from LPDs (i.e. a waste product) to 'waters'. The impacts associated with this practice are the subject of this EA amendment. Furthermore, disturbances will continue to be rehabilitated to meet existing final acceptance criteria prescribed in Schedule J of the EA. As such, environmental values associated with air, noise, rehabilitation, and waste are not addressed further.

Risks and potential impacts to relevant environmental values as a result of the proposed amendment, and associated mitigation measures for potential impacts, are discussed in Section 5.0. Given 'waters' have the ability to occur anywhere across the landscape, the values presented are a description of values present across all of the FAPA.

4.1 Regional Ecosystems

The project area is located within the Brigalow Belt bioregion which covers 36,400,000 ha from the Queensland – New South Wales border to Townsville and is characterised by *Acacia harpophylla* (Brigalow) which forms forest and woodland on clay soils. There are 36 provinces within the Brigalow Belt, seven of which are within the project area:

- Southern Downs – Is based on the Jurassic and Cretaceous sediments that outcrop around the rim of the Great Artesian Basin. These are predominantly fine grained, forming a low, hilly landscape including the watershed formed by the Great Dividing Range. In the southern part there are extensive Late Cainozoic flood-outs/clay plains, while minor areas of Tertiary volcanics are scattered throughout the province. Vegetation includes belah *Casuarina cristata*, brigalow *Acacia harpophylla*, poplar box *Eucalyptus populnea* and narrow-leaved ironbark *E. crebra* communities and less extensively spotted gum *Corymbia citriodora*, dusky leaved ironbark *E. fibrosa* subsp. *nubila*, semi evergreen vine thicket, *Astrebla* and *Acacia* communities. The province overlaps with the Mulga Lands bioregion in the far west.
- Carnarvon Ranges - is an extensive belt of predominantly coarse sandstones that form the north-eastern margin of the Great Artesian Basin. These have been partly dissected to form an undulating to hilly surface with areas of deep valleys and gorges. Soils are predominantly coarse, with deep sands or with deep sandy-surfaced texture contrast soils on less steep areas. A mixed eucalypt woodland or forest, usually with a shrubby understorey, is the most widespread vegetation type, the dominant tree species being narrow-leaved ironbark *Eucalyptus crebra*, spotted gum *Corymbia citriodora* and bloodwoods *Corymbia* spp. Cypress pine *Callitris glaucophylla* is common on the deeper soils of undulating areas, whereas rusty gum *Angophora leiocarpa* is common in valleys.
- Arcadia - formed primarily on Triassic sediments of the Bowen Basin with minor areas of Permian sediments in the east. Eastern, southern and western areas are predominantly rugged on coarse sandstones with narrow-leaved ironbark *Eucalyptus crebra* and bloodwood *Corymbia* spp. communities. The central and northern areas are more undulating and largely contained within a broad valley. Clay soils carry brigalow *Acacia harpophylla* communities with areas of softwood scrub, while the shallow texture-contrast soils have a narrow-leaved ironbark *Eucalyptus crebra* woodland, with areas of poplar box *E. populnea*. Poplar box dominates alluvial areas.
- Woorabinda - is based on the Expedition and Dawson Ranges and the colluvium and alluvium derived from them. The sandstone ranges carry mixed eucalypt communities dominated by narrow-leaved iron bark *Eucalyptus crebra* and bloodwood *Corymbia* spp., with lancewood *Acacia shirleyi* on rockiest areas. The outwash to the north carries shrub woodlands and open forests dominated by narrow-leaved ironbark and bloodwoods, with gum-topped box *Eucalyptus moluccana* or lemon-scented gum *C. citriodora* on the finer-textured soils. The central outwash has extensive areas of cypress *Callitris glaucophylla* and bulloak *Allocasuarina luehmannii* on finer soils and rusty gum *Angophora leiocarpa*, forest red gum *Eucalyptus tereticornis* and narrow-leaved white mahogany *E. tenuipes* on coarser soils. This central area has a very diverse vegetation. In the north-east there are also areas of tableland formed on laterised Tertiary deposits with narrow-leaved ironbark and bloodwood communities.
- Isaac-Comet Downs – It is a largely undulating province dominated by Tertiary and other Cainozoic deposits. Tablelands and dissected remnants of the upper Tertiary surface are widespread, carrying a narrow-leaved Eucalyptus crebra woodland on the earths of undulating plateaus, and bendee *Acacia catenulata* or lancewood *A. shirleyi* on the rocky hills and mesas. The lower parts of the Tertiary-surface are dominated by brigalow *Acacia harpophylla* and Dawson gum *Eucalyptus cambageana* communities on undulating clay or tenure contrast soils. These communities dominate the province. Alluvium is also prominent, and the predominantly fine-textured soils carry brigalow

or coolibah *Eucalyptus coolabah* woodlands. Fine-grained Permian sediments are exposed in some areas, giving rise to grasslands, open woodland and areas of brigalow.

- Dawson River Downs - is an essentially undulating province in which outcrops of sediments of the Bowen Basin and Tertiary sediments occur in about equal proportions. The dominant Tertiary surfaces are of the lower catena. The Tertiary soils form undulating to flat plains dominated by brigalow *Acacia harpophylla* and softwood communities. Exposed rocks of the underlying sedimentary basin form plains or hills with softwood scrub.
- Basalt Downs – is formed almost entirely on Tertiary basalts. It occurs as two separate parts: a northern section, which is dominantly undulating and contains areas of lower catena Tertiary sediments; and a southern section which is predominantly hilly and contains areas of outcrop of Permian sediments. The more undulating area carry a bluegrass *Dichanthiurn sericeum* grassland with mountain coolibah *Eucalyptus orgadophila* on hillier area, often with silver-leaved ironbark *E. melanophloia* and red bloodwood *Corymbia erythrophloia*. Coolibah *Eucalyptus coolabah* occurs on floodplains. In the north, on Tertiary weathered basalts, gidgee *Acacia cambagei* scrub and brigalow *A. harpophylla* scrub are common, belah *Casuarina cristata* often occurring with the latter. Narrow leaved ironbark *Eucalyptus crebra* forms woodlands with silver-leaved ironbark *E. melanophloia* and red bloodwood *C. erythrophloia* on rugged basalt areas. On the Permain sediments, narrow-leaved ironbark or poplar box *Eucalyptus populnea* form open or shrubby woodlands.

The project area is predominantly vegetated (approximately 64% of the total project area) with the dominant vegetation being *Corymbia citriodora* woodland on course-grained sedimentary rocks. REs present within the project area are detailed in Table 5, which has been sourced from both ground-truthed and State data.

Table 5: Regional Ecosystems within FAPA

RE Code	VM Act Class	BD Status	RE Short Description (QLD Herbarium, 2018)	Area (ha) Remnant	Area (ha) Regrowth
11.3.1	E	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	27	11
11.3.2	OC	OC	*Eucalyptus populnea* woodland on alluvial plains	5,966	391
11.3.4	OC	OC	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland on alluvial plains	186	38
11.3.6	LC	OC	*Eucalyptus melanophloia* woodland on alluvial plains	16	0
11.3.17	OC	E	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	577	366
11.3.18	LC	NCAP	*Eucalyptus populnea*, *Callitris glaucophylla*, *Allocasuarina luehmannii* shrubby woodland on alluvium	13	4
11.3.19	LC	NCAP	*Callitris glaucophylla*, *Corymbia spp.* and/or *Eucalyptus melanophloia* open forest to woodland on Cainozoic alluvial plains	25	11

RE Code	VM Act Class	BD Status	RE Short Description (QLD Herbarium, 2018)	Area (ha) Remnant	Area (ha) Regrowth
11.3.25	LC	OC	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	3,339	20
11.3.27	LC	OC	Freshwater wetlands	5	0
11.3.39	LC	NCAP	*Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils	2,847	12
11.4.8	E	E	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	28	0
11.4.9	E	E	*Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	17	1
11.5.2	LC	NCAP	*Eucalyptus crebra*, *Corymbia spp.*, with *E. moluccana* woodland on lower slopes of Cainozoic sand plains and/or remnant surfaces	3,594	0
11.5.3	LC	NCAP	*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	79	0
11.5.5	LC	NCAP	*Eucalyptus melanophloia*, *Callitris glaucophylla* woodland on Cainozoic sand plains and/or remnant surfaces. Deep red sands	67	0
11.5.9	LC	NCAP	*Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp*. woodland on Cainozoic sand plains and/or remnant surfaces	864	0
11.5.13	OC	OC	*Eucalyptus populnea* +/- *Acacia aneura* +/- *E. melanophloia* woodland on Cainozoic sand plains and/or remnant surfaces	1	0
11.5.20	LC	NCAP	*Eucalyptus moluccana* and/or *E. microcarpa* and/or *E. woollsiana* +/- *E. crebra* woodland on Cainozoic sand plains	26	0
11.7.2	LC	NCAP	*Acacia spp*. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	912	0
11.7.5	LC	NCAP	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	2	0
11.8.3	OC	OC	Semi-evergreen vine thicket on Cainozoic igneous rocks	11	27
11.8.4	LC	NCAP	*Eucalyptus melanophloia* open woodland on Cainozoic igneous rocks.	2,598	0

RE Code	VM Act Class	BD Status	RE Short Description (QLD Herbarium, 2018)	Area (ha) Remnant	Area (ha) Regrowth
11.8.5	LC	NCAP	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	237	0
11.8.11	OC	OC	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	28	0
11.9.1	E	E	*Acacia harpophylla-Eucalyptus cambageana* woodland to open forest on fine-grained sedimentary rocks	163	26
11.9.2	LC	NCAP	*Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks	446	2
11.9.4	OC	E	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks	6,648	926
11.9.5	E	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	5,846	2,014
11.9.7	OC	OC	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	305	194
11.9.8	LC	OC	*Macropteranthes leichhardtii* thicket on fine grained sedimentary rocks	248	0
11.9.9	LC	NCAP	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	199	0
11.9.10	OC	E	*Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks	62	13
11.10.1	LC	NCAP	*Corymbia citriodora* woodland on course-grained sedimentary rocks.	81,364	545
11.10.2	OC	OC	Tall open forest in sheltered gorges on coarse-grained sedimentary rocks	136	0
11.10.3	LC	NCAP	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps	4,764	292
11.10.4	LC	NCAP	*Eucalyptus decorticans*, *Lysicarpus angustifolius* +/- *Eucalyptus spp.*, *Corymbia spp.*, *Acacia spp.* woodland on coarse-grained sedimentary rocks	21,269	25
11.10.7	LC	NCAP	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	9,555	1,153
11.10.8	OC	OC	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	425	4

RE Code	VM Act Class	BD Status	RE Short Description (QLD Herbarium, 2018)	Area (ha) Remnant	Area (ha) Regrowth
11.10.9	LC	NCAP	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	15,508	211
11.10.11	LC	NCAP	*Eucalyptus populnea*, *E. melanophloia* and/or Callitris glaucophylla woodland on coarse-grained sedimentary rocks	3,429	162
11.10.13	LC	NCAP	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	41,087	465

Key: VM class and BD status under the *Vegetation Management Act 1999*: NCAP – No Concern at Present, LC – Least Concern, OC – Of Concern, E – Endangered

4.2 Flora and Fauna

The project area provides suitable habitat for a range of threatened fauna and flora species based on RE associations. A Wildlife Online search (both Wildnet records and modelled potential habitat) of the project area indicates there are 57 *Nature Conservation Act 1992* (NC Act) and *Environment, Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed flora and fauna species potentially occurring as detailed in Table 6 and Table 7. There are also multiple high risk areas present in FAPA as shown on the Protected Plants Survey Trigger Map.

Several areas of wetland / aquatic habitat are present in FAPA. These areas are largely riverine in nature and associated with major watercourses i.e. Comet and Dawson Rivers and Hutton Creek.

The aquatic habitat of watercourses in the Comet River sub-catchment comprises water channels during flowing conditions, as well as isolated perennial waterholes present during dry season. The lacustrine wetlands also provide habitat for aquatic fauna and flora. The State of the Rivers assessment, identified the aquatic habitat of the Comet River catchment as being poor to very poor, although larger water courses, such as the Brown River support a moderate amount of aquatic habitat and macroinvertebrate data (DNRM 2000). The Lower Dawson sub-catchment provides limited riverine wetland habitat, which is primarily associated with the Shotover State Forest and Planet Creek. These areas are located outside FAPA. There are no nationally or internationally significant wetlands present in the Lower Dawson sub-catchment. The Upper Dawson sub-catchment supports numerous wetland areas that are predominantly riverine or floodplain swamps with grass, sedge and annual vegetation. The largest area of wetland located within FAPA in the sub-catchment is centred on Beilba State Forest area, and associated with the Dawson River.

Table 6: Threatened Fauna Potentially Occurring within the Project Area and Associated Habitat

Species Name	General Potential Habitat RE Code	Conservation Rating	
		NC Act	EPBC Act
Mammals			
Eastern Long-eared Bat (*Nyctophilus corbeni*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.3, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.8, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	V

Species Name	General Potential Habitat RE Code	Conservation Rating	
		NC Act	EPBC Act
Ghost bat (*Macroderma gigas*)	11.3.1, 11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.8.11, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	N/A
Koala (*Phascolarctos cinereus*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.11, 11.10.13	V	V
Large-eared Pied Bat (*Chalinolobus dwyeri*)	11.3.1, 11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.8.11, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	V
Northern Quoll (*Dasyurus hallucatus*)	11.3.1, 11.3.2, 11.3.4, 11.3.17, 11.3.19, 11.3.25, 11.3.39, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	LC	E
Greater glider (*Petauroides volans*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.11, 11.10.13	V	V
Birds			
Australian painted snipe (*Rostratula australis*)	11.3.1, 11.3.2, 11.3.25, 11.3.27	V	E
Glossy black cockatoo (eastern) (*Calyptorhynchus lathami lathami*)	11.3.1, 11.3.17, 11.3.18, 11.3.19,11.3.25, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.20, 11.8.3, 11.8.5, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.9, 11.10.11, 11.10.13	V	N/A
Painted honeyeater (*Grantiella picta*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.5, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.9, 11.10.11, 11.10.13	V	N/A
Powerful owl (*Ninox strenua)*	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	N/A
Squatter Pigeon (southern subspecies)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.9.1, 11.9.2,	V	V

Species Name	General Potential Habitat RE Code	Conservation Rating	
		NC Act	EPBC Act
(*Geophaps scripta scripta*)	11.9.5, 11.9.7, 11.9.8, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.9, 11.10.11, 11.10.13		
Swift parrot (*Lathamus discolour*)	11.3.4, 11.3.6, 11.3.25, 11.3.27, 11.3.39, 11.5.2, 11.5.9, 11.5.20, 11.8.4, 11.9.9, 11.10.1, 11.10.2, 11.10.11	E	E
Australiasian bittern (*Botaurus poiciloptilus*)	11.3.1, 11.3.2, 11.3.25, 11.3.27	LC	E
Reptiles			
Collared delma (*Delma torquata*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.7.5, 11.8.3, 11.8.4, 11.8.5, 11.8.11, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.8, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	V
Dunmall's Snake (*Furina dunmalli*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.7.5, 11.8.3, 11.8.4, 11.8.5, 11.8.11, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.8, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.8, 11.10.9, 11.10.11, 11.10.13	V	V
Golden-tailed gecko (*Strophurus taenicauda*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.39, 11.4.8, 11.4.9, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.5, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.9, 11.10.11, 11.10.13	NT	N/A
Grey snake (*Hemiaspis damelii*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.39, 11.4.8, 11.4.9, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.9	E	N/A
Yakka Skink (*Egernia rugosa*)	11.3.1, 11.3.2, 11.3.4, 11.3.6, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.39, 11.5.2, 11.5.3, 11.5.5, 11.5.9, 11.5.13, 11.5.20, 11.7.2, 11.8.4, 11.8.5, 11.9.1, 11.9.2, 11.9.4, 11.9.5, 11.9.7, 11.9.8, 11.9.9, 11.9.10, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.7, 11.10.9, 11.10.11, 11.10.13	V	V
Insects			
Pale imperial hairstreak (*Jalmenus eubulus*)	11.3.1, 11.3.17, 11.4.8, 11.4.9, 11.9.1, 11.9.4, 11.9.5, 11.9.10	V	N/A

E = Endangered; V = Vulnerable; NT = Near Threatened; LC = Least Concern.

Table 7: Threatened Flora Potentially Occurring within the Project Area

Species Name	Conservation Rating	
	NC Act	EPBC Act
Acacia calantha	NT	N/A
Acacia islana	V	N/A

Species Name	Conservation Rating	
	NC Act	EPBC Act
Acacia spania	NT	N/A
Apatophyllum teretifolium	NT	N/A
Arthraxon hispidus	V	V
Bertya opponens	LC	V
Cadellia pentastylis	V	V
Calytrix islensis	V	N/A
Cyperus clarus	V	N/A
Dichanthium queenslandicum	V	E
Dichanthium setosum	LC	V
Diuris parvipetala	V	N/A
Eriocaulon carsonii	E	E
Eucalyptus curtisii	NT	N/A
Eucalyptus pachycalyx subsp. waajensis	E	N/A
Eucalyptus virens	V	V
Haloragis exalata subsp. velutina	V	V
Macrozamia crassifolia	V	N/A
Macrozamia platyrhachis	E	E
Marsdenia brevifolia	V	V
Melaleuca irbyana	E	N/A
Micromyrtus carinata	E	N/A
Ochrosperma obovatum	V	N/A
Picris barbarorum	V	N/A
Polianthion minutiflorum	V	V
Pomaderris coomingalensis	E	N/A
Pseudanthus pauciflorus subsp. arenicola	NT	N/A
Rhaponticum australe	V	V
Rutidosis lanata	V	N/A

Species Name	Conservation Rating	
	NC Act	EPBC Act
Sannantha brachypoda	V	N/A
Solanum adenophorum	E	N/A
Solanum elachophyllum	E	N/A
Thesium australe	V	V
Trioncinia retroflexa	E	N/A
Xerothamnella herbacea	E	E

E = Endangered; V = Vulnerable; NT = Near Threatened; LC = Least Concern.

4.3 Environmentally Sensitive Areas

FAPA supports several ESAs including National Parks, State Forests, Resource Reserves and remnant and regrowth vegetation. ESAs present within FAPA are listed in Table 8. Approximately 52 % of FAPA is located within an ESA, with a further 25 % in a Primary Protection Zone (PPZ).

Table 8: Environmentally Sensitive Areas within Project Area

ESA Category	Type	ESA		PPZ[#]		SPZ[#]	
		Area (ha)	% of Project area	Area (ha)	% of Project area	Area (ha)	% of Project area
A	National Park	62,462	18.3	6,285	1.8	2,899	0.85
B	Endangered regional ecosystem	16,798	4.9	32,229	9.4	N/A	N/A
C	Of concern regional ecosystem	20,967	6.1	28,362	8.3	N/A	N/A
	Essential habitat	17,458	5.1	16,878	4.9	N/A	N/A
	State Forest and Timber Reserves	55,770	16.3	N/A	N/A	N/A	N/A
	Resource Reserves	2,772	0.8	1,255	0.4	N/A	N/A

[#] The Secondary Protection Zone (SPZ) for Category B and C and the PPZ for State Forests and Timber Reserves is not a constraint and therefore is not applicable.

Note: there will be some overlap with the areas presented in Table 1 as a result of overlap with the different ESAs and protection zones.

4.4 Water Resources

4.4.1 Soils

The dominant soils are rudosols (approximately 61%) which have a shallow profile dominated by rock and little topsoil. These have a high erosion risk when disturbed due to weak structure and lack of cohesion. General descriptions of soils within the project area are summarised in Table 9.

Table 9: Description of Soils within the Project Area

ASRIS code[1,2]	Dominant Northcote[3]	Dominant ASC[4]	Description[4, 5]	Area (ha)
Bz4 High plateaux with steep-scarped margins and relatively narrow dissected valleys	Uc1.21	Rudosol	Soils that have negligible pedologic organisation. They have a shallow profile, which is dominated by rock and there is little, if any, topsoil.	95,610
Bz1 High hilly to mountainous, strongly dissected, sandstone ranges and plateaux with strong scarps and often deep narrow ravines	Uc1.21	Rudosol	Soils that have negligible pedologic organisation. They have a shallow profile, which is dominated by rock and there is little, if any, topsoil.	88,921
Ub65 Moderate to strongly undulating lands	Dy3.42	Sodosol	Soils with strong texture contrast between A horizons and B horizons. Deep sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoil material has moderate to high levels of exchangeable sodium, with clay content between 10 and 20 percent. This layer can be hard-setting.	33,339
Rf3 Moderately undulating lands with some rounded low hills	Db1.13	Chromosol	Soils with strong texture contrast between A horizons and B horizons. Shallow, sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoils are low in exchangeable sodium.	28,570
MM7 Low hilly to hilly terrain on volcanic rocks and appearing as open valleys in steep hilly to mountainous land, gentle to moderate side slopes to shallow streams with significant flats	Ug5.34	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	26,907

ASRIS code[1,2]	Dominant Northcote[3]	Dominant ASC[4]	Description[4, 5]	Area (ha)
Fz6 High hills, strongly dissected low ranges with some mesas	Um1.43	Rudosol	Soils that have negligible pedologic organisation. They have a shallow profile, which is dominated by rock and there is little, if any, topsoil.	13,175
Mz3 Undulating lands with occasional low lateritic scarps	Gn2.11	Kandosol	Soils which lack strong texture contrast and have massive or only weakly structured B horizons. They are generally well-drained loamy soils found on the crests of plateaus.	11,782
Fz9 Strongly undulating or low hilly areas, the hills mostly of mesa – or cuesta- like form with steep-scarped dissected margins	Um1.43	Rudosol	Soils that have negligible pedologic organisation. They have a shallow profile, which is dominated by rock and there is little, if any, topsoil.	7,751
CC21 Gently undulating or level plains	Ug5.24	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	5,475
Ii2 Former lake beds and flood-plains	Ug5.2	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	5,063
Rf6 Level or very gently undulating alluvial plains fringing drainage-ways	Db1.13	Chromosol	Soils with strong texture contrast between A horizons and B horizons. Shallow, sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoils are low in exchangeable sodium.	4,979
Rf5 Moderate or occasionally strongly undulating lands	Db1.13	Chromosol	Soils with strong texture contrast between A horizons and B horizons. Shallow, sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoils are low in exchangeable sodium.	4,934

ASRIS code[1,2]	Dominant Northcote[3]	Dominant ASC[4]	Description[4, 5]	Area (ha)
Ub67 Gentle to moderately undulating plains	Dy3.42	Sodosol	Soils with strong texture contrast between A horizons and B horizons. Shallow, sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoil material has moderate to high levels of exchangeable sodium, with clay content between 10 and 20 percent. This layer can be hard-setting.	4,527
Si5 Alluvial flood-plains mostly associated with major streams; the area is sometimes dissected by broad shallow drainage lines and there are occasional old low levees	Dy2.33	Sodosol	Soils with strong texture contrast between A horizons and B horizons. Shallow, sand-dominated topsoils with an abrupt increase in clay in the subsoil. The subsoil material has moderate to high levels of exchangeable sodium, with clay content between 10 and 20 percent. This layer can be hard-setting.	3,594
Bz5 Elevated undulating to low hilly lands with many large rock outcrops	Uc1.21	Rudosol	Soils that have negligible pedologic organisation. They have a shallow profile, which is dominated by rock and there is little, if any, topsoil.	3,216
Ii3 Alluvial plains associated with major drainage lines	Ug5.28	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	1,636
Kb10 Gentle or moderately undulating plains with occasional higher stony ridges or broad low hill crests	Ug5.12	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	569
Me4 Undulating or occasionally low hilly lands with some residual mesas	Gn3.2	Dermosol	Uniform clay soils that are not shrink-swell. They have deep topsoils with a gradual increase in clay, sodium and salt content with depth.	567

ASRIS code[1,2]	Dominant Northcote[3]	Dominant ASC[4]	Description[4, 5]	Area (ha)
Wa15 Moderate to strongly undulating lands with occasional low mesa-like hills	Dy5.41	Kurosol	Soils with strong texture contrast between A horizons and strongly acid B horizons. These are shallow, rock dominated soils that support native vegetation.	479
Wa16 Undulating or moderately undulating lands	Dy5.41	Kurosol	Soils with strong texture contrast between A horizons and strongly acid B horizons. These are shallow, rock dominated soils that support native vegetation.	307
CB3 Gentle to moderately undulating or rolling lands	Ug5.22	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	55
Kd8 Gentle or moderately undulating lands	Ug5.15	Vertosol	Soils with high shrink-swell capacity that exhibit strong cracking when dry. They can have deep topsoil, although the thickness is highly variable.	50

Note:

1 – ASRIS. (2011). ASRIS - Australian Soil Resource Information System. http://www.asris.csiro.au. Accessed Oct 2018.

2 – Northcote, K. H. with Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., Hubble, G. D., Isbell, R. F., McArthur, W. M., Murtha, G. G., Nicolls, K. D., Paton, T. R., Thompson, C. H., Webb, A. A. and Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne).

3 – Northcote, K.H. (1979). A Factual Key for the Recognition of Australian Soils. 4th edn., Rellim Technical Publishers, Glenside, SA.

4 – Isbell, R. F. (2002). The Australian Soil Classification. Revised Edition. CSIRO Publishing, Melbourne

5 – Landloch (2014) Soil Landscapes of the Roma and Fairview – Distribution and Management; Consultancy Report for prepared for Fluor Australia Pty Ltd.

4.4.2 Surface Water

FAPA is located within the Upper and Lower Dawson River and the Comet River sub-catchments of the Fitzroy Basin. Major watercourses in project area include:

- Dawson River;
- Hutton Creek;
- Baffle Creek;
- Juandah Creek;
- Eurombah Creek;
- Commissioner Creek;
- Broken Creek;
- Dry Branch Creek;
- Arcadia Creek; and
- Planet Creek.

Mapped drainage features and associated Stream Order (SO) located within FAPA are displayed on Figure 11 and Figure 12.

Environmental values applicable to FAPA surface waters, as defined by the Comet River Sub-basin Environmental Values and Water Quality Objectives, EPP Water (DERM, 2011a) and Dawson River Sub-basin Environmental Values and Water Quality Objectives, EPP Water (DERM, 2011b), and are as follows:

- Protection of the aquatic ecosystems;
- Primary industries:
    - Irrigation;
    - Farm use;
    - Stock watering;
- Recreation and aesthetics:
    - Primary and secondary recreation;
    - Visual appreciation;
- Drinking water;
- Industrial use; and
    - Cultural and spiritual values.

The Dawson and Comet River catchments are considered to be moderately disturbed waters in accordance with the relevant Sub-basin Environmental Values and Water Quality Objectives (WQOs), EPP Water (DERM, 2011a; 2011b).

Hydrology

The majority of mapped surface water features in the project area are minor drainage features with Stream Orders (SO) of 1 to 3. A small number of larger watercourses (creeks and rivers) with SOs of 4 to 6 are also present (as listed in the dot points above) (refer to Figure 11 and Figure 12).

Analysis of relevant streamflow gauge data for the project area identified the majority of these drainage features and watercourses are characterised as ephemeral, with the exception of the spring / baseflow fed Dawson River. These features typically flow during or immediately following significant rainfall events, with rapid flow recessions. Rainfall and resultant streamflow are also highly seasonal and variable. Annual and monthly rainfall for the project area is highly variable, which suggests the area is susceptible to both flood and drought events. Following periods of flow, surface water can persist in some drainage features as non-flowing, disconnected pools separated by large areas of dry / exposed stream beds. Surface water (flowing or non-flowing) is typically only present for a minor part of the hydrological cycle. Peak stream discharges typically occur during the wet season from December to March when rainfall is generally highest. As a consequence, surface water features in the project area do not typically support instream perennial surface water bodies (e.g. perennial waterholes). The exception to this is the spring / baseflow fed Dawson River. Furthermore, lower order minor drainage features (SO 1 to 3) are subject to substantial erosion and scouring as a result of high velocity ephemeral flows, as opposed to higher order features (SO 4 and above) which are typically depositional in nature, and support areas of alluvial deposits.

The Dawson River and Hutton Creek spring complexes (which discharge downstream of the confluence with the Hutton Creek) contribute a relatively consistent baseflow to the Dawson River. Baseflow accounts for the majority of streamflow in the Dawson River throughout most of the year.

Geomorphology

Watercourses in the project area demonstrate a wide range of geomorphologic character and typically exhibit a moderate to high level of impact from changes in land use e.g. clearing, grazing, stock access, cropping and disturbance of riparian vegetation.

Watercourses in the headwater catchments of the Comet River and Upper and Lower Dawson River sub-catchments are typically located in steep, confined to partially-confined valleys which at times become gorges (e.g. the Dawson River). As these watercourses transition from the steep headwater catchment to lower energy mid and lower catchments they typically become located in partially confined to unconfined valleys and eventually low relief terrain. The minor low order channels also become more suspended load dominated and show lateral instability.

Changes in land use such as land clearance, grazing and cropping has resulted in disturbance to soil and riparian vegetation, which has led to significant bank and bed instability along many sections of the abovementioned watercourses. These changes are particularly evident during high energy flood events, which facilitate downstream movement of large volumes of sediment and can result in rapid adjustments in channel morphology. These changes have also resulted in increased suspended sediment load and more frequent sediment deposits in downstream higher order features.

Wetlands

FAPA contains several wetland areas defined as Referable Wetlands of General Ecological Significance (GES) and High Ecological Significance (HES) (refer to Figure 11 and Figure 12). These wetlands are largely associated with perennial waterholes and spring locations.

Typical Surface Water Quality in FAPA

As discussed above, the Dawson and Comet River catchments are considered to be moderately disturbed waters in accordance with the relevant Sub-basin Environmental Values and Water Quality Objectives (WQOs), EPP Water. WQOs are defined under the Water Act and EPP Water for the purpose of protecting the identified EVs for a particular receiving environment. WQOs are available for the Upper and Lower Dawson River and Comet River sub-catchments under the broader Fitzroy River Basin Water Resources Plan (2011).

Water quality objectives for the Dawson and Comet Rivers are presented in Section 2.5 and Table 3.

Existing surface water quality in FAPA was assessed against relevant WQOs during the Santos GFD Project EIS. Key trends in surface water quality as part of the EIS were identified for each sub-catchment (where sufficient data was available). Detailed findings of the EIS are provided in Appendix N - Surface Water of the EIS report (which is accessible at the QLD Coordinator General's website). General trends in the findings of the EIS in relation to FAPA are summarised below.

Comet River

Key surface water trends:

- High turbidity - greater than 50 NTU, ranging up to 1,070 NTU. Increased turbidity downstream of Rolleston from a median of 150 NTU to approximately 800 NTU (possibly due to riparian de-vegetation and erosion as a result of grazing activities and erosive soils).
- Significant variation in EC throughout the catchment (between 100 to 919 µS/cm).
- Median EC values calculated from historic data indicated consistent exceedance of the local guideline value of 375 µS/cm in baseflow conditions. EC was generally lower than the guideline value in Comet River (240 µS/cm).
- Significant variation in EC between high and low flow conditions (based on DNRM gauge data.)
- Alkaline pH (generally in the range of 7 – 8.2 pH units).
- High levels of filterable reactive phosphorus and total phosphorus – exceeding local guideline values for Comment River sub-basin.
- Heavy metals present in high concentrations above ANZECC 2000 trigger levels including chromium, copper, nickel, lead and zinc.

Upper Dawson River main channel (headwaters to junction with Hutton Creek)

Key surface water trends:

Physiochemical parameters:

- Water quality exceeds local guideline values (based on 95th percentile) for: dissolved oxygen, EC, pH, suspended solids and turbidity.
- Median and 95th percentile values for pH of 7.6 to 8.8, respectively – indicates receiving waters tend to be slightly to moderately alkaline.
- 95th percentile for turbidity was over 20 times of local guideline value at 1040 NTU, and median value of 48 NTU, which is within the local guideline value.

Nutrient and microbiological parameters:

- Water quality exceeds local guideline values (based on median and 95th percentile) for:
    - Chlorophyll α (median and 95th percentile)
    - Oxidised nitrogen (nitrite + nitrate as N) (median and 95th percentile)
    - Reactive phosphorus as P (95th percentile)
    - Total nitrogen as N (median and 95th percentile)
    - Total phosphorus as P (95th percentile)
    - Sulphate as SO_4^{2-}(95th percentile)
    - Nutrients such as nitrogen, phosphorus and sulphate were found at levels greater than relevant trigger values, which indicates the sub-catchment is affected by eutrophication, with potentially harmful conditions for aquatic ecosystems.

Toxicants:

- Water quality exceeds regional guideline values (based on median and 95th percentile) for:
  - Ammonia as N (median and 95th percentile);
  - Chromium (95th percentile);
  - Copper (median and 95th percentile);
  - Lead (95th percentile); and
  - Zinc (95th percentile).

Upper Dawson River main channel (Hutton Creek to Taroom)

Key surface water trends:

Physiochemical parameters:

- Water quality exceeds local guideline values (based on 95th percentile) for: dissolved oxygen, EC, and turbidity.
- The median and 95th percentile for turbidity was 3 to 13 times greater, respectively, than the local guideline value at 1040 NTU, and median value of 48 NTU, which is within the local guideline value of 50 NTU.

Nutrient and microbiological parameters:

- Water quality exceeds local guideline values (based on median and 95th percentile) for:
  - Chlorophyll α (median and 95th percentile)
  - Oxidised nitrogen (nitrite + nitrate as N) (median and 95th percentile)
  - Reactive phosphorus as P (95th percentile)
  - Total nitrogen as N (median and 95th percentile)
  - Total phosphorus as P (95th percentile)
  - Chlorophyll α was found to be present in concentrations of over 2 to 5 times greater than the local guideline value of 5 µg/L.
  - The 95th percentile values for nutrients listed above are significantly elevated above the relevant local guidelines values. The waters of the Dawson River main channel were found to be nutrient enriched as per the findings of previous studies.

Toxicants:

- Water quality exceeds regional guideline values (based on median and 95th percentile) for:
  - Ammonia as N (median and 95th percentile)
  - Chromium (95th percentile)
  - Copper (median and 95th percentile)
  - Lead (95th percentile)
  - Zinc (95th percentile)

Ammonia (median and 95th percentile) values were found to be 2 to 7 times greater than the local guideline value of 20 µg/L. Chromium (95th percentile) was found to be over 6 times greater than the regional guideline value of 1 µg/L. Total zinc (95th percentile) was found to be over 3 times greater than the regional guideline value of 8 µg/L. These results were similar to those identified upstream at the Upper Dawson River main channel (headwaters to junction with Hutton Creek).

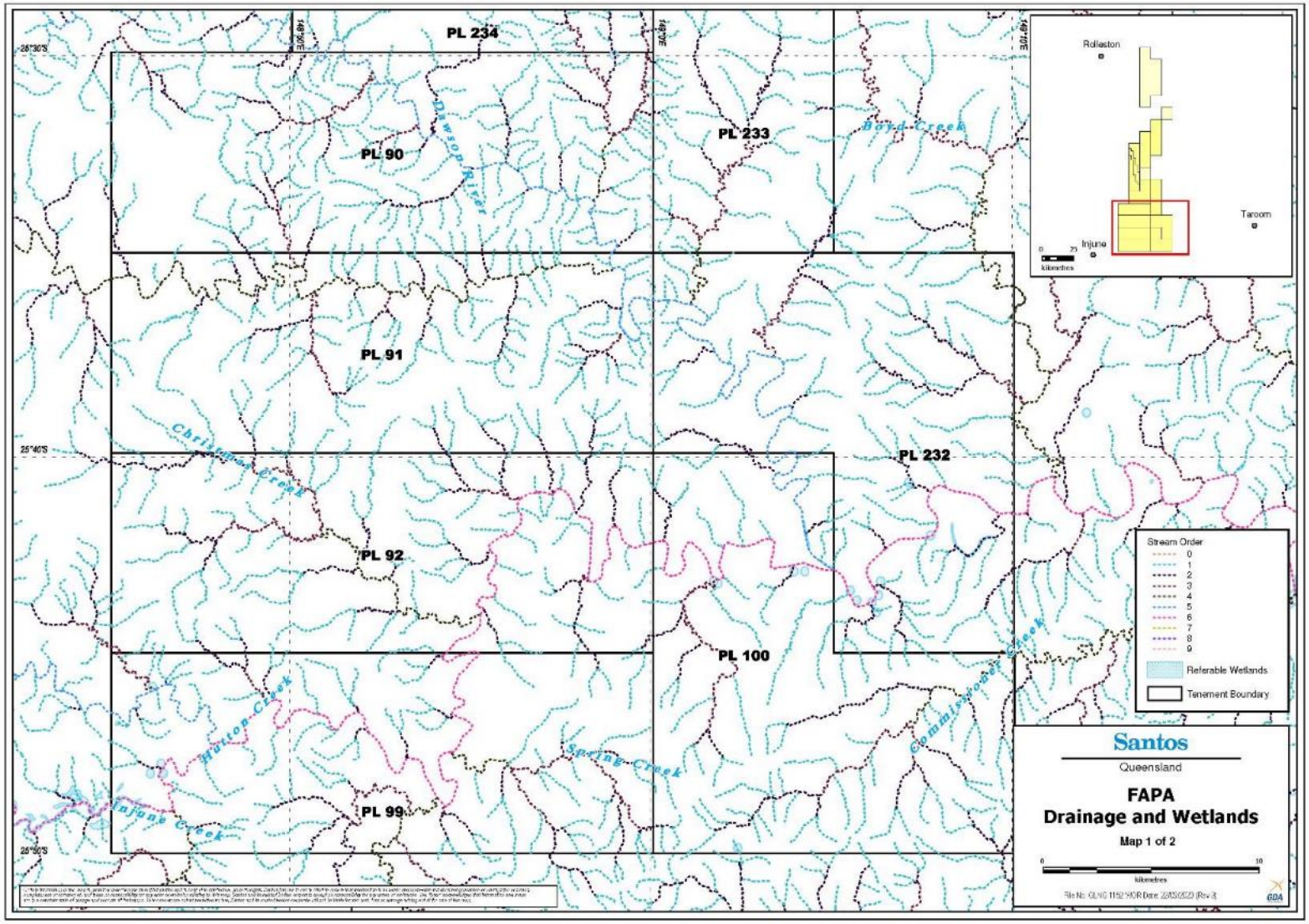


Figure 11 – Fairview Project Area - mapped drainage and referable wetlands

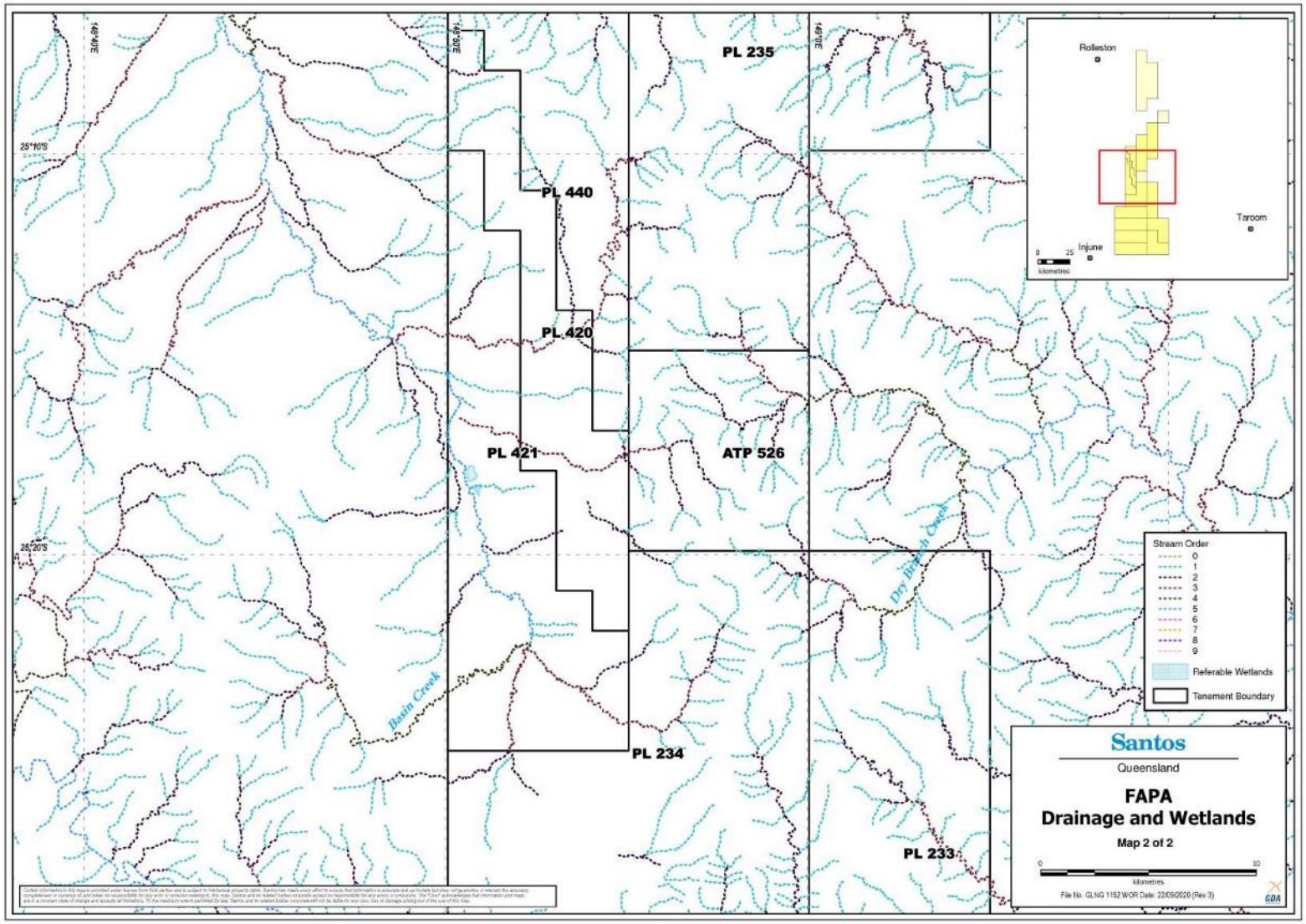


Figure 12 – Arcadia Project Area - mapped drainage and referable wetlands

4.4.3 Groundwater

FAPA is located within the Comet and Dawson river catchment of the Fitzroy Basin. The environmental values identified for these basins are derived from the Comet River Sub-basin Environmental Values and Water Quality Objectives (DERM, 2011a) and Dawson River Sub-basin Environmental Values and Water Quality Objectives (DERM, 2011b), and are as follows:

- Protection of aquatic ecosystems;
- Primary Industries;
    - Irrigation;
    - Stock watering;
    - Farm supply / use;
- Recreation and aesthetics;
    - Primary and secondary recreation
    - Visual appreciation;
- Drinking water;
- Industrial use; and
- Protection of cultural and spiritual activities

Sensitive groundwater receptors in the FAPA include:

- Users that access groundwater from hydrogeological units for domestic water supplies and stock watering;
- Ecosystems dependent on groundwater from springs, including spring vents and watercourse springs.

Groundwater values of FAPA are detailed in the Santos GFD Project EIS, Chapter 14 - Groundwater and Appendix O - Groundwater of the EIS report (which is accessible at the QLD Coordinator General's website). A summary of groundwater values identified within FAPA is provided below.

4.4.3.1 Confined Sandstone Aquifers

FAPA is underlain by several deep and confined sandstone aquifers that provide reliable sources of good quality water for stock and domestic supply. The major water bearing aquifers are associated with the Great Artesian Basin (GAB), which comprises water bearing units of the Surat Basin, and aquifers of the upper Bowen Basin.

The vast majority of registered bores within FAPA take groundwater from the Precipice Sandstone of the Surat Basin. The Boxvale Sandstone of the Surat Basin may also be targeted along the southern boundary of the FAPA, but are generally absent or non-productive across most of FAPA. The Clematis Sandstone is targeted for water supply further north of FAPA where the Precipice Sandstone is typically absent. These aquifers typically contain fresh water that is used for stock and domestic water supply. Across most of the project area, aquifers targeted for water supply are confined by low-permeability units of the Evergreen Formation of the Surat Basin or Rewan Formation of the Bowen Basin. Steep escarpments are typically formed where these aquifers outcrop in the landscape.

Within FAPA, spring vents and watercourse springs fed by natural discharge from the Precipice Sandstone aquifer of the GAB are present. These are described in the EIS and in the *Underground Water Impact Report for the Surat Cumulative Management Area* (2019 UWIR). Refer to Figure 9-2 of the 2019 UWIR for locations within FAPA.

4.4.3.2 Shallow unconfined aquifers

There are no major unconfined aquifers within FAPA because alluvial deposits are generally poorly developed across the region. Where unconfined water-bearing zones are present, they do not support sustainable water extraction or ecosystems unless they are immediately proximal to (and in direct connectivity with) permanent or semi-permanent riparian waters.

Such unconfined water-bearing systems are expected to be extremely limited in volume and extent adjacent to the Dawson River due to the steep slope and general absence of flood plain adjacent to the water course. Such unconfined alluvial systems would be poorly developed adjacent to the Comet River due to the absence of porous source material. The Comet River across FAPA overlies the Rewan Formation. Erosion of the Rewan Formation results in alluvial material comprising fine silt that is not permeable (i.e. would not yield groundwater).

5.0 Potential Impacts, Mitigation Measures and Environmental Risk Assessment

This section identifies and assesses potential impacts, mitigation measures (control strategies), and environmental risks to the environment values identified in Section 4.0 resulting from the proposed EA amendment.

As discussed in Sections 2.3 and 4.0, the majority of FAPA LPDs are located outside areas defined as 'waters' by the EA, and Santos is currently authorised to release water from LPDs to land. As such, the release of water from LPDs to land is not considered as part of this amendment application. Specifically, this amendment application is applying for authorisation to release water from LPDs to 'waters' as defined by the EA.

Furthermore, the small number of FAPA LPDs located within areas defined as 'waters' under the EA are primarily located near highly ephemeral drainage features that do not typically contain discernible watercourse features, and are dry for extended periods of time. These LPDs typically release to dry land when no surface water is present i.e. the risks and potential impacts of these releases to dry 'waters' are largely consistent with those currently authorised by the EA for releases to land.

5.1 Regional Ecosystems, Terrestrial Flora and Fauna and ESAs

As discussed on Section 4.0, the release of water from LPDs to land is already authorised by the EA, and no change is proposed. This section only addresses this value in context of where it is present within an area described as 'waters' under the EA.

As discussed in Section 5.1, LPDs are located in and release within operational areas that have been previously disturbed as part of the disturbance footprint (RoW) created for pipeline construction activities. Consequently, environmental values associated with REs, flora and fauna, and ESAs are largely absent from these areas.

RoWs are maintained to be free of woody vegetation to maintain pipeline integrity. Therefore, the opportunity for native vegetation to directly interact with water released from low point drains is low. Furthermore, Santos maintains and removes vegetation from within and immediately around LPDs to ensure operational integrity, and maintain access for inspection of LPDs and discharge areas. Moreover, the immediate areas within and surrounding LPDs are typically covered in gravel or rock, which limits vegetation growth.

The abovementioned operational requirements, combined with the low volumes of water typically released at any one location, further mitigate the potential for pooling, ponding or run-off of water released from LPDs to interact with vegetated areas.

Similarly, the opportunity for fauna species to interact with released water is mitigated by the above-mentioned factors. Water released from LPDs is undertaken to prevent pooling, ponding and run-off.

The introduction of weed species or their persistence resulting from the availability of additional water source points is possible. However, LPDs and pipeline RoWs are frequently monitored as part of ongoing inspections for weed incursions, and treated and removed where identified.

Management (control) strategies, potential impacts and the level of risk associated with the proposed activities are summarised in Table 10. The results of the risk assessment indicate the residual risk to regional ecosystems and terrestrial flora and fauna environmental values as a result of the proposed activities is classified as 'very low'.

5.2 Water Resources

5.2.1 Soils

As discussed on Section 4.0, the release of water from LPDs to land is already authorised by the EA, and no change to this is proposed. This section only addresses this value in context of where it is present within an area described as 'waters' under the EA (i.e. when there no water present).

As discussed in Section 2.3, water from LPDs is released to previously disturbed soils (as part of the disturbance footprint (RoW) created for pipeline construction activities). LPD release areas are 'operational areas'.

It is unlikely soil quality will be significantly adversely affected by water released from LPDs as the water is typically of good quality (70% of reported EC concentrations are < 370 µS/cm), typically low in volume and velocity, and the release areas are protected from erosion by the placement of rock or gravel over soils (i.e. LPDs release to a gravelled area, or into a shallow pit filled with rock). Furthermore, any minor accumulation of salts in the near surface and root zone will be regularly diluted as a result of natural processes i.e. rainfall and surface water flow and infiltration.

There is some potential for minor impacts to soil structure because water released from LPDs can have a higher Sodium Adsorption Ratio (SAR). Impacts may include localised loss of soil structure over time by increasing soil exchangeable sodium percentage (ESP) and causing dispersion of clay colloids. This risk however can be readily managed through early warning triggers identified through visual inspection of release locations (as per the inspections currently undertaken by Santos discussed in Section 2.6). The potential for impacts can therefore be successfully mitigated by moving the release location to adjacent soil and / or the application of gypsum (equivalent of 10 t/ha or 1 kg/m^2) to the wetted area at the discharge point. New Santos LPD installations typically include a discharge point in the form of a small pit filled with rock. These pits are typically pre-treated with gypsum as a precautionary measure.

Management (control) strategies, potential impacts and the level of risk associated with the proposed activities are summarised in Table 10. The results of the risk assessment indicate the residual risk to land resources (soils) environmental values as a result of the proposed activities is classified as 'very low'.

5.2.2 Surface Water

As described in Section 2.3, approximately 16% of LPDs within the FAPA are located within 10 m of a mapped drainage feature / watercourse. 95% of these LPDs are located within 10 m of SO1, SO2 or SO3 feature.

SOs 1, 2 and 3 are typically highly ephemeral drainage features occurring high in the catchment, that do not typically contain discernible watercourse features i.e. distinct bed or banks, evidence of extended flows and/or riparian vegetation. Instead, these drainage features are often depressions in the landscape that will naturally collect and flow water during heavy periods of rainfall. These features are dry for extended periods of time, and typically only contain water for very short periods of time during and immediately following high rainfall events.

As discussed in Section 5.1, water released from LPDs has low potential to move beyond the release area. Where LPDs are located near drainage features it is highly unlikely that released water will pool, pond or flow away from discharge areas. Interactions between LPDs and surface water is typically a function of surface water flowing into or over LPD installations. This process is not desirable for Santos from an operational perspective, but it does not pose any risk of environmental harm. Furthermore, as discussed in Section 5.2.1, any surface water interaction with LPD discharge areas will only serve to

dilute any potential minor accumulation of salts in the near surface and root zone with limited to no potential to accumulate within the surface water.

As discussed in Section 2.3, there are only limited examples (9) of LPDs being located close to higher order creeks or rivers in FAPA (i.e. SO 4, 5 and 6). Santos avoids placing LPDs within the “bed and banks” of pipeline crossings of higher order creeks or rivers (e.g. Dawson River) where standing or permanent surface waters are known to exist, and/or where there may be potential for water from LPDs to interact with surface water bodies.

As discussed in Sections 5.1 and 5.2.1, LPD installation occurs during the construction and installation of gas gathering lines. As such, LPDs are located in (and discharge to) pre-disturbed operational areas (i.e. pipeline RoW), and environmental values associated with flora (e.g. riparian vegetation) and fauna (including aquatic fauna) are largely absent from these areas. LPDs also have limited potential to interact with flora and fauna values located outside these operational areas as discharges are undertaken to prevent pooling, ponding and run-off. Furthermore, where LPDs are located near mapped drainage features, these features are typically low Stream Order and ephemeral in nature with limited ecological value, and do not typically support riparian vegetation, permanent or semi-permanent water, or provide significant habitat for aquatic fauna.

A key requirement of the outcome based conditions negotiated in 2013 was to ensure the discharge of water from LPDs was managed in a controlled manner. This was done to ensure no pooling, ponding or runoff from LPD discharge areas occurred, and that no releases of LPD water to ‘surface waters’ occurred. The agreed intent of the outcome based conditions was to prohibit the release of LPD water directly to surface water bodies, while permitting LPDs to release water to land located near or on the edge of drainage features and watercourses. LPDs by their very design must be located in these areas as topographical low areas and to function correctly.

Furthermore, during periods of heavy rainfall resulting in overland water flow, these flows may encroach upon LPDs and their associated release areas. In this circumstance, overland flow may also enter LPD release locations. Given that there is no ponding of released water, and the typical quality of water released from LPDs (70% of reported EC concentrations are < 370 µS/cm), combined with dilution associated with rainfall and overland flow water, this is highly unlikely to result in any adverse impacts to vegetation (including aquatic flora), fauna (including aquatic fauna) or surface waters.

Santos has identified one LPD that is located within a mapped Referable Wetland of General Ecological Significance (GES) in the Fairview Project Area (refer to Figure 13). However, this mapped wetland is a spring location that has been buffered by the State for the purposes of mapping. Ground-truthing demonstrates the spring is in a different location, and therefore the LPD discharges to an area outside of the Referable Wetland. The LPD is located approximately 320 m away from the spring (refer to Figure 13).

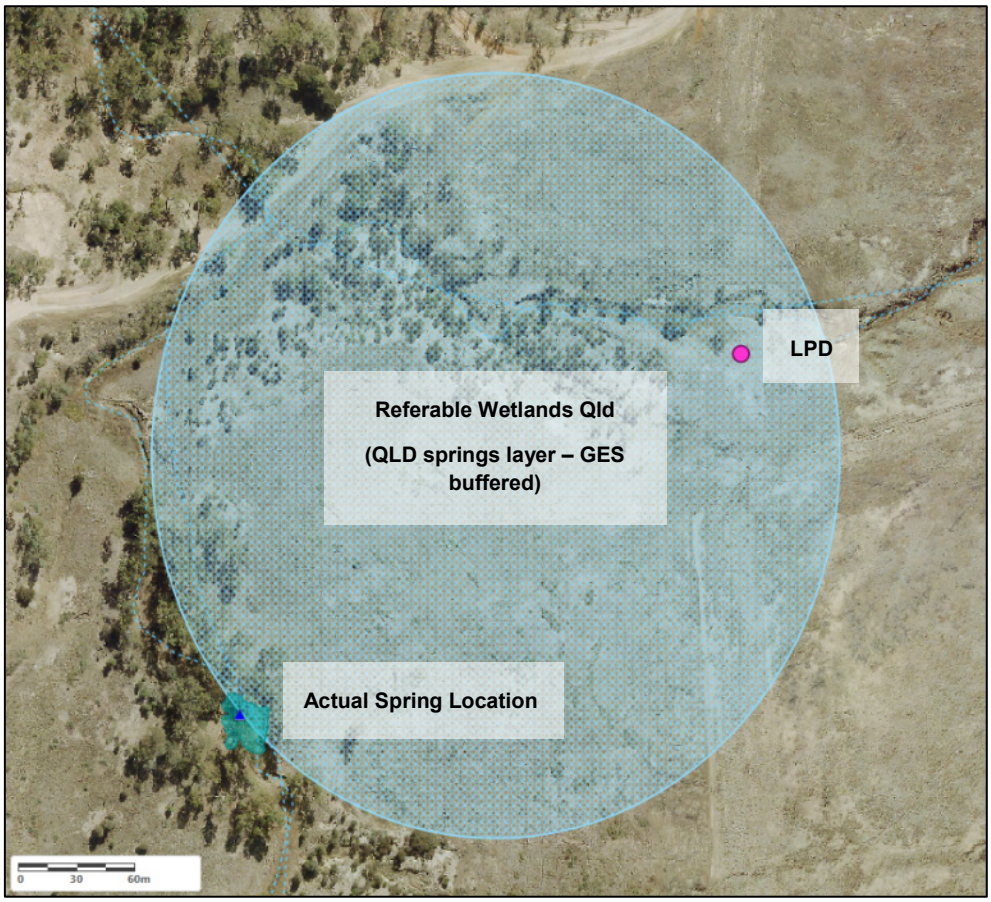


Figure 13 – FAPA – LPD and Referable Wetland (GES)

Management (control) strategies, potential impacts and the level of risk associated with the proposed activities are summarised in Table 10. The results of the risk assessment indicate the residual risk to surface water environmental values as a result of the proposed activities is classified as 'very low'. This predominantly due to the following factors:

- only a proportion of LPDs are located near drainage features, and only a very small number of LPDs are located near higher order drainage features;
- not all LPDs location near 'waters' have the potential to release to 'waters;
- where LPDs are located near drainage features, these features are typically low Stream Order and ephemeral in nature with limited ecological value, and do not typically support riparian vegetation, permanent or semi-permanent water, or provide significant habitat for aquatic fauna.
- controlled manner in which water is released from the LPDs i.e. water released from LPDs is undertaken to prevent pooling, ponding and run-off.
- the typically low volumes and short duration of released water; and
- the typically quality of released water (i.e. low toxicity (refer Table 3).

5.2.3 Groundwater

As discussed on Section 4.0, the release of water from LPDs to land is already authorised by the EA, and no change to this is proposed. The risks and impacts to groundwater associated with the authorised release to land and the proposed release to 'waters' are considered to be largely consistent. This section only addresses this value in context of where it is present within an area described as 'waters' under the EA.

Water released from LPDs is undertaken in compliance with existing EA conditions for release to land i.e. the outcome based conditions, which include the following conditions at Part A, D2: *(e) deep drainage below the root zone of any vegetation is minimised; and (f) the quality of shallow aquifers is not adversely affected*. No change to these conditions is proposed.

To ensure compliance with these conditions, LPD water is released to gravelled areas or shallow pits filled with rocks, which allows water to seep into the root zone and above. As discussed in Sections 2.4 and 2.5, water released from LPDs is typically of good quality (70% of reported EC concentrations are < 370 µS/cm) and low in volume. Any minor accumulation of salts in the near surface and root zone will be diluted as a result of rainfall infiltration.

As discussed in Section 4.4.3, unconfined shallow groundwater in FAPA is only located adjacent to permanent or semi-permanent surface water (i.e. higher order drainage features). Only a small number of groundwater bores are recorded as targeting unconfined alluvial material in FAPA, and most of these were abandoned soon after they were drilled.

Infiltration of LPD water to shallow groundwater resources is highly unlikely to adversely impact shallow groundwater resources given general absence of shallow groundwater except where immediately adjacent to permanent or semi-permanent riparian water (i.e. major creeks such as Dawson or Comet River)

As discussed in Sections 2.3 and 4.4.1, only a minor number of LPDs (9) are located within or immediately adjacent to potentially shallow groundwater resources i.e. associated with SO 4 and above watercourses.

Deeper sandstone aquifers such as the Precipice Sandstone and Clematis Sandstone are generally isolated from surface water infiltration by thick and competent aquitards such as the Evergreen and Rewan Formation respectively. Where these sandstones outcrop (i.e. where aquitards are absent), the

landscape is typically steep and rocky. Such ground conditions typically preclude the development of linear pipeline infrastructure.

Management (control) strategies, potential impacts and the level of risk associated with the proposed activities are summarised in Table 10. The results of the risk assessment indicate the residual risk to groundwater environmental values as a result of the proposed activities is classified as 'very low'.

5.3 Environmental Risk Assessment

A risk assessment of the release of water from LPDs to 'waters' is presented in Table 10. The risk assessment has been undertaken in accordance with the Santos Management System (SMS) Risk Management Standard. The SMS Risk Management Standard is based on accepted principles and applicable Australian standards.

Table 10: Environmental Risk Assessment

Identification			Unmitigated Risk			Control Strategies	Residual Risk		
Risk Event / Activity	Relevant EV	Potential Impact	Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Release of water from low point drains	Flora, Regional Ecosystems, ESAs and Fauna	Toxicity to terrestrial flora and fauna Adverse impacts to native vegetation / riparian vegetation	I	d	Low	**General** • Compliance with relevant Environmental Authority conditions, and all relevant internal and external approvals in place before work undertaken. • All disturbance undertaken in accordance with Santos standards. • Appropriate emergency response plans in place. • Industry standards and good industry practices are followed. • Assess proposed disturbance locations for the potential presence of high value flora and fauna or suitable habitat before commencement of construction, and implement appropriate avoidance or mitigation measures. **Flora, Regional Ecosystems, ESAs and Fauna** • Maximise avoidance of high constraint areas (e.g. wetland REs, high value vegetation / habitat areas) (where appropriate / required). • Infrastructure micro-sited to avoid impacts to threatened species and habitat (as required). • Installation of LPD infrastructure and release points within operational pipeline RoW (where environmental values have been largely removed). • Pipeline RoWs and LPD areas to be maintained to be free of woody vegetation. • Immediate areas within and surrounding LPDs covered in gravel or rock to limit vegetation growth (where appropriate). • LPD discharge point and release rates managed to ensure maximum infiltration to shallow soil, and to prevent pooling, ponding and run-off from the designated release area. **Monitoring** • LPD release areas to be visually inspected for: o evidence of water from LPDs leaving the designated release area. o adverse impacts to vegetation. o LPDs and pipeline RoWs monitored for weed incursions. o signs of activity by native fauna within proximity of LPD discharge points; and o appropriate rectification measures implemented where any of the above is present.	I	b	Very Low
Surface Water (and Soils)		Degradation of surface water quality Toxicity to aquatic fauna / fauna Degradation of surface water quality from sediment releases / increased sedimentation Soil erosion Impacts to soil structure Contamination of soil resources	II	d	Low	**General** • Refer to Control Strategies listed under the Flora, Regional Ecosystems, ESAs and Fauna EV. **Surface Water** • No new LPDs to be located: o within or in proximity to Referable Wetlands or springs. o within close proximity to higher stream order / perennial watercourses or where the potential for interaction with semi-permanent surface water is high; and o in erosion prone soils and/or steep slopes where practicable. • Activities to be located outside areas subject to periodic inundation wherever practicable. • LPD discharge point and release rates managed to ensure maximum infiltration to shallow soil, and to prevent pooling, ponding and run-off from the designated release area. • Erosion and sediment controls installed where necessary, and prior to disturbance. • Infrastructure prepared and constructed to maintain pre-existing surface water flows. • Sensitive land systems (e.g. wetlands) avoided wherever possible. Where activities are undertaken in or near these areas, appropriate review, assessment and mitigation measures are in place to ensure that surface water flows are maintained. • Flood o Activity planning will consider seasonal conditions including potential risk and impacts of flood. **Soils** • Surface disturbance restricted to the minimum area required to safely carry out activities. • No new LPDs to be located:	I	c	Very Low

Identification			Unmitigated Risk			Control Strategies	Residual Risk		
Risk Event / Activity	Relevant EV	Potential Impact	Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
						○ within close proximity to higher stream order / perennial watercourses or where the potential for interaction with semi-permanent surface water is high; and ○ in erosion prone soils and/or steep slopes where practicable. • LPD discharge point and release rates managed to ensure maximum infiltration to shallow soil, and to prevent pooling, ponding and run-off from the designated release area. • Erosion and sediment controls installed where necessary, and prior to disturbance. • LPD discharge areas to be covered in rock / gravel or discharged into rock filled shallow pits. • All new LPD installations to include discharge pits pre-treated with gypsum. • LPDs located within operational pipeline RoW to ensure water is only released to pre-disturbed 'operational areas'. • Activity planning will consider seasonal conditions including potential risk and impacts of flood. • LPDs to be fenced where practicable to avoid interference by livestock. **Loss of Containment** • Regular monitoring of control systems (e.g. emergency shutdown valves) to ensure that protection levels are adequate. • Emergency spill response equipment on site. • Loss of containment is managed via appropriate Santos incident management system, and implementation of corrective actions is based on incident investigation. • Emergency response training for emergency response personnel. **Monitoring** • LPD release areas to be visually inspected: ○ for signs of erosion, and rectification works implemented where erosion or scouring is observed. ○ for signs of earlier warning of potential impacts to soil structure (i.e. dispersion and hard setting), and gypsum applied where appropriate. ○ to ensure LPDs are in good and proper working order; and ○ appropriate rectification measures implemented where any of the above is present.			
Release of water from low point drains	Groundwater	Contamination of shallow groundwater	I	b	Very low	**General** • Refer to Control Strategies listed under the Flora, Regional Ecosystems, ESAs and Fauna EV. **Groundwater** • No new LPDs to be located: ○ within close proximity to higher stream order / perennial watercourses. ○ within the bed and banks of watercourses; and ○ within close proximity to groundwater bores that access shallow groundwater resources. • LPD discharge point and release rates managed to ensure maximum infiltration to shallow soil, and to prevent pooling, ponding and run-off from the designated release area. **Loss of Containment** • Regular monitoring of control systems (e.g. emergency shutdown valves) to ensure that protection levels are adequate. • Emergency spill response equipment on site. • Loss of containment is managed via appropriate Santos incident management system, and implementation of corrective actions is based on incident investigation. • Emergency response training for emergency response personnel. **Monitoring** • LPD release areas to be visually inspected to ensure LPDs are in good and proper working order.	I	b	Very Low

6.0 Legislative Considerations

6.1 *Environmental Protection Act 1994 (EP Act)*

6.1.1 General Requirements for an EA Amendment Application (s226 EP Act)

Section 226 and 226A of the EP Act specifies the general requirements for an EA amendment application. Table 11 contains a summarised checklist of the EP Act general requirements against this proposed amendment application.

Table 11: General requirements EA amendment application (s226 EP Act)

Section 226 and 226A EP Act	Relevance to amendment application
226(1)(a) be made to the administering authority	The EA amendment application has been lodged with DES who is the administering authority for the EP Act.
226(1)(b) be made in the approved form	Refer to Attachment 1 of the application package, which includes the *Application to amend an environmental authority.*
226(1)(c) be accompanied by the fee prescribed under a regulation	The applicable fee was paid upon lodgement of this application.
226(1)(d) describe the proposed amendment	Refer to Section 2.9
226(1)(e) describe the land that will be affected by the proposed amendment	Refer to Sections 3.0 and 4.0
226(1)(f) include any other document relating to the application prescribed under a regulation.	Refer to the information provided throughout this supporting report.
226A(1)(a) describe any development permits in effect under the Planning Act for the carrying out of the relevant activity for the authority; and	Not applicable – No development permits are in effect under the *Planning Act 2016* for the activities, which are the subject of this amendment application
226A(1)(b) state whether each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity	Not applicable – There are currently no eligibility criteria relevant to the activities proposed by the amendment application.
226A(1)(c) if the application states that each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity— include a declaration that the statement is correct	Not applicable – There are currently no eligibility criteria relevant to the activities proposed by the amendment application.
226A(1)(d) state whether the application seeks to change a condition identified in the authority as a standard condition	Not applicable - The respective EA does not contain any standard conditions.
226A(1)(e) if the application relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—state whether the applicant seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit	Not applicable - The application does not relate to a new resource tenure.

Section 226 and 226A EP Act	Relevance to amendment application
226A(1)(f) include an assessment of the likely impact of the proposed amendment on the environmental values, including—	Refer to Section 5.0.
226A(1)(f)(i) a description of the environmental values likely to be affected by the proposed amendment;	Refer to Sections 3.0 and 4.0.
226A(1)(f)(ii) details of any emissions or releases likely to be generated by the proposed amendment;	Refer to Section 5.0.
226A(1)(f)(iii) a description of the risk and likely magnitude of impacts on the environmental values;	Refer to Section 5.0.
226A(1)(f)(iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts;	The prevention/minimisation of adverse impacts associated with the amendment will be achieved through compliance with conditions of the EA, by the implementation of local and international best practice, and the implementation of management plans as appropriate. Refer to Section 5.0.
226A(1)(f)(v) details of how the land the subject of the application will be rehabilitated after each relevant activity ceases;	Land affected by the proposed activities will be rehabilitated in accordance with the conditions of the EA.
226A(1)(g) include a description of the proposed measures for minimising and managing waste generated by any amendments to the relevant activity;	Not Applicable – The proposed amendment does not involve the generation of a new waste stream.
226A(1)(h) include details of any site management plan or environmental protection order that relates to the land the subject of the application;	Not applicable – There is no relevant site management plan or current Environmental Protection Orders relating to land located within the relevant tenure areas.

6.1.2 CSG Activities Requirements for EA Amendment Applications (s227 EP Act)

Section 227 of the EP Act specifies requirements for an amendment application for CSG activities as follows:

***Section 227* Requirements for amendment applications—CSG activities**

(1) This section applies for an amendment application if—

(a) relates to an EA for a CSG activity; and

(b) the proposed amendment would result in changes to the management of CSG water; and

(c) the CSG activity is an ineligible ERA.

(2) The application must also—

(a) state the matters mentioned in section 126(1); and

(b) comply with section 126(2).

This application relates to the release of pipeline waste water from LPDs. The disposal mechanism is already approved by the conditions of the EA. The application seeks clarity regarding the approved release of water from LPDs to land and to 'waters'.

It is arguable that the management of CSG water has not changed. However, for completeness, the requirements of s126 of the EP Act has been addressed in Table 12 below.

Table 12: Requirement for site-specific applications – CSG activities (s126 *EP Act*)

Section 126 *EP Act*	Relevance to amendment application
(1) A site-specific application for a CSG activity must also state the following -	
(a) the quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant CSG activity;	The proposed amendment will not result in any changes to the quantity of CSG water produced by activities currently authorised under EA EPPG00928713.
(b) the flow rate at which the applicant reasonably expects the water will be generated;	The proposed amendment will not result in any changes to the flow rate of CSG water produced by activities currently authorised under EA EPPG00928713.
(c) the quality of the water, including changes in the water quality the applicant reasonably expects will happen while each relevant CSG activity is carried out;	The proposed amendment will not result in any changes to the quality of water produced by activities currently authorised under EA EPPG00928713.
(d) the proposed management of the water including, for example, the use, treatment, storage or disposal of the water;	Santos is currently authorised to release water from LPDs to land in accordance with outcome based conditions contained in EA EPPG00928713. The proposed amendment will not result in any changes to the management, use, treatment or disposal of water produced by activities currently authorised under EA EPPG00928713. The purpose of this amendment application is to resolve ambiguity associated with the existing authorisation to release water from LPDs to land; and to explicitly authorise release to 'waters' as defined by the EA. Refer Section 2.0 for further information about the management of water released from LPDs.
(e) the measurable criteria (*the management criteria*) against which the applicant will monitor and assess the effectiveness of the management of the water, including, for example, criteria for each of the following -	
(i) the quantity and quality of the water used, treated, stored or disposed of;	The quantity and quality of water released by LPDs in FAPA is described in Sections 2.4 and 2.5, respectively.
(ii) protection of the environmental values affected	Compliance with mitigation measures outlined in Section 5.0, and any future conditions of the FAPA EA relating to the release of contaminants from LPDs.

Section 126 *EP Act*	Relevance to amendment application
by each relevant CSG activity'	
(iii) the disposal of waste, including, for example, salt, generated from the management of the water;	The purpose of this amendment application is to resolve ambiguity associated with the existing authorisation to release water from LPDs to land; and to explicitly authorise release to 'waters' as defined by the EA.
(f) the action proposed to be taken if any of the management criteria are not complied with, to ensure the criteria will be able to be complied with in the future.	If Santos was to detect any non-compliance with EA conditions pertaining to the authorised release of water from LPDs, the cause of the non-compliance would be investigated and corrective actions implemented. The cause of a non-compliance may potentially include: • Damage to vegetation; • Adverse impacts to soil quality; • Release of aerosols or odours; • Visible scouring or erosion; and • A material build-up of sediment in waters (as defined in the EA). Where a potential non-compliance is identified, the following actions and mitigation measures would be implemented: • Site investigation – including site inspection, root cause investigation, water/soil sampling and other monitoring (as required). • Apply gypsum to mitigate potential impacts to soil structure. • Inspect (and rectify) LPD release area to ensure appropriate measures/structure are in place, and are effectively preventing, ponding, pooling or run-off. • Inspect LPD to ensure it is operating effectively. • Inspect (and rectify) erosion, sediment control measures/structures where required. Refer to Section 5.0 for additional mitigation measures (control strategies) relevant to the proposed amendment.
(2) The proposed management of the water can not provide for using a CSG evaporation dam in connection with carrying out a relevant CSG activity unless-	
(a) the application includes an evaluation of -	The amendment does not seek the authorisation of (or relate to) a produced water evaporation dam.
(i) best practice environmental management for managing the CSG water; and	Refer above.
(ii) alternative ways for managing the water; and	Refer above.
(b) the evaluation shows there is no feasible alternative to a CSG evaporation dam for managing the water.	Refer above.

6.1.3 Underground Water Rights - EA Amendment Applications (s227AA EP Act)

Section 227AA of the EP Act specifies the requirements for an amendment application where the application involves changes to the exercise of underground water rights for a petroleum lease:

Section 227AA Requirements for amendment applications—underground water rights

(1) This section applies for an amendment application if—

(a) the application relates to a site-specific environmental authority for—

(i) a resource project that includes a resource tenure that is a mineral development licence, mining lease or petroleum lease; or

(ii) a resource activity for which the relevant tenure is a mineral development licence, mining lease or petroleum lease; and

(b) the proposed amendment involves changes to the exercise of underground water rights.

(2) The application must also state the matters mentioned in section 126A(2).

As described in Section 2.0, the amendment does not involve a change to the exercise of underground water rights. As such, Section 227A of the EP Act does not apply to this application.

6.1.4 Assessment Level Decision for Amendment Application (s228 EP Act)

Santos considers the proposed amendment satisfies all requirements of the definition of a minor amendment (threshold) in accordance with Section 223 of the EP Act. Refer to Table 13 for further information with regards to the determination of this application being a minor amendment.

Table 13: Minor amendment (threshold) assessment

Minor amendment (threshold), for an environmental authority, means an amendment that the administering authority is satisfied -		Relevance to amendment application
(a) is not a change to a condition identified in the authority as a standard condition, other than	✓	The EA does not identify any standard conditions.
(i) a change that is a condition conversion; or	✓	
(ii) a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates; and	✓	
(b) Does not significantly increase the level of environmental harm caused by the relevant activity; and	✓	The proposed amendment will not significantly increase the level of environmental harm authorised under the existing EA as described in Sections 2.0 and 5.0. The amendment is required to resolve ambiguity associated with existing conditions and definitions.
(c) Does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the authority; and	✓	The amendment does not seek to change any rehabilitation objectives of the EA.
(d) Does not significantly increase the scale or intensity of the relevant activity; and	✓	The proposed amendment would not significantly increase the scale or intensity of the relevant activity. No change to Schedule A Table 1 is proposed as part of this application.
(e) Does not relate to a new relevant resource tenure for the authority that is – *(iii) a new mining lease; or*	✓	The amendment does not relate to a new resource tenure for the authority.

Minor amendment (threshold), for an environmental authority, means an amendment that the administering authority is satisfied -		Relevance to amendment application
(iv) a new petroleum lease; or *(v) a new geothermal lease under the Geothermal Energy Act; or* *(vi) a new GHG injection and storage lease under the GHG storage Act; and*		
(f) Involves an addition to the surface area for the relevant activity of no more than 10% of the existing area; and	✓	The proposed amendment does not relate to new or additional disturbance to land.
(g) For an environmental authority for a petroleum activity – *(i) if the amendment involves constructing a new pipeline – the new pipeline does not exceed 150km; and*	✓	The amendment does not involve constructing a new pipeline more than 150 km in length.
(ii) if the amendment involves extending an existing pipeline – the extension does not exceed 10% of the existing length of the pipeline; and	✓	The amendment does not involve extending an existing pipeline.
(h) If the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit - the amendment application under section 224 seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority to the extent it relates to the permit.	✓	The amendment does not relate to a new relevant resource tenure that is an exploration permit or GHG permit.

6.1.5 The Standard Criteria (EP Act)

The standard criteria (as defined by Schedule 4 of the EP Act) are required to be considered by the administering authority for deciding site-specific applications. Refer to Table 14 for consideration of the standard criteria.

Table 14: Standard criteria (EP Act)

Schedule 4 EP Act	Relevance
a) the following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment – *(i) the precautionary principle;* *(ii) intergenerational equity;* *(iii) conservation of biological diversity and ecological integrity; and*	The precautionary principle was considered for the application. It is considered that the proposed activities will use 'proven' technology and sufficient scientific data exists that a reverse onus does not exist. The principle of intergenerational equity was considered for the application. It is considered that the proposed activities would not impact the use of environmental values by future generations. The principles of conservation of biological diversity and ecological integrity were considered for the application.
b) any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development	The proposed activities would be undertaken in accordance with the applicable requirements of the following (but not limited to): • EP Act; • EPBC Act; • *Petroleum and Gas (Production and Safety) Act (P&G Act)* • *Nature Conservation Act 1992* (NC Act) • *Vegetation Management Act 1999 (VM Act)* • *Regional Planning Interests Act 2014*

Schedule 4 EP Act	Relevance
c) *any relevant environmental impact study, assessment or report*	N/A
d) *the character, resilience and values of the receiving environment*	Refer to Section 4.0
e) *all submissions made by the applicant and submitters*	The EA amendment application is considered to be a minor amendment (refer to Table 13) and as such, will not be subject to public notification.
f) *Best Practice Environmental Management (BPEM) for activities under any relevant instrument, or proposed instrument, as follows-* *(i) an environmental authority;* *(ii) a transitional environmental program;* *(iii) an environmental protection order;* *(iv) a disposal permit;* *(v) a development approval;*	BPEM of the proposed activities would be achieved through compliance with the conditions of the EA and implementation of environmental management measures described in this report, refer to Section 5.0.
g) *Financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out under the instrument;*	Santos will continue to provide adequate funds, equipment and staff time to comply with the conditions of the amended EA.

7.0 References

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