DEPARTMENT OF THE ENVIRONMENT AND ENERGY

To: James Barker, Assistant Secretary, Assessments and Governance Branch (for decision)

Referral Decision Brief – Project Atlas Coal Seam Gas Project, between Wallumbilla and Wandoan, Queensland (EPBC 2018/8329).

Timing: 10 December 2018 - Statutory timeframe.

Recommended Decision	**NCA** ☒ **NCA(pm)** ☐ **CA** ☐
Person proposing the action	Senex Assets Pty Ltd
Controlling Provisions triggered or matters protected by particular manner	World Heritage (s12 & s15A) Yes ☐ No ☒ No if PM ☐ National Heritage (s15B & s15C) Yes ☐ No ☒ No if PM ☐ Ramsar wetland (s16 & s17B) Yes ☐ No ☒ No if PM ☐ Threatened Species & Communities (s18 & s18A) Yes ☐ No ☒ No if PM ☐ Migratory Species (s20 & s20A) Yes ☐ No ☒ No if PM ☐ C'wealth marine (s23 & 24A) Yes ☐ No ☒ No if PM ☐ Nuclear actions (s21 & 22A) Yes ☐ No ☒ No if PM ☐ C'wealth land (s26 & s27A) Yes ☐ No ☒ No if PM ☐ C'wealth actions (s28) Yes ☐ No ☒ No if PM ☐ GBRMP (s24B & s24C)* Yes ☐ No ☒ No if PM ☐ A water resource – large coal mines and CSG (s24D & s24E) Yes ☐ No ☒ No if PM ☐ C'wealth heritage o/s (s27B & 27C) Yes ☐ No ☒ No if PM ☐
Public Comments	Yes ☐ No ☒
Ministerial Comments	Yes ☒ No ☐ Who: See Attachment E

Recommendation/s:

1. Consider the information in this brief, the referral (Attachment A) and other attachments.

Considered / Please discuss

2. Agree with the recommended decision.

Agreed / Not agreed

3. If you agree to 2, indicate that you accept the reasoning in the departmental briefing package as the basis for your decision.

Accepted / Please discuss

4. Sign the notice at Attachment F (which will be published if you make the recommended decision).

Signed / Not signed

5. Sign the letters at Attachment G.

Signed / Not signed

Date: 18/1/2019

James Barker,
Assistant Secretary,
Assessments and Governance Branch:

Comments:

KEY ISSUES:

- Potential impacts on the endangered Dulacca woodland snail (*Adclarkia Dulacca*)
- Potential impacts on third party water resources, including bore users

BACKGROUND:

Description of the referral

A referral was received on 12 November 2018. The action was referred by Senex Assets Pty Ltd, which has stated its belief that the proposal is not a controlled action for the purposes of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Description of the proposal (including location)

The proposed action is to develop a coal seam gas (CSG) field in Petroleum Lease (PL) 1037 (Project Atlas), located approximately 44 km north of the Warrego Highway, between Wallumbilla and Wandoan, Queensland.

The project involves developing production wells and supporting infrastructure to provided gas exclusively for the domestic market. At least 40 years of commercial gas production is anticipated. The project involves the construction and operation of up to 113 wells and associated well site facilities; a gas and water gathering system; access tracks; produced water management facilities including additional aggregation dam capacity, a water treatment facility, brine storage and an irrigation management system; and ancillary facilities to support gas field development.

The proponent intends to utilise third party owned and operated infrastructure, including a compression facility and pipeline, to transport the gas from the compression facility to market. These are not included in the referral action.

The proponent expects to drill 15-35 wells per year. The proponent estimates it will take up to 6 months to dewater each production well sufficiently for gas to flow, and approximately 18 months to reach peak production. The target production rate is 25 to 40 terrajoules per day. Once depleted the wells will be capped, rehabilitated and abandoned. This is expected to be between 15-30 years after production commences for each well.

Senex Energy Pty Ltd, the parent company of the proponent, controls another CSG project via another of its subsidiary companies, Stuart Petroleum Cooper Basin Gas Pty Ltd, for the

development of a 425 well gas field in the Surat Basin, the Western Surat Gas Project (EPBC 2015/7469). The referred project is geographically separate, and is not an extension of the Western Surat Gas Project.

Description of the environment

The proposed action is located within the Upper Dawson River sub-basin, which is part of the Fitzroy River Basin. The project area lies almost entirely within the sub-catchment of Woleebee Creek. Watercourses are ephemeral and typically flow only during significant runoff events.

Existing land use is predominantly cattle grazing, feed lotting along with petroleum activities in the region. Approximately 51% of the project area is mapped as Strategic Cropping Area, an "area of regional interest" under the *Regional Planning Interests Act (2014)* (Qld).

The target measure is the Walloon Coal Seam (WCM). The WCM and the overlying and underlying strata form part of the Great Artesian Basin.

State process

The proponent holds an Environmental Authority (EA 0001207) for exploration issued by the Queensland Department of Environment and Science (DES) under the *Environment Protection Act (1994)*(QLD). This EA authorises the drilling of wells and construction of facilities to progress the project, it has a limit of 15 wells and associated infrastructure. On 10 December 2018, the proponent lodged an application for an amendment to the Environmental Authority (EA) to enable the remaining 113 well gasfield project to be authorised. The proponent has a Petroleum Lease (PL 1037) issued by the Queensland Department of Natural Resources Mines and Energy (DNRME) under the *Petroleum and Gas (Production and Safety) Act (2004)*(QLD) allowing petroleum-related activities on the site.

Comparative projects

A table of comparative projects for CSG in Queensland is attached (Attachment B1).

RECOMMENDED DECISION:

Under section 75 of the EPBC Act you must decide whether the action that is the subject of the proposal referred is a controlled action, and which provisions of Part 3 (if any) are controlling provisions for the action. In making your decision you must consider all adverse impacts the action has, will have, or is likely to have, on the matter protected by each provision of Part 3. You must not consider any beneficial impacts the action has, will have or is likely to have on the matter protected by each provision of Part 3.

The Department recommends that you decide that the proposal is not a controlled action, because there are not likely to be significant impacts on any controlling provisions. The reasons for this recommendation are detailed further below.

PROTECTED MATTERS THAT ARE NOT CONTROLLING PROVISIONS:

Listed threatened species and communities

The Department's Environment Reporting Tool (ERT) indicates that a total of 21 species and 3 ecological communities may occur within 5 km of the proposed action (see the ERT report at Attachment B2). Based on the location of the action, likely habitat present in the area of the proposed action and the nature of the proposed action, the Department considers that impacts potentially arise in relation to the following matters.

Koala (*Phascolarctos cinereus)* (combined populations of Queensland, New South Wales and the Australian Capital Territory) - Vulnerable

Species information

A description of the species can be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104.

The main threats to the Koala are from loss and fragmentation of habitat, vehicle strike, disease, and predation by dogs.

Proposed action area

The project area has the Koala food tree, *Eucalyptus tereticornis*, present along the riparian zones. The proponent's habitat assessment scored 245 ha of potential Koala habitat as a 7 under the *EPBC Act referral guidelines for the vulnerable Koala 2014*. The riparian area along Wandoan and Woleebee Creeks, is within an unconsolidated sandy alluvial aquifer with an inferred presence of groundwater at 9 m depth. *E. tereticornis* is the dominant species and is known to have a root depth that can reach the groundwater depth.

Potential impacts

The majority of the Koala habitat will be avoided. The area of potential direct impact from vegetation clearing is a maximum of 1.4 ha. The proponent considered that as this is below the threshold of 20 ha described in the referral guidelines, they will not have a significant impact on the Koala. The proponent further considered that there would be no indirect impacts. The proponent put forward the following support for their conclusion of no indirect impacts. Based on the site-specific groundwater model, the project is not predicted to draw down the shallow groundwater (discussed in the water resources section), therefore it is unlikely that the riparian vegetation supporting Koala habitat will be impacted by groundwater level change. The project will not increase the risk of dog attack on the Koala, the risk of vehicle strike is low as the traffic volume is low, predominantly during daylight and at restricted speeds (less than 40 km/h on access tracks).

The proponent has developed a Significant Species Management Plan (SSMP) that aims to avoid and mitigate impacts on listed species. Measures include providing a fauna spotter during vegetation clearance, biosecurity controls, inspection of excavations and trenches for fauna within two hours of sunrise and prior to backfilling or laying pipes and clearing from open to vegetated areas to enable fauna movement away from the clearing activities.

The Department's Office of Water Science (OWS) reviewed the referral information. OWS agreed with the proponent's assessment that there was unlikely to be any drawdown impacts on the alluvial aquifers (discussed further in the water resources section).

Conclusion

The Department concludes that as there will be a maximum of 1.4 ha of Koala habitat directly impacted by the project, and indirect impacts are unlikely, that it is unlikely that there will be a significant impact on the Koala.

Ooline *(Cadellia pentastylis)* and Belson's Panic *(Homopholis belsonii)* - Vulnerable

Species information

A description of the Ooline and its habitat may be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=9828

A description of Belson's Panic and its habitat may be found at

http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2406

The project area provides 242.7 ha of potential habitat for Ooline and 319.4 ha of potential habitat for Belson's Panic. No individuals of either species were recorded during the proponent's surveys. The nearest record of Ooline is located 9.6 km from the project area and 6.5 km for Belson's Panic.

The project will have a direct impact on a maximum of 4.4 ha of potential Ooline and Belson's Panic habitat. The proponent determined that there were no important populations of Ooline or Belson's Panic present. The approved conservation advice for Ooline does not list an important population in this region.

The proponent will implement their Environmental Protocol for Field Development and Constraints Analysis, which requires pre-clearance surveys for any area of proposed direct impact, and will avoid the species, where possible if located. In addition the SSMP contains measures to ensure indirect impacts area avoided. These measures included biosecurity controls, avoidance of sensitive flora and managing for erosion.

The Department concludes that as the species have not been found on site, there are no known important populations present, only a small area of potential habitat will be disturbed and there are management measures to avoid indirect impacts, there is unlikely to be a significant impact on the Ooline or Belson's Panic.

Dulacca woodland snail *(Adclarka dulacca)* - Endangered

Species information

A description of the species and its habitat may be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2406

The main threats to the species are from land-clearing, small scale disturbance to habitat and predation from rats.

The project area provides 262.1 ha of potential habitat for the species but no individuals were recorded as part of the field surveys. The nearest record is located approximately 15 km from the project area. The project will involve clearance of small patches of potential habitat totalling 5.2 ha. The referral states that where habitat is proposed to be disturbed, microhabitat features for the species will be avoided where practicable.

The proponent will implement their Environmental Protocol for Field Development and Constraints Analysis, which requires pre-clearance surveys for any area of proposed direct impact. Since submitting the referral the proponent has provided a commitment that if a population of the species is found during pre-clearance surveys, then that area of habitat will not be cleared (Attachment C1). The proponent has submitted an updated Environmental Protocol for Field Development and Constraints Analysis that includes this commitment (Attachment C1).

The Department considers that as no Dulacca woodland snails were detected during the surveys, there are no known populations within the project area and that the proponent has committed to avoiding the habitat if and where a population of the species is found during pre-clearance surveys, that there is unlikely to be a significant impact on the species.

Brigalow (*Acacia harpophylla* dominant and co-dominant) - Endangered and Semi-Evergreen vine thickets of the Brigalow Belt (North and south) and Nandewar Bioregions (SEVT) - Endangered

A description of the Brigalow Threatened Ecological Community (TEC) may be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=28

A description of the SEVT may be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=24

The proponent's field surveys confirmed that 42.3 ha of the Brigalow TEC and 1.7 ha of the SEVT TEC is present in the project area. The Brigalow TEC is present as 17 remnant/regrowth patches, with a mean patch size of 2.5 ha.

The referral states that through their gas field layout and implementing their Environmental Protocol for Field Development and Constraints Analysis, there will be no disturbance to the TEC's. In addition, the SSMP contains measures to avoid or mitigate potential impacts on the TEC. These measures include biosecurity controls to avoid weed infestation, fencing off sensitive areas, site inductions and chemical management controls.

The Department concludes that as there will be no direct disturbance, and potential indirect impacts are managed, there is unlikely to be a significant impact on the Brigalow or SEVT TEC's.

Other listed species

The Department's ERT identifies the potential presence of an additional 18 threatened species or communities within 5 km of the proposed action area. Based on information available to the Department, such as the Species Profile and Threats database and information from the referral documentation, the Department considers that significant impacts to any of these species or communities are unlikely.

Listed migratory species

The ERT indicated 11 migratory species may occur within 5 km of the proposed action (Attachment B2). Two migratory species considered 'fly over species', the Fork-tailed swift and White-throated needletail, were assessed by the proponent to have a high likelihood of occurrence in the area. Neither species were detected during field surveys. The remaining nine species, which may use the woodlands and riparian habitat, were considered as having a medium likelihood of occurrence. The project will be avoiding disturbance to woodlands and riparian areas, which have the potential to provide habitat to migratory species. The Department considers a significant impact to migratory species is unlikely.

A water resource, in relation to a large coal mining development or coal seam gas development

The proponent has assessed the potential impacts from the proposal against the Department's *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments-impacts on water resources 2013* and considers the proposed action is unlikely to have a significant impact on water resources. OWS (Attachment D1) concurs with the proponent's assessment. Geoscience Australia (GA) (Attachment E2) considers the project should be triggered for water resources because, in their view, additional information is required to assess the potential impacts to bores and GDEs. The Department notes that the level of information provided by the proponent in this referral is equivalent in coverage and detail to the Public Environmental Report (PER) provided for the Western Surat Gas Project assessment.

OWS advice and Geoscience Australia comments are discussed below at 'Advice and comments'.

Groundwater is utilised within the vicinity of the project site for stock watering and domestic supply, agriculture irrigation and town water supply purposes. There are 412 registered third party groundwater bores within the project area and a 25 km radius of the project area.

Potential surface expression Groundwater Dependent Ecosystems (GDEs) and subsurface GDEs are mapped as potentially being present in the vicinity of the project. These GDEs and terrestrial GDEs generally correspond with the location of the mapped alluvium associated with creeks.

No spring complexes or watercourse springs are located within the project area. Four Great Artesian Basin watercourse springs, as identified in the Underground Water Impact Report (UWIR) produced by the Queensland Office of Groundwater Impact Assessment (OGIA), are located within 25 km of the project area. These source water from the Gubberamunda Sandstone, and Mooga Sandstone/Orallo Formation which are not predicted to suffer drawdown from the proposed action.

Modelling

The proponent has taken into account the requirements of the Independent Expert Scientific Committee (IESC) *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* (May 2018) when preparing their referral information. OGIA modelled the groundwater scenarios for both a 'Project only' and cumulative scenario to assess potential impacts in combination with surrounding operators. This information is included in the referral documentation. The proponent has undertaken separate modelling to assess impacts on the shallow groundwater system and carried out a field assessment to identify water related impacts to MNES.

Water monitoring and management plans

The proponent provided a CSG Water Management Plan (CWMP)(Attachment A) and a Water Monitoring and Management Plan (WMMP)(Attachment C2).

The CWMP has been developed to meet the requirements of the following Queensland policies and legislation; the *CSG Water Management Policy 2012*, the *Petroleum and Gas (Safety and Production) Act 2004* (Qld), the *Water Act 2000* (QLD) and the *Environmental Protection Act 1994* (QLD). The plan includes information on storage and treatment infrastructure, seepage monitoring, landowner agreements for irrigation, and brine and salt management. In addition, the plan outlines the water management criteria, actions and performance indicators that will be undertaken to avoid and mitigate impacts on water resources.

The WMMP outlines the proposed monitoring, management and mitigation measures to specifically address impact to groundwater from the proposed action. The plan also addresses the monitoring and management obligations that are imposed on the proponent by OGIA. The plan includes information on regional and shallow groundwater monitoring, data management and analysis, petroleum hydrocarbon monitoring, make good arrangements for bores, and trigger thresholds that will require further investigation and action in consultation with OGIA.

The Department notes that the proponent is required under the *Water Act 2000* (Qld) to comply with monitoring, management and mitigation changes imposed by OGIA in response to the three yearly UWIR and annual updates. The WMMP includes commitments to review and update the WMMP as new information becomes available, or when changes are made in

response to investigations of water monitoring results. The revised plans will be published on the proponent's website.

Potential impacts-Groundwater

The target WCM is approximately 250 m below ground level (bGL). For the 'Project only' scenario, the predicted long-term drawdown impacts are limited to the lower Springbok Sandstone (above the WCM), the WCM and upper Hutton Sandstone (below the WCM). By 2060 the project is modelled to result in a drawdown of; 50 – 150 m in the WCM within the project area, and up to 50 m outside the project area; <10 m in the lower Springbok Sandstone and <2 m in the upper Springbok Sandstone; and <1 m in the upper Hutton Sandstone aquifer.

Groundwater Dependent Ecosystems

The shallow alluvial groundwater which may support potential GDEs, is separated from the affected aquifers by layers with low permeability. The proponents modelling indicates that drawdown is not predicted in the shallow alluvium and consequently there is unlikely to be an impact on GDEs. The proponent's field verification and analysis of major ion chemistry from the alluvial groundwater, surface water and groundwater in the GAB aquifers indicated that the groundwater within the alluvium is not sourced from the Surat Basin aquifers and is recharged by rainwater and surface water flow. This supports the proponent's conclusion that there is unlikely to be an impact on GDEs.

Springs

As guidance for their impact assessment, the proponent has used the drawdown trigger thresholds of the *Water Act 2000* (QLD) of 0.2 m for springs. Their modelled results indicate that no trigger exceedances were predicted under the 'Project only' or cumulative scenarios for spring complexes and or watercourse springs as these springs do not source water from the affected aquifers.

Bores

As guidance for their impact assessment, the proponent has used the drawdown trigger thresholds of the *Water Act 2000* (QLD) of 5 m for bores into a consolidated aquifer (e.g. Surat Basin units) and 2 m for unconsolidated aquifer (e.g. alluvium). The modelling predicts drawdown of; 5.84 m in one bore; 1-2 m in four bores; 10 cm-1 m in 47 bores; and <10 cm in 106 bores. The bore modelled to have 5.84 m drawdown has already been triggered by the adjacent GQC CSG project (EPBC 2008/4398) and is covered by make good arrangements imposed by OGIA.

Within a 25 km radius of the project area, 62 bores already have a drawdown greater than 5 m as a result of existing CSG projects. The cumulative scenario modelling shows that the contribution of the proposed action does not result in any additional bores being triggered. The WMMP notes that OGIA may impose make good obligations on the proponent in relation to bore drawdown.

Stygofauna

The proponent tested water from four bores for Stygofauna. Stygofauna were found in two bores, one at 67 m bGL sourced from the Gubberamunda Sandstone/Westbourne Formation which is not predicted to suffer any drawdown from the project, and the other at 25 m bGL sourced from the upper Springbok Sandstone. OGIA modelling shows a maximum predicted

drawdown of <2 m in the upper Springbok Sandstone but no reduction in saturated thickness, consequently there is unlikely to be any impact on the Stygofauna.

CSG production from the project will occur within the WCM at depths greater than 250 m bGL, which is deeper than any known occurrence of Stygofauna (100 m bGL) in the Surat Basin. The shallow groundwater assessment did not predict any drawdown greater than 0.2 m in the alluvial aquifers, therefore the proponent considered the project to have a low risk of impact on any stygofauna that may be in shallow systems.

Potential impacts – Surface water flows

The surface water flows have the potential to be affected by groundwater or alluvium drawdown where the stream is gaining water from those sources. In addition further impacts may arise from surface activities such as abstraction from or discharge to stream, construction and associated land disturbance.

As discussed previously, the four watercourse springs in the vicinity of the proposed action do not source water from the aquifers that are modelled to suffer drawdown as a result of the proposed action. The proponent's modelling for the shallow groundwater system shows that surface alluvium that may provide baseflow to surface water systems will not suffer drawdown as a result of the proposed action.

The proponent will not be abstracting from or discharging to watercourses. The proponent's Erosion and Sediment Control Plan (Attachment C4) includes measures to avoid or mitigate impacts on waterways from land disturbance. Where access tracks are required to cross waterways, the proponent must either comply with the *Self-Assessable Codes for Waterway Barrier Works)*(DAFF 2013) to minimise impacts or obtain a Development Approval under the Queensland Sustainable Planning Act 2009. The protection of surface water values will also be regulated under an EA.

Potential impacts – Water quality

Chemicals

There is the potential for impacts on aquifer water quality if CSG wells leak and drilling chemicals leak or water from aquifers with differing water quality mix. Drilling chemicals and naturally occurring compounds from the WCM may impact the quality of the co-produced water used for beneficial re-use such as dust suppression, construction and irrigation.

The proponent's chemical risk assessment identified products and chemicals to be used during the drilling process and assessed their hazardous nature. Drilling chemicals will be used for initial drilling of the wells, 3 to 5 year periodic maintenance and decommissioning.

The hazardous chemicals are mainly biocides which are readily biodegradable and do not bio-accumulate. The proponent's chemical risk assessment considered the chemical solubility, the fate and transport in the environment as well as an assessment of the proposed volumes of chemicals to be used. An exposure assessment then identified the potential chemical sources and the 'risk events' which may result in their release to the environment and the likely exposure pathways and potential impacts on matters of national environmental significance (MNES).

The proponent concluded that risks to MNES were limited to above ground chemical spills, the loss of chemicals to aquifers below ground and the eventual disposal of drilling fluids. The Environmental Management Plan provides information on storage, transport and handling in accordance with Australian Standards in order to minimise risks.

To minimise the risk of loss of drilling fluids to aquifers, drilling and well construction will be undertaken in accordance with the *Code of Practice for Constructing and Abandoning CSG Wells and Associated Bores in Queensland* (DNRME 2018). Where possible, drilling fluids will be recycled and at the end of their lifecycle, the proponent will dispose of the fluids at an appropriately licenced facility.

If a chemical is planned to be used that has not been included in the proponents current register of chemicals provided with the referral, the proponent will conduct a chemical risk assessment, consistent with the IESC checklist requirements. Chemicals will only be used when it is likely that drilling fluid will not adversely impact MNES and with the identified controls, the overall risk is not significant.

Co-produced water and brine

There is the potential for seepage from storage dams for co-produced water to contaminate surrounding natural systems and shallow aquifers. As part of the associated infrastructure, the proponent will construct a reverse osmosis plant for treatment of produced water. The brine produced from treatment may potentially contaminate the environment if it leaks from storage facilities. In addition, there is the potential for water provided for beneficial reuse or under a water supply agreement to contaminate surrounding natural systems if the water quality is not appropriate.

The CWMP contains management measures to avoid or mitigate the above discussed potential impacts. These include a monitoring program for beneficial reuse water to ensure that water quality objectives are in accordance with *General beneficial use approval* (DEHP 2014) and water storage dam monitoring for water quality and seepage. In addition, the WMMP contains measures for monitoring for long chain hydrocarbons. CSG water storage dams for co-produced water and brine will be designed and assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Structures* (DES 2016). Any salt produced or brine will be disposed of at a regulated waste facility offsite.

Advice and comments

The Office of Water Science considered that all the information provided by the proponent supports their position that there are unlikely to be substantial impacts on water resources (Attachment D1). The limited nature of changes to surface landform and the proposed treatment of co-produced water make impacts to surface water resources unlikely. OWS noted that the proponent has not stated what the actual response or mitigation measures will be in response to monitoring results and this should be provided, and that there is some uncertainty about long term risks associated with well integrity. The Department notes that the need for a response and any responses and mitigation measures are determined by OGIA and bore integrity will be regulated by DES under an EA.

OWS reviewed the proponent's chemical risk assessment and considered that, assuming the standard operational procedures are followed, the risk from above ground chemical spills and disposal of drilling fluids is very low and the risk of groundwater contamination is also very low.

Comment provided by GA (Attachment E2) considered that the impacts to groundwater resources resulting from groundwater drawdown and depressurisation should be assessed due to the potential for drawdown to affect groundwater users and GDEs. The Department notes that the information provided with the referral was equivalent in coverage and detail to that provided in the PER for the Western Surat Gas Project (EPBC 2015/7469) assessment and considers that this referral information is sufficient to allow an assessment of the likelihood of significant impacts to groundwater resources. GA considered that as there is no local scale

modelling there is insufficient information on the significance of the local scale impacts. GA noted that although only one bore will be drawn down by more than 5 m, many bores will receive drawdown below this threshold and will suffer cumulative impacts.

The Department considered further advice from OWS (Attachment D1) in relation to the local scale modelling and concluded that there is no reason to consider this inadequate for identifying potential impacts to water resources.

The Department's Post-Approvals Section (PAS) reviewed the proponent's water management measures and monitoring plans. PAS noted that the plans and management measures considered the range of potential impacts (Attachment D2).

Conclusion

The Department considers that; there are no springs or GDE's likely to be affected by the proposed action; water quality and quantity change impacts will be managed through water management and monitoring plans; chemical risk will be appropriately managed, and impacts on bore users are minimal and those impacts will be managed by OGIA. Therefore, the Department concludes that there is unlikely to be a significant impact on water resources.

Ramsar Wetlands	The ERT did not identify any Ramsar listed wetland of international importance within or adjacent to the proposed action area. The nearest Ramsar listed wetland is the Narran Lake Nature Reserve, more than 400 km distant and in another surface water catchment. It is unlikely activities related to the project will impact any Ramsar sites. For this reason the Department considers that sections 16 and 17B are not controlling provisions for the proposed action.
World Heritage properties	The ERT did not identify any World Heritage properties located within or adjacent to the proposed action area. The closest is the Great Barrier Reef World Heritage Area, approximately 290 km from the project area. As the project is unlikely to significantly affect the surface water flows or water quality of water going into the catchment, it is unlikely the project will impact the Great Barrier Reef World Heritage Area and therefore this controlling provision does not apply. For this reason the Department considers that sections 12 and 15A are not controlling provisions for the proposed action.
National Heritage places	The ERT did not identify any National Heritage places located within or adjacent to the proposed action area. The closest is the Great Barrier Reef National Heritage place, approximately 290 km from the project area. As the project is unlikely to significantly affect the surface water flows or water quality of water going into the catchment, it is unlikely the project will impact the Great Barrier Reef National Heritage place and therefore this controlling provision does not apply. For this reason the Department considers that sections 15B and 15C are not controlling provisions for the proposed action.
Commonwealth marine environment	The proposed action does not occur in the vicinity of a Commonwealth marine environment therefore this controlling provision does not apply. For this reason, the Department considers sections 23 and 24A are not controlling provisions for the proposed action.

Commonwealth action	The referring party is not a Commonwealth agency, therefore this controlling provision does not apply. For this reason, section 28 is not a controlling provision for the proposed action
Commonwealth land	The proposed action is not being undertaken on Commonwealth land therefore this controlling provision does not apply. For this reason, the Department considers section 26 and 27A are not controlling provisions for the proposed action.
Nuclear action	The proposed action does not meet the definition of a nuclear action as defined in the EPBC Act therefore this controlling provision does not apply. For this reason the Department considers sections 21 and 22A are not controlling provisions for the proposed action.
Great Barrier Reef Marine Park	The Great Barrier Reef Marine Park is approximately 290 km from the project area. As the project is unlikely to significantly affect the surface water flows or water quality of water going into the catchment, it is unlikely the project will impact the Great Barrier Reef Marine Park and therefore this controlling provision does not apply. For this reason the Department considers that sections 24B and 24C are not controlling provisions for the proposed action.
Commonwealth Heritage places overseas	The proposed action is not located overseas, therefore this controlling provision does not apply. For this reason, the Department considers sections 27B and 27C are not controlling provisions for the proposed action.

SUBMISSIONS:

Public submissions

The proposal was published on the Department's website on 13 November 2018 and public comments were invited until 27 November 2018. No public submissions were received.

The proponent has engaged with the local community and held community drop-in sessions in Miles and Wandoan and a community dinner. The referral information states that those who attended the session (over 55 residents and local business people) were generally in favour of the project and used the opportunity to build their understanding of the environment and controls in place for minimising impacts on it. The proponent has entered into a cultural management agreement with local indigenous groups the Iman People and the Wardingarri Aboriginal Corporation.

Comments from Commonwealth Ministers

By letter dated 13 November 2018, the following ministers were invited to comment on the referral:

- Senator the Hon Nigel Scullion, Minister for Indigenous Affairs
- Senator the Hon Matt Canavan, Minister for Resources and Northern Australia
- The Hon David Littleproud MP, Minister for Agriculture and Water Resources
- The Hon Angus Taylor, Minister for Energy

The delegate for the Minister for Agriculture and Water Resources responded on 5 December 2018 (Attachment E1). The delegate raised the following issues:

- The proponent should maintain communication and consultation throughout the lifespan of the proposed action to mitigate sensitivities amongst stakeholders.
- Water assessments including the establishment of robust baseline data on surface and groundwater monitoring should be carried out in accordance with management plans and made publicly accessible.
- Stakeholders should be provided with adequate and relevant information about the proposed action.
- The proponent should be audited periodically to ensure that conditions stipulated in any approval is complied with adequately.

The Department notes the proponent has consulted with stakeholders and will have ongoing contact with indigenous stakeholders, and landowners via access and water management agreements. The water assessment was published with the referral information and in addition the proponent has included in their WMMP a commitment to publish revised WMMPs.

On 27 November 2018, Geoscience Australia responded on behalf of the Minister for Resources and Northern Australia (Attachment E2). GA's comments are discussed at 'Advice and comments' in the water resources section.

No comments were received from the Minister for Indigenous Affairs or the Minister for Energy.

Comments from State/Territory Ministers

By email on 13 November 2018 s22 the delegated contact for the Queensland Minister for Environment and the Great Barrier Reef, Minister for Science and Minister for the Arts, the Hon Leeanne Enoch MP, was invited to comment.

s22 responded on 16 November 2018 and noted that Department of Environment and Science had not yet received an environmental authority amendment application for the project and the Department would be advised after an application was received and a decision made about the assessment approach (Attachment E3).

OTHER MATTERS FOR DECISION-MAKING:

Significant impact guidelines

The Department has reviewed the information in the referral against the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance* (December 2013) and other relevant material. While this material is not binding or exhaustive, the factors identified are considered adequate for decision-making in the circumstances of this referral. Adequate information is available for decision-making for this proposal.

Precautionary principle

In making your decision under section 75, you are required to take account of the precautionary principle (section 391). The precautionary principle is that a lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

s22

A/g Director
Queensland North Assessments
Assessments and Governance Branch
s22

s22
Queensland North Assessments
s22

ATTACHMENTS

A: Referral documentation

B: B1- Table of comparative projects

B2- ERT 7 January 2019

C: Additional information provided by proponent

C1- updated Constraints Protocol dated 11 December 2018

C2- updated WMMP dated 15 January 2019

C3- Email from proponent re QGC bore

C4- Erosion and Sediment Control Plan

D: D1- OWS advices

D2- Post-approval comments

E: Ministerial comments

E1- Minister for Agriculture and Water Resources

E2- Geoscience Australia

E3- DES

F: Decision notice FOR SIGNATURE

G: Letters to the proponent & Ministers FOR SIGNATURE

Feature	Point	Coordinates
Project Atla	1	-26.166070165178,149.75315835289
Project Atla	2	-26.166224234538,149.78663232139
Project Atla	3	-26.199652469537,149.78714730552
Project Atla	4	-26.199652469537,149.8334958773
Project Atla	5	-26.248468174551,149.83486916832
Project Atla	6	-26.248622134889,149.75092675499
Project Atla	7	-26.166070165178,149.7500684481
Project Atla	8	-26.166070165178,149.75315835289
Project Atla	9	-26.166070165178,149.75298669151
Project Atla	10	-26.166070165178,149.75315835289

Feature	Point	Coordinates
Project Atla	1	-26.166070165178,149.75315835289
Project Atla	2	-26.166224234538,149.78663232139
Project Atla	3	-26.199652469537,149.78714730552
Project Atla	4	-26.199652469537,149.8334958773
Project Atla	5	-26.248468174551,149.83486916832
Project Atla	6	-26.248622134889,149.75092675499
Project Atla	7	-26.166070165178,149.7500684481
Project Atla	8	-26.166070165178,149.75315835289
Project Atla	9	-26.166070165178,149.75298669151
Project Atla	10	-26.166070165178,149.75315835289

Project Atlas Rehabilitation Plan

Document Number:

SENEX-ATLS-EN-PLN-003

Revision: 1

Position	Name	(tick one column only)		Signature	Date
		Approve	Review		
Environment Manager	s47F	☒	☐	s47F	12/09/18

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REVISION HISTORY

Revision	Revision Date	Document Status	Author	Approved By
A	20/10/2017	Document creation	s47F	
0	25/10/2017	Issued for Use		
1	12/09/2018	Revised to include production activities		

ABBREVIATIONS

Abbreviation	Meaning
CSG	Coal Seam Gas
DES	Department of Environment and Science (formerly DEHP)
EA	Environmental Authority
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act* (1999) (Cth)
ESA	Environmentally Sensitive Area
NC Act	*Nature Conservation Act 1992* (Qld)
Project Atlas	Gas production field to be developed on PL1037
RE	Regional Ecosystem
RoW	Right of Way
SOM	Soil organic matter

1. INTRODUCTION

1.1. Purpose

Senex Assets PTY LTD ACN 160 649 338, a wholly-owned subsidiary of Senex Energy Limited ACN 008 942 827 (Senex), is proposing a gas project known as 'Project Atlas' in Queensland's Surat Basin. To enable gas production to be undertaken, a site specific environmental authority application has been prepared according to the requirements of section 224 of the *Environmental Protection Act 1994* (EP Act). This plan has been prepared to describe how the land, the subject of the application will be rehabilitated after each relevant activity ceases. Rehabilitation of disturbed areas is also a regulatory requirement under conditions of the EA.

Located approximately 15.6 kilometres south west of Wandoan and 57 kilometres north-west of Miles, in southern-central Queensland, the PL Area covers an area of approximately 58.5 square kilometres (refer to Figure 1-1). Senex holds petroleum lease (PL 1037) over the area, which is the location of the proposed gas production program.

This document identifies rehabilitation methods that may be implemented to successfully rehabilitate land to the pre-disturbance land use. The plan also identifies rehabilitation monitoring, indicators and acceptance criteria to be met in returning land to a pre-disturbance land use.

1.2. Environmental Authority Conditions

Senex is the holder of EA0001207, which contains the streamlined model conditions for rehabilitation. Senex does not propose to change to the existing rehabilitation conditions.

The plan has been developed to achieve compliance with rehabilitation conditions in the EA. **Table 1-1** identifies the conditions relating to rehabilitation that are relevant to the plan. For the purposes of the plan and in accordance with the EA, rehabilitation means:

'the process of reshaping and revegetating land to restore it to a stable landform and in accordance with acceptance criteria and, where relevant, includes remediation of contaminated land. For the purposes of pipeline rehabilitation, rehabilitation includes reinstatement, revegetation and restoration'.

Figure 1-1 Location of Project Atlas

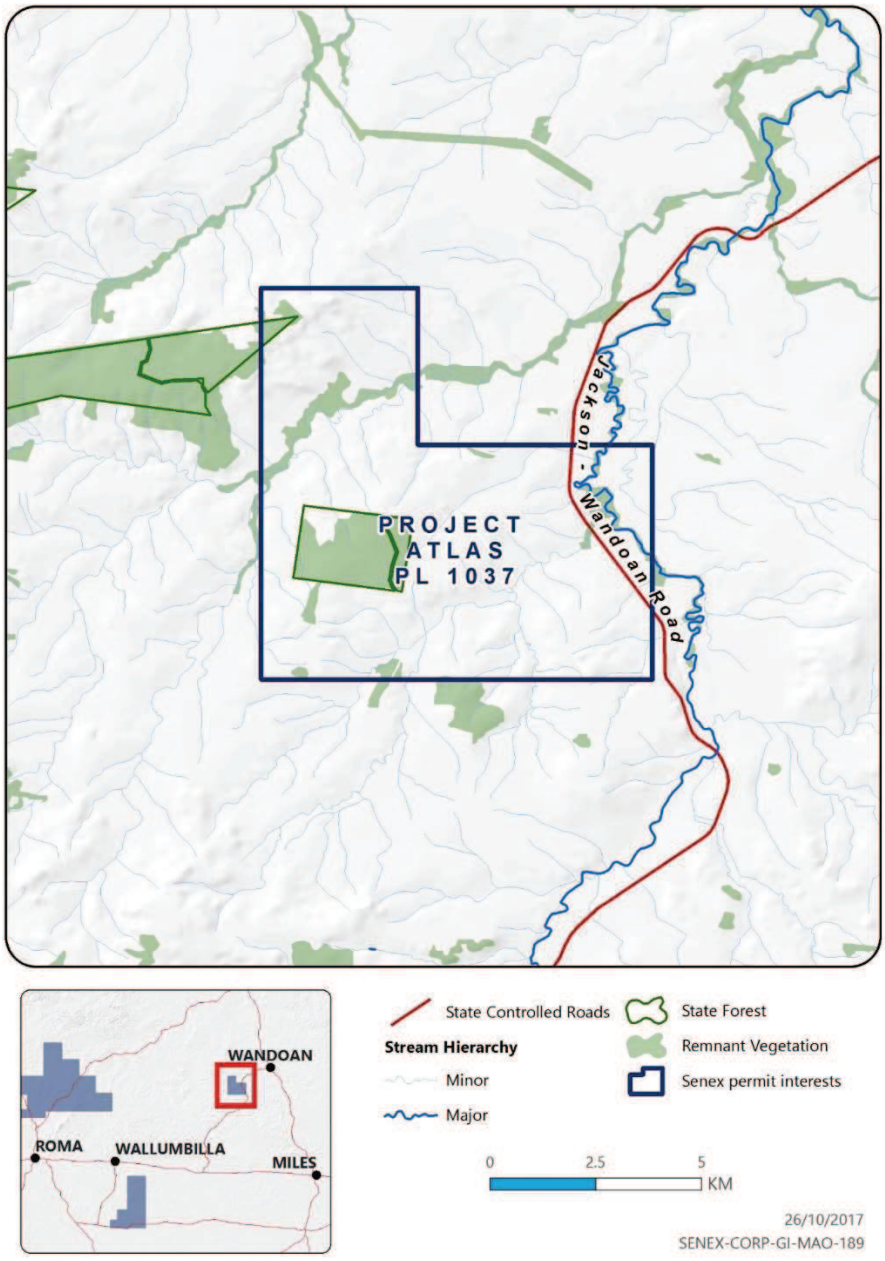


Table 1-1 EA conditions for rehabilitation on the Atlas project area

Environmental Authority Condition Number	Requirement
(E2) Topsoil management	Topsoil must be managed in a manner that preserves its biological and chemical properties.
(E3) Land management	Land that has been significantly disturbed by the petroleum activities must be managed to ensure that mass movement, gully erosion, rill erosion, sheet erosion and tunnel erosion do not occur on that land.
(E7) Pipeline reinstatement and revegetation	Pipeline trenches must be back filled and topsoils reinstated within three months after pipe laying.
(E8)	Reinstatement and revegetation of the pipeline right of way must commence within 6 months after cessation of petroleum activities for the purpose of pipeline construction
(E9)	Backfilled, reinstated and revegetated pipeline trenches and right of ways must be: a) a stable landform b) re-profiled to a level consistent with surrounding soils c) re-profiled to original contours and established drainage lines; and d) vegetated with groundcover which is not a declared pest species, and which is established and growing.
* Decommissioning and Rehabilitation	Dams must not be abandoned but be either: a) decommissioned and rehabilitated to achieve compliance with condition (127); or b) be left in-situ for a beneficial use(s) provided that: i) it no longer contains contaminants that will migrate into the environment; and ii) it contains water of a quality that is demonstrated to be suitable for its intended beneficial use(s); and iii) the administering authority, the holder of the environmental authority and the landholder agree in writing that the dam will be used by the landholder following the cessation of the environmentally relevant activity(ies).
*	After decommissioning, all significantly disturbed land caused by the carrying out of the environmentally relevant activity(ies) must be rehabilitated to meet the following final acceptance criteria: a) the landform is safe for humans and fauna; b) the landform is stable with no subsidence or erosion gullies for at least three (3) years; c) any contaminated land (e.g. contaminated soils) is remediated and rehabilitated; d) not allowing for acid mine drainage; or e) there is no ongoing contamination to waters (including groundwater); f) rehabilitation is undertaken in a manner such that any actual or potential acid sulfate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the Instructions for the treatment and management of acid sulfate soils (2001); g) all significantly disturbed land is reinstated to the pre-disturbed soil suitability class; h) for land that is not being cultivated by the landholder: i) groundcover, that is not a declared pest species is established and self-sustaining

Environmental Authority Condition Number	Requirement
	ii) vegetation of similar species richness and species diversity to pre-selected analogue sites is established and self-sustaining, and iii) the maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance caused by carrying out the petroleum activity(ies). i) for land that is to be cultivated by the landholder, cover crop is revegetated, unless the landholder will be preparing the site for cropping within 3 months of petroleum activities being completed.
(J1) Rehabilitation Planning	A Rehabilitation Plan must be developed by a suitably qualified person and must include the: a) rehabilitation goals; and b) procedures to be undertaken for rehabilitation that will: i) achieve the requirements of conditions (J2) to (J8), inclusive; and ii) provide for appropriate monitoring and maintenance.
(J2) Transitional rehabilitation.	Significantly disturbed areas that are no longer required for the on-going petroleum activities, must be rehabilitated within 12 months (unless an exceptional circumstance in the area to be rehabilitated (e.g. a flood event) prevents this timeframe being met) and be maintained to meet the following acceptance criteria: a) contaminated land resulting from petroleum activities is remediated and rehabilitated b) the areas are: i) non-polluting ii) a stable landform iii) re-profiled to contours consistent with the surrounding landform c) surface drainage lines are re-established; d) top soil is reinstated; and e) either: i) groundcover, that is not a declared pest species, is growing; or ii) an alternative soil stabilisation methodology that achieves effective stabilisation is implemented and maintained.
(J3) Final rehabilitation acceptance criteria.	All significantly disturbed areas caused by petroleum activities which are not being or intended to be utilised by the landholder or overlapping tenure holder, must be rehabilitated to meet the following final acceptance criteria measured either against the highest ecological value adjacent land use or the pre-disturbed land use: a) greater than or equal to 70% of native ground cover species richness; b) greater than or equal to the total per cent of ground cover; c) less than or equal to the per cent species richness of declared plant pest species; and d) where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then at least one regional ecosystem(s) from the same broad vegetation group, and with the equivalent biodiversity status or a biodiversity status with a higher conservation value as any of the regional ecosystem(s) in either the adjacent land or pre-disturbed land, must be present.
(J4) Final rehabilitation acceptance criteria in environmentally sensitive areas.	Where significant disturbance to land has occurred in an environmentally sensitive area (ESA), the following final rehabilitation criteria as measured against the pre-disturbance biodiversity values assessment (required by conditions (F1) and (F2)) must be met: a) greater than or equal to 70% of native ground cover species richness; b) greater than or equal to the total per cent ground cover; c) less than or equal to the per cent species richness of declared plant pest species; d) greater than or equal to 50% of organic litter cover; e) greater than or equal to 50% of total density of coarse woody material; and

Environmental Authority Condition Number	Requirement
	f) all predominant species in the ecologically dominant layer, that define the pre-disturbance regional ecosystem(s) are present.
(J5)	Conditions (J2), (J3) and (J4) continue to apply after this environmental authority has ended or ceased to have effect.
(J6) Remaining dams	Where there is a dam (including a low consequence dam) that is being or intended to be utilised by the landholder or overlapping tenure holder, the dam must be decommissioned to no longer accept inflow from the petroleum activity(ies) and the contained water must be of a quality suitable for the intended on-going uses(s) by the landholder or overlapping tenure holder.

*Condition expected to be included in the EA for the production field program.

Where a work site for an activity/ facility requires an approval under the *Regional Planning Interests Act 2014* (RPI), a site-specific plan will be prepared and the rehabilitation requirements for that site will be outlined and implemented.

1.3. Relevant Standards and Guidelines

The following standards and guidelines have been used to develop this plan and should be considered accordingly for periodic revision and implementation purposes:

- Rehabilitation requirements for mining resource activities – Department of Environment and Heritage Protection (Queensland): Revision 2, 23 May 2014.
- Code of Practice for constructing and abandoning coal seam gas wells and associated bores in Queensland – Department of Natural Resources and Mines (Queensland): Edition 2.0, October 2013.
- Indicators of Ecosystem Rehabilitation Success – CSIRO July 2003.
- Mine Closure and Completion – Australian Government: October 2006.
- BioCondition: A condition assessment framework for terrestrial biodiversity in Queensland: Assessment manual. Version 2.0 February 2015.
- Best Practice Erosion and Sediment Control. International Erosion Control Association. 2008.
- Australian Standard 2885.3—2012, Pipelines—Gas and liquid petroleum Part 3: Operation and maintenance.
- Australian Petroleum Production and Exploration Association, Code of Environmental Practice, October 2008.
- Australian Pipeline Industry Association Ltd, Code of Environmental Practice – Onshore Pipelines, October 2013.

2. BACKGROUND

2.1. Tenure Overview

2.1.1 Landscape and soils

The predominant land use within the project area is primary agriculture (cattle grazing), with some areas of State Forest. Approximately 51% of the Petroleum Lease is mapped as Strategic Cropping Area (SCA) under the Regional Planning Interests Act 2014 (RPI Act). The lease area is predominantly

cleared of remnant vegetation (87%), with the remaining remnant vegetation associated with waterway riparian areas, state forest areas, and isolated patches that have remained uncleared.

The landscape ranges from gentle to moderately undulating or rolling lands, to strongly undulating or low hilly lands, dissected with small stream floodplains that rise gradually to moderately undulating marginal valley slopes.

The land units and dominant soil types associated with the Petroleum Lease are summarised in Table 2-1.

Table 2-1 Land Units and Dominant Soil Types

Government mapping code	Concept	Dominant soils
CB3	Gentle to moderately undulating or rolling lands	Moderate to shallow depth, chiefly grey clays but with important areas of dark clays or brown clays.
Rq1	Strongly undulating or low hilly lands	Gravelly mostly shallow loamy duplex soils with mottled clay subsoil. A wide range of other shallow duplex soils are associated, chiefly alkaline forms. Associated drainage lines have small flood-plains with loamy soils together with small areas of clays.
SI4	Small stream flood-plains that rise gradually to moderately undulating marginal valley slopes	Loamy duplex soils. Associated are smaller areas of similar soils and local occurrences of clays. Some stream levees have deep sand soils. The marginal valley slopes have alkaline soils with some uniform clays. Upslope these soils merge into the cracking clays of unit CB3

Acid-sulfate soil-prone areas or acid-bearing rock formations are not expected in the project area.

2.1.2 Terrestrial Ecology

The project Atlas lease is located within the Queensland Brigalow Belt South bioregion. Native vegetation of the bioregion is characterised by woodland and forest communities of *Acacia harpophylla* (Brigalow) with scattered ecosystems dominated by eucalypt species, cypress pine, acacia species and grassland (Sattler and Williams, 1999).

There are no mapped high-risk areas under the Queensland Nature Conservation Act 1992 (NC Act).

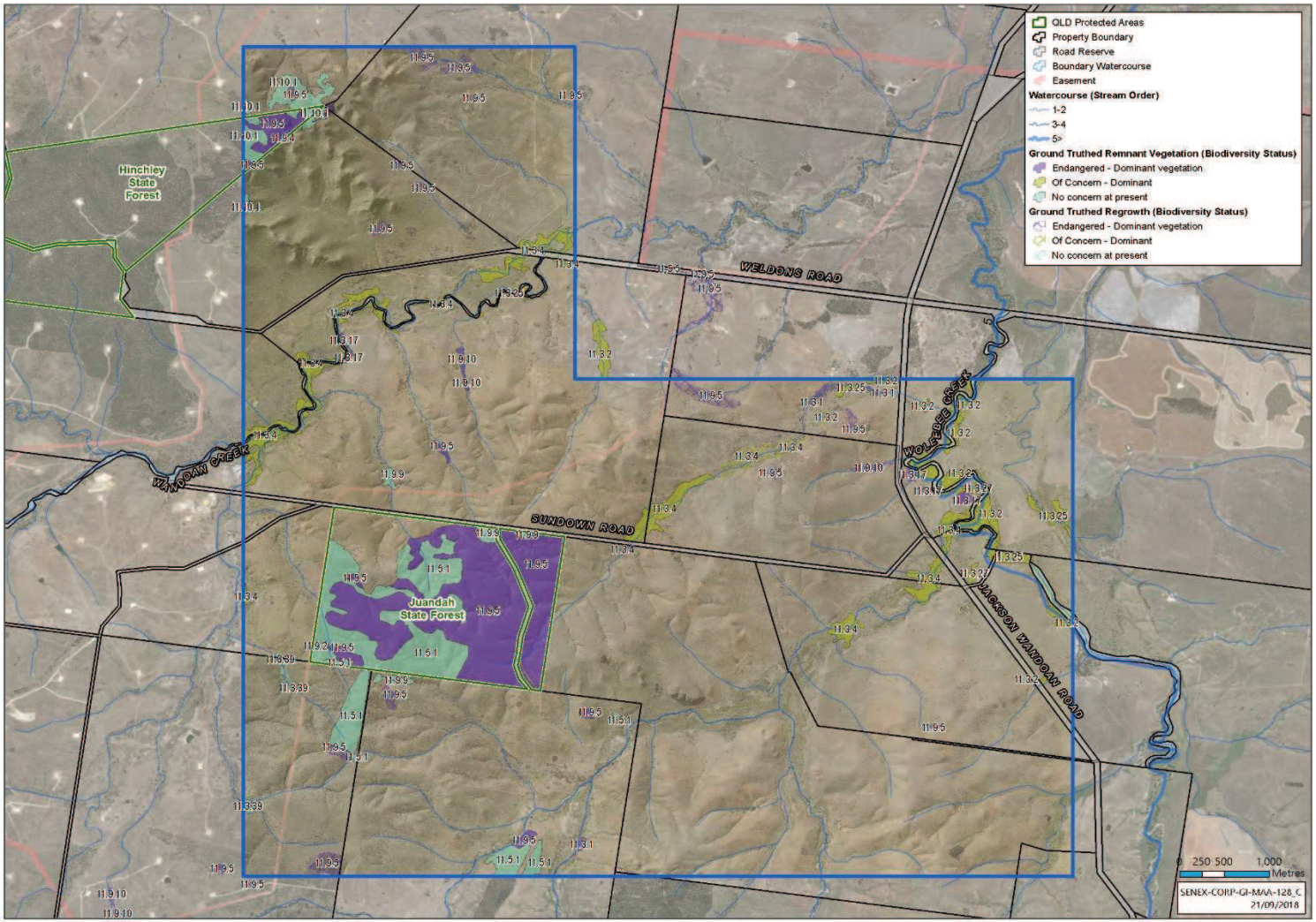
The Petroleum Lease encompasses eight regional ecosystem (RE) communities listed under the Queensland Vegetation Management Act 1999 (VM Act) as well as areas of regrowth vegetation and non-remnant areas. The remnant REs and their respective Biodiversity Status (based the dominant RE) are presented in Table 2-2 and shown in Figure 2.

The development activities are planned to be located in previously cleared, non-remnant vegetation where possible to avoid / minimise disturbance to areas of remnant vegetation.

Table 2-2 Validated Regional Ecosystems (Biodiversity Status)

RE Code	RE Short Description	Biodiversity Status	Ground-truthed extent (ha)	Comments
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	Remnant: 1.0 Regrowth: 2.9	
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Remnant: 14.6 Regrowth: 3.1	
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	Of Concern	Remnant: 97.6 Regrowth: 13.0	
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Endangered	Remnant: 3.0 Regrowth: 2.5	
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Of Concern	Remnant: 59.5	
11.3.27	Freshwater wetlands. Vegetation is variable including open water with or without aquatic species and fringing sedgelands and eucalypt woodlands. Occurs in a variety of situations including lakes, billabongs, oxbows and depressions on floodplains.	Of Concern	Remnant: 1.9	Associated with areas of RE 11.3.25 or 11.3.4
11.3.39	*Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils	No concern at present	Remnant: 1.3 Regrowth: 2.4	
11.5.1	*Eucalyptus crebra* and/or *E. populnea, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	Remnant: 144.4 Regrowth: 1.2	
11.9.2	*Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks	No concern at present	Remnant: 4.0 (nil)	
11.9.4	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks	Endangered	Remnant: 1.6	Limited to Hinchley SF
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Remnant: 247.8 Regrowth: 41.2	Majority of remnant RE is dominated by *Casuarina cristata* and is within Juandah SF
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	No concern at present	Remnant: 9.1	
11.9.10	*Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks	Endangered	Remnant: 1.8 Regrowth: 1.6	
11.10.1	*Corymbia citriodora* woodland on coarse-grained sedimentary rocks	No concern at present	Remnant: 29.6	
[1] *Extent for each remnant and regrowth RE is given for entirety of Production Area*				

Figure 2-1 Regional ecosystems (biodiversity status) in the project area



3. REHABILITATION STRATEGY

3.1. Objectives

The plan has been developed to outline rehabilitation objectives that, when implemented, will achieve compliance with the EA conditions, relevant standards and legislative requirements. The objectives of rehabilitation are to achieve agreed final land uses that are:

- Safe to humans and wildlife
- Stable and non-polluting
- Self-sustaining
- do not require significantly more management input than their pre-disturbed state (DES 2018).

CSG development can alter the physiochemical and biological characteristics of disturbed sites, which potentially limits the likelihood of returning certain vegetation communities back to a pre-disturbed condition of equal composition and structural complexity. This plan aims to reinstate vegetation communities to reflect the pre-disturbed predominant species within the ecologically dominant layer that are self-sustaining and complements the ecosystems services provided by the adjoining undisturbed landscape.

3.2. Hierarchy

The overall goal of rehabilitation is to reinstate land to the pre-disturbance land use unless otherwise agreed. Prior to commencing rehabilitation activities, the post-disturbance land use to be achieved by rehabilitation must be identified in consultation with the relevant landholder (refer 3.4). However, where this is not practical, final rehabilitation goals should be determined according to the following hierarchy, in order of preference (DES, 2018).

- Reinstating native ecosystem(s) as similar as possible to the original ecosystem present prior to the disturbance by the activities; then
- Establishing an alternative outcome with a higher environmental value than the present disturbance from petroleum activities where it can be demonstrated that returning to the original ecosystem is not possible; then
- Reinstating the previous land use (e.g. cropping or grazing).

3.3. Approach

A distinction is made in the plan between transitional rehabilitation and final rehabilitation, and the two stages are outlined in the sections below.

3.3.1 Transitional Rehabilitation

Transitional rehabilitation (also known as reinstatement or partial rehabilitation) will be undertaken on disturbance associated with ongoing operational activities where part of the disturbed area is no longer required.

Examples include where:

- the construction area of a well lease pad is reduced from approximately 1 ha to an operational area of 0.36 ha (60m x 60m);
- the construction width required for an access track is reduced to a narrower operational width;
- The pipeline has been installed and the RoW can be reinstated.

The aim of transitional rehabilitation is to stabilise disturbed land during the operational phase, thereby minimising potential impacts on surrounding environmental values (e.g. minimising erosion and potential for weed establishment). Transitional rehabilitation will generally involve re-contouring the land surface if required, replacing topsoil, and direct seeding groundcover species (pasture or native grasses depending on the final post-disturbance land use) or allowing natural recruitment of plant species, with ongoing maintenance where required.

3.3.2 Final Rehabilitation

Final rehabilitation will be undertaken once the site is no longer required for exploration or operational activities (e.g. the well has been plugged and abandoned and the lease pad is no longer required). Final rehabilitation may involve remediating any contamination, re-contouring the landform, replacing subsoil and topsoil, ripping as required, and direct seeding pasture grass or native grass, or allowing natural recruitment of plant species. Acceptance criteria that the final rehabilitation must meet are discussed in 3.4. The acceptance criteria for final rehabilitation require additional criteria to those of the transitional criteria to be met, specifically relating to the quality of vegetation.

3.4. Outcomes

3.4.1 Landholder Considerations

Prior to commencing rehabilitation activities, engagement and consultation must occur between all relevant parties (e.g. landholders) to seek agreement on rehabilitation objectives so that the final agreed land use and associated ecological values can be established.

Consistent with EA Conditions (refer (J3) in Table 1-1, Senex will enter into a written agreement such as a Conduct and Compensation Agreement (CCA), with the landholder detailing site specific rehabilitation requirements relevant to the area and its intended future use. The CCA will identify that the landholder has a preferred use of the land such that rehabilitation standards for revegetation outlined in the EA are no longer required (DEHP 2014).

Rehabilitation requirements and objectives subject to a CCA will be developed on a case by case basis, however, it is anticipated that each indicator and acceptance criteria relevant to safety, landforms, cover and soil stability will be compatible with those developed in this plan.

EA Condition J2 in Table 1-1 must be complied with, irrespective of whether a landholder wishes to utilise those areas already disturbed by CSG activities.

3.4.2 Meeting final rehabilitation acceptance criteria

Significantly disturbed areas must be rehabilitated to meet the following final acceptance criteria measured either against the highest ecological value adjacent land use or the pre-disturbed land use (refer EA Condition J3 in Table 1-1):

- Greater than or equal to 70% of native ground cover species richness; and

- Greater than or equal to the total per cent of ground cover; and
- Less than or equal to the per cent species richness of declared plant pest species; and
- Where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then at least one regional ecosystem(s) from the same broad vegetation group, and with the equivalent biodiversity status or a biodiversity status with a higher conservation value as any of the regional ecosystem(s) in either the adjacent land or pre-disturbed land, must be present.

To determine the individual site-specific rehabilitation requirements to satisfy this condition (i.e. to determine the species to be established, the required species diversity, the required abundance and composition and the required ground cover), and achieve the nominated post-disturbance land use, adjacent areas or the area to be disturbed will be assessed to obtain data used to develop final acceptance criteria for rehabilitation. This is required regardless of whether the post-disturbance land use is pasture grassland, cropping or native ecosystem.

This will be obtained by utilising the pre-disturbance ecological assessment results for each project site. Comparative ecological assessments will be conducted in adjacent vegetation as the site is re-establishing and considered near final completion criteria.

Areas to be rehabilitated should be compared with a reference site that occurs as close as practicable to the area to be assessed and has similar environmental conditions, that is, the same regional ecosystem, vegetation community, similar climate (same subregion), similar landscape conditions (soil, slope, position in the landscape, geology etc.) and similar natural disturbance (such as fire history).

3.5. Site relinquishment

The progress of the rehabilitation over time will be monitored and assessed against the final acceptance criteria to determine whether the rehabilitation is progressing toward achieving, or has achieved, the post-disturbance land use (refer Sections 6 and 7). When monitoring indicates that the rehabilitation has achieved the final acceptance criteria and the site meets the rehabilitation objectives above, a rehabilitation report that meets DES requirements will be prepared and submitted to DES. The site can then be relinquished, and the financial assurance provided by Senex to DES to cover the costs of rehabilitation of the site returned, where progressive certification can be issued.

The conduct and compensation agreement (CCAs) can also cease between Senex and the landholder, if no further access to the land is required.

4. REHABILITATION METHODS

Generally, rehabilitation methods will be undertaken sequentially as outlined in this section. Site-specific variation to these methods may be necessary depending on the site requirements. Sections 4 and 5 of this plan outline the component methods that are typically employed for each infrastructure disturbance type.

4.1. Vegetation Clearing and Mulching

Vegetation cleared for development may be mulched or left intact to use in rehabilitation and/or sediment and erosion control works. The use of mulch or green waste for rehabilitation works can assist in soil moisture retention, create micro-habitats for seed germination, provide seed stock for rehabilitating areas and provide fauna habitat. During clearing and mulching, all reasonable efforts

should be made to avoid the spread of reproductive material of pest plant species to ensure that translocation does not occur. Where there is a high risk of pest plant translocation, respreading of mulch should ideally be undertaken in consultation with the landholder.

Cleared vegetation should be stockpiled in a manner that facilitates re-spreading or salvaging and does not impede vehicle, stock or wildlife movements. The general procedure for clearing, mulching and stockpiling vegetation is as follows:

- Mature trees should be identified during ground-truthing ecological surveys, and where practicable, clearing of these will be avoided.
- Prior to commencing vegetation clearing, habitat identified during ground-truthing ecological surveys (e.g. trees with hollows and fallen timber) should be checked and cleared of fauna by a suitably qualified fauna spotter-catcher.
- Mulched and cleared vegetation may be stockpiled to facilitate re-spreading or salvaging post-disturbance.

Within well pad leases, the mulch may be stored at the edge of the lease for later spreading. Along pipeline routes it may be stored in windrows along the edge of the Right of Way (RoW) with gaps left to facilitate fauna movement.

4.2. Natural Regeneration

Natural regeneration is one of the key methods used to re-establish vegetation, particularly in areas that were previously native vegetation. It will be achieved by respreading the topsoil stockpile across the site, and recruitment of seed occurs on the site from insitu sources and from wind borne seed from adjacent areas. Natural regeneration may be supplemented with direct seeding (refer Section 4.5).

Trees, shrubs and grasses should be allowed to regenerate naturally where:

- Soil is not disturbed and root stock is left in the ground to facilitate rapid regrowth and soil stabilisation (e.g. seismic surveys); and
- On cleared areas that are not required to be kept tree free for the purpose of operating and maintenance;
- Where the re-establishment of native vegetation is the final land use objective.

Specific to the Project Atlas, natural regeneration is required for Brigalow communities where the dominant species Acacia harpophylla re-establishes through root suckering, and disturbance will occur.

4.3. Soil Management

4.3.1 Potential Impacts

The physical processes that affect soil fertility relate to soil temperature, aeration, water availability and soil strength (Ozsoils; Brady and Weil 2010). The biological processes that affect soil fertility are associated with soil biota and the living components of soil organic matter (SOM). Both physical and biological processes affect soil health and vitality and ultimately plant productivity (Brady and Weil 2010; Lee and Foster 1991; Riches et al. 2013).

The process of topsoil stripping and subsoil removal can impact soil physical characteristics particularly structure and horizon development (Brady and Weil 2010; Peverill, Reuter and Sparrow 1999). Altering

soils by removal, mixing and working (compaction) may alter the bulk density that can affect hydraulic conductivity, soil porosity, soil water balance, field capacity and plant-available water capacity. This may in-turn affect ecosystem recovery and rehabilitation outcomes even if natural regeneration occurs (Brady and Weil 2010; Peverill, Reuter and Sparrow 1999).

A range of soil types occur within the project area (refer Section 2). Consideration will be given to soil types when rehabilitating disturbed areas to ensure successful outcomes. Where the soil properties are uncertain, soil classification relating to the proposed reinstatement and rehabilitation areas shall be considered prior to topsoil and subsoil amelioration activities.

4.3.2 Topsoil and Subsoil Stripping

Topsoil contains the nutrients, microbes and seed bank required for regenerating vegetation during rehabilitation activities. As such, topsoil should be stripped prior to excavating subsoil during activities on the area. Prior to commencing soil stripping it is necessary to identify how the topsoil will be reinstated during rehabilitation, and to plan accordingly, to maximise direct re-spreading and to minimise the length of time that soil is stockpiled. Handling and storage methods should aim to minimise chemical and physical deterioration of the topsoil to maintain its viability.

Construction of some infrastructure will require excavating the subsoil, or it will be exposed when topsoil is stripped. As described above, depending on the soil type, subsoil can be sodic and dispersive and must be excavated and managed to:

- Prevent mixing and potential contamination of topsoil;
- Prevent degradation of the subsoil structure;
- Ensure reinstatement in the correct location and in the correct order; and
- Ensure effective management of unused subsoil.

4.3.3 Stockpiling

The primary objectives of topsoil and subsoil stockpiling are to:

- Minimise damage to, and maintain fertility of, stockpiled material;
- Ensure soil is stockpiled in a manner that will preserve its biological and chemical properties for use in rehabilitation activities; and
- Ensure stockpiles have minimal impact on surrounding environmental values.

Topsoil should be stockpiled separately from other site reinstatement material and stabilised to minimise erosion. Topsoil and subsoil stockpiles should be separated by an adequate distance to ensure they are not mixed during construction or rehabilitation works. This is because subsoil can be highly saline, sodic and dispersive.

Any backfill/subsoil material not utilised may be stockpiled in locations approved by the Site Supervisor or removed prior to topsoil placement. Subsoil and topsoil stockpile locations will be identified by the Site Supervisor prior to commencement of construction work.

The following should be considered in stockpiling topsoil and subsoil:

- Where both topsoil and subsoil are stripped and stockpiled, topsoil stockpiles should be clearly identified to avoid any inadvertent losses.
- Topsoil should be stockpiled within well leases or RoWs, not be stockpiled against fence lines or vegetation to be retained, and will be stockpiled separately from mulch.
- Senex Priority Weeds as defined in the Biosecurity Management Plan Queensland Operations (SENEX-QLDS-EN-PLN-001) occurring on the stockpiles will be monitored and controlled to help prevent further spread.
- Stockpiles should be located close to the original location and in a manner that does not block diversion or natural drainage flow paths.
- Long-term stockpiles will be located outside known flood plains wherever reasonably practicable.
- Stockpiles should be located where they will not interfere with or be disturbed by other activities.
- Erosion and sediment control measures must be implemented where stockpiles are to be located within 50 m of watercourses to prevent contamination of waterways.
- Topsoil stockpiles should be vegetated by direct seeding of pasture or native grasses (depending on final land use of the disturbance) to provide an adequate cover to maintain biological activity and to prevent soil loss through erosion. Exotic pasture species must not be used for stabilisation objectives where native vegetation communities are the rehabilitation objective.

4.3.4 Backfilling

Backfilling of trenches and other areas generally involves the following, although site-specific requirements may apply depending on soil type:

- Pipeline trenches will be backfilled within three months of pipe laying (refer Table 1-1).
- During backfilling of pipeline trenches, soil will be replaced so that topsoil does not mix with subsoils. Topsoil will not to be used as backfill.
- Subsoil will not be contaminated with general rubbish or any foreign material that may damage the pipe during backfill.
- Pipeline backfill, and compaction of the fill will be controlled to minimise subsidence and the need for excessive temporary soil mounding.
- Excess subsoil material should be disposed of appropriately or stockpiled for use in future rehabilitation or construction or utilised elsewhere in consultation with landowners.

4.3.5 Re-contouring

Re-contouring disturbed areas may be required to reinstate surface drainage lines, and to create a stable, non-polluting landform consistent with the surrounding land form. This will ensure water flowing over the surface is comparable with the surrounding landscape and minimises the risk of erosion. It also ensures that the final landform is consistent with the surrounding land features. Infrastructure siting and field planning should aim to reduce the need for significant cut and fill to minimise the need for re-contouring. Surface re-contouring will be completed prior to re-spreading of topsoil.

4.3.6 Ripping and Scarification

Prior to the re-spreading of topsoil, the ground surface may need to be ripped. Ripping assists with binding of the soil layers, increases retention time of water on the slope, aids water infiltration into the soil increasing the opportunity of seed germination success, and reduces the volume and velocity of

runoff generated from the slope. Requirements for ripping depend on the degree of compaction of the ground surface.

Ripping should be undertaken along contours, particularly on heavily trafficked areas such as temporary access tracks, camps and hardstands. Areas with hard-set mud or clay such as drilling mud pits may also need to be ripped. Ripping depth will be reduced to no greater than 300 mm in areas where pipelines are buried, as ripping any deeper could potentially result in the rupture of buried pipelines.

After topsoil is spread the surface may be lightly scarified to assist with relief of compaction, water penetration and plant establishment. Scarification will be completed prior to seeding (after topsoil is spread) and should ensure no subsoil is brought to the surface. The scarification should be completed using appropriate equipment such as the rear mounted ripping tines of a grader or a purpose designed harrowing implement rear mounted on a tractor. Alternatively, scarification can also be achieved by ploughing the sub-surface material prior to topsoil reinstatement. A figure eight or zigzag rip lines may be appropriate to prevent rill erosion in flat to low gradient areas.

Where topsoil is limited (less than 100mm thick) and it will be difficult to apply after ripping consideration should be given to applying the topsoil before ripping and scarification.

4.3.7 Soil Amelioration

The need for soil amelioration will depend on soil type and associated chemistry and physical properties, and the length of time soil has been stockpiled (or if in situ, the time it has been exposed and previous treatments). This should be determined on a case by case basis. Soil samples should be collected and analysed, primarily to grass root depth.

Vertosols and Chromosols should be assessed for dispersive tendencies using accepted techniques (Emerson 1967) and potential toxicity if acidic subsoils are encountered. Highly dispersive soils should be treated with lime or gypsum (depending upon soil pH) to alter the soils exchangeable sodium content (with calcium ions) and further stabilised using mulched material where available. Organic or inorganic fertiliser may also be used to improve soil quality and the likelihood of revegetation success.

4.3.8 Topsoil Re-spreading

Topsoil will be replaced on disturbed areas and generally be spread to the following specifications, although site specific requirements, including depth of spreading will be determined by the Site Supervisor in consideration of on-site conditions:

- Topsoil should be spread back over the disturbance in an even layer and left ‘rough’ (rather than smooth and compacted) to minimise potential erosion, increase water infiltration and to trap seed.
- Topsoil should be spread to cover the entirety of the disturbed area so that there is no exposed sub-surface material. This will ensure seed has the best opportunity to germinate and establish groundcover.
- Topsoil depths will be determined by that recovered from the disturbed site, recognising that the soils types in the area have limited depth and delineation of topsoil.
- If insufficient topsoil exists, additional materials may be sourced from other locations but confirmation of the source and quality, including that it is weed free (declaration), must be obtained and provided to the Site Supervisor. Importing topsoil from other areas in the tenure must be approved by landholders. If no other sources exist on tenure, then amelioration techniques should be employed to ensure the soil is as optimal as reasonably practicable for growing conditions.

- Topsoil re-instating should only take place following initial reinstatement of the subsoil, construction of contour banks on steep slopes and compaction of subsoils to account for subsidence as required.
- Topsoil stockpiled for extended periods should be turned over and mixed prior to reinstating on the site.

Sites where reinstated topsoil fails to promote vegetative growth should be assessed and cost-effective soil amelioration options employed to restore soil condition and health.

4.4. Erosion and Sediment Control

Erosion can have an adverse effect on soil structure and fertility and can result in undermining structures (such as fences), exposed pipelines, stream bank erosion, downstream sedimentation, increased dust generation and poor rehabilitation outcomes.

Erosion levels are expected to be more significant in coarser textured soils, where there is little structure and organic matter to assist in binding the soil.

Deep clay soils have a low to moderate erosion rating where undisturbed. However, subsoils can be sodic to strongly sodic and these soils will erode due to clay dispersion where soil is exposed after vegetation removal. Such soils can be particularly prone to gully and tunnel erosion.

Where applicable, the following erosion and sediment control measures should be considered (refer Queensland Erosion and Sedimentation Management Plan):

- Where diversion of clean runoff water around a disturbed area is required, design should be mindful of possible erosion effects, including potential gully and tunnel erosion.
- Sediment basins should be constructed on the downhill side of major facility sites when they are near watercourses.
- Drainage lines and areas of concentrated water flow near project facilities should be inspected regularly for erosion and to determine whether remedial action is required.
- Sediment and erosion control measures and areas receiving concentrated flows should be inspected on a regular basis, replaced where damaged and maintained following rainfall events, as required.
- Erosion and sediment control measures, such as contour banks, should be placed as needed at intervals along flow paths, and discharge locations created to ensure discharges have low velocities and volumes, rather than channelling discharges to a central point exacerbating erosion.
- Point source discharges of runoff should be directed into stable waterways and/or drainage lines with engineering controls, such as scour protection and flow velocity limits as required.
- Slopes should be re-vegetated as soon as reasonably practicable after disturbance.
- Stockpiles should be vegetated as soon as reasonably practicable to minimise surface erosion.
- Diversion and erosion and sediment controls should be implemented as required to provide effective erosion control prior to undertaking land disturbance activities and kept in place and maintained fully functional until the area has been effectively rehabilitated.
- Tracks should be preferably aligned across slopes, but where this is not possible, contour banks should be used at intervals appropriate to the slope and soil type to control the flow of surface water.
- Where necessary, erosion and sediment control devices should be constructed in consideration of the IECA Best Practice Erosion and Sediment Control Guidelines 2008.

4.5. Revegetation

4.5.1 Transitional Rehabilitation Revegetation

Where transitional works are to be undertaken prior to final rehabilitation, disturbed areas may be direct seeded with either pasture species or native grasses, depending on the desired post-disturbance land use and any requirements for the area to remain treeless during operations.

Direct seeding can be undertaken using a spreader attached to the rear of a tractor delivering seed onto the soil. Alternatively a drill seeder with press wheels may be used. Hand seeding should be considered for steep slopes due to safety concerns regarding the use of machinery in these areas. Rehabilitation crews should assess each site on a case by case basis, according to the topography and level of risk involved if machinery is utilised.

Hydro-seeding, hydro-mulching, ecoblanket products or polymer sprays with seed, may be considered for revegetating steep slopes to encourage more rapid establishment and stabilisation of the rehabilitated area.

Natural recruitment of seed to a site will also be considered in certain circumstances.

4.5.2 Final Rehabilitation Revegetation

4.5.2.1. Cropping land

On areas where the landholder will be sowing a crop, a cover crop will be sown to protect the soil, where the soil will be exposed for 3 months, prior to cropping.

4.5.2.2. Pasture Grassland

Pasture establishment during final rehabilitation will involve direct seeding as described in Section 4.5.3 Species selection will be made in consultation with landholders.

4.5.2.3. Native Vegetation

The selection of species to be used in rehabilitation where native vegetation is the post-disturbance land use should consider:

- Structural and floristic composition of the reference sites (refer Section 3.4).
- Significance to traditional owners.
- Potential to provide food and shelter resources to local fauna.
- Soil conditions, micro-climate and aspect of the new landform.

4.5.3 Direct Seeding

Where sites are no-longer required for operational activities, direct seeding of grass cover species (native/introduced species) should be undertaken as soon reasonably practicable after the topsoil has been re-spread but before spreading any mulch. Timeframes for seeding will consider the most appropriate season for germination and establishment of seedlings (i.e. immediately before the commencement of the wet season). Where practicable fencing off from stock may be required,

depending on adjacent land use and landholder considerations, to facilitate revegetation and regrowth until site stability is established.

Native seed should be sourced as locally as possible, preferably from undisturbed naturally occurring remnant vegetation in the vicinity of the intended rehabilitation areas. Seed should be procured from a reputable supplier that can vouch that the seed is of good genetic quality, viable and has been collected in a suitable manner. When procured seed is not of local provenance, efforts should be made to match the key environmental characteristics of the intended rehabilitation sites with the locations the seed is sourced from.

4.5.4 Planting Tubestock

Although the preference for recruiting species other than grass will be natural recruitment, certain situations may warrant considering tube stock planting, such as where species unsuited to direct seeding must be established (based on reference site composition and knowledge of the regeneration strategies of the component species). Requirements for tube stock planting are as follows:

- Species to be selected for planting should be sourced from local provenance seed where reasonably practicable.
- Tube stock should be planted in the early wet season (December to February).
- Spacing should be determined according to the species, but will typically be 2 m apart for most tree species.
- Tube stock should be watered immediately following planting and as required thereafter.
- Mulch may be placed around tube stock, but should not touch the stems.
- Fencing will be required following planting to prevent browsing damage.

4.5.5 Transplanting

Transplanting may be appropriate for certain species such as stoloniferous grasses and native species that sucker from an underground rhizome or other rootstock. This has the advantage of establishing a root system rapidly in erosion prone areas and enabling some species that do not readily set seed to be re- established. However, this can only occur where a suitable source of transplants is located nearby, for example an adjacent area that is to be cleared.

In undertaking transplanting, the following should be considered:

- Undertake transplanting in the early wet season (December – February).
- Ensure that the source site is required to be cleared and is located close to the recipient site.
- Ensure that the plant is excavated to retain most of the root system and accompanying soil.
- Minimise the time between transplant removal and planting to prevent drying out.
- Water transplants immediately following planting and as required thereafter.

4.6. Mulch Re-spreading

Where appropriate mulch should be respread after seeding as follows:

- Material should be evenly spread over the area to assist distributing seed and provide shelter for fauna.

- Mulch should be sourced from salvage specific to that site to minimise the spread of weeds and pathogens.
- Mulch should be spread evenly once seeding and planting has been completed in a thin layer (50 mm or less). This will allow seeds to germinate establish and establish groundcover.
- If excess mulch needs to be utilised, contour banks and erosion control structures can be constructed using mulch instead of soil.

4.7. Weed and Pest Management

Weed and pest management is governed by the Biosecurity Management Plan Queensland Operations (SENEX-QLDS-EN-PLN-001) and associated procedures. In relation to rehabilitation, controlling Senex Priority Weeds is required during transition and final rehabilitation development.

Controlling Senex Priority Weeds during germination and establishment of vegetation on rehabilitation areas should be undertaken to increase the chance of revegetation success where uncontrolled weeds can out-compete establishing vegetation for resources including nutrients, space and sunlight.

Pest control on establishing rehabilitated areas may also be required to minimise grazing, trampling and uprooting of vegetation (e.g. by rabbits and pigs) occurring.

Treatment applications should consider the impact on established vegetation and comply with requirements of the Queensland Operations Biosecurity Plan and supporting documentation.

4.8. Maintenance and Rework

Following rehabilitation works, limited access to infrastructure will be allowed to perform essential maintenance requirements. Traffic should be restricted on the rehabilitation areas to enable successful establishment of groundcover. Fencing of rehabilitation areas may be required to prevent grazing. Depending on results of rehabilitation monitoring (refer Section 7 or other observations, maintenance and rework activities may be required to ensure:

- Landforms remain stable
- Erosion control measures remain effective and stormwater runoff and seepage from rehabilitated areas does not impact on nearby watercourses
- Senex Priority Weed species are managed on rehabilitated areas
- Vegetation is establishing to reflect relevant reference sites or baseline site data.

Unstable sites (e.g. erosion) or those lacking adequate vegetation cover may be re-seeded (or replaced with tube stock).

Areas requiring rapid stabilisation (e.g. slopes, creek backs etc.) should be watered whenever reasonably practicable to promote groundcover establishment. Wherever tube stock planting or transplanting is undertaken, follow-up watering may be necessary depending on climatic conditions to ensure those plants establish successfully.

Watering should be undertaken with water of a quality suitable for the purpose.

5. DISTURBANCE TYPE

Depending of the activity or infrastructure built, transitional rehabilitation will be undertaken prior to final rehabilitation on areas no longer required for operational activities. Rehabilitation timeframes are governed by EA conditions and are required within six months of completing petroleum activities (refer Table 1-1), This section outlines how the rehabilitation methods in Section 4, will be employed for specific types of infrastructure to be constructed for the Atlas Project.

5.1. Well Lease Pads

Constructing well lease pads for exploration, appraisal, production wells and monitoring bores wells, and associated infrastructure, generally involves clearing all standing vegetation, stripping topsoil from disturbance areas, stockpiling topsoil, levelling the well lease pad, installing fencing, and constructing sumps if required. The shape of the well site is determined based on topographical relief and other physical or environmental constraints. The area of disturbance associated with the establishment of a well lease pad is approximately 1 ha, however, and depending on the activity being carried out (e.g multi-well drilling) the lease pad can be larger.

After completing primary drilling of the well, but usually before the completion rig is mobilised, drilling fluids and muds in sumps must be disposed of in accordance with EA conditions, that is, either removed from the project area for disposal at a licenced facility, or disposed of using mix-bury-cover or other method of disposing to land that is certified as not causing environmental harm.

After well completion, the disturbance area associated with well construction is then reduced through transitional rehabilitation to a hardstand area of approximately 0.36 ha. This area is maintained for the operational life of the well, typically up to 30 years. Transitional rehabilitation of well lease pads generally involves ripping any compacted areas, partial respreading of topsoil and direct seeding with species that will provide an appropriate level of groundcover and that are suitable considering the post-disturbance land use.

Once the well lease pad is no longer required for ongoing petroleum activities, final rehabilitation will be undertaken as follows:

- Decommissioning/removing the well head, pumps and other infrastructure.
- Cut and fill batters profiled to re-contour the land surface and drainage lines.
- Compacted hardstand areas are ripped.
- Stockpiled topsoil is respread.
- Topsoil is seeded with pasture grasses, or native species depending on the final land use.

Fencing should be considered to be installed prior to the final rehabilitation process, if it has not been installed, to expedite restoration.

5.2. Drilling Sumps

Drilling muds vary in profile and composition, depending on the depth, rock type, and drilling speed, however, drilling muds generally consist of water, clay materials, and some trace chemical additives (e.g. salts), and do not contain oil-based or synthetic compounds.

Drilling mud sumps are decommissioned once drilling activities have ceased. Drilling mud sumps and turkeys nests must be decommissioned within 6 months of the use no longer being required.

Drilling activities should be planned in a manner that allows maximum re-use or recycling of drilling materials, whenever possible. Clean drilling materials that do not contain harmful contaminants may also be disposed of on-site by using the mix-bury-cover method (in accordance with approved quality criteria).

Contaminated drilling materials that do not meet the quality acceptance criteria should be evaporated in-situ and the residue removed for appropriate disposal by a licensed waste contractor.

5.3. Access Tracks

Temporary access tracks no longer required for ongoing operational activities or not to be retained by the landholder will be closed and reinstated to a condition compatible with the surrounding land use. This will generally involve ripping to remove compaction, re-spreading stockpiled topsoil and revegetating. Landholder tracks in existence prior to construction will have access re-instated and will not be blocked in anyway. Where tracks are to be retained by landholders, any wheel ruts should be graded and erosion-control measures such as diversion drains installed prior to relinquishment to the landholder.

5.4. Water Crossing

Waterway crossings should be rehabilitated by re-contouring disturbed areas to match the surrounding land as soon as practicable after petroleum activities have ceased. The surface will usually be lightly scarified before spreading the topsoil, to promote vegetation re-growth and protect against the topsoil loss. Temporary waterway barriers will be removed and reseeding undertaken where required to minimise erosion and promote regeneration of riparian vegetation.

5.5. Flare Pits

Flare pits, that may be required for drilling, should be decommissioned within 12 months of their use no longer being required.

As with dams and other containment systems, flare pits should have all remaining liquids removed and transported to an appropriate treatment and disposal facility or, where appropriate, reused in accordance with the waste management hierarchy (per the Waste Reduction and Recycling Act 2011) and the requirements of the EA.

Synthetic liners (if used) should be removed and disposed of to landfill. Associated pipework, pumps, and water treatment systems should be decommissioned and removed from site unless the landowner indicates that they would prefer that the infrastructure remains in place for their use.

Because of the nature and purpose of flare pits, investigations may be required by a suitably qualified person to determine the presence or absence of soil contamination.

In all circumstances, soil investigations should be conducted in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM 1999) and, where necessary, should be remediated following the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites.

Backfilling should be undertaken in a manner that is complimentary to the natural contours of the existing landscape to ensure surface subsidence is avoided where practicable. In circumstances where backfilling is not practical, contours should be ripped and returned to a state similar to the surrounding environment. Seeding or revegetation should also be undertaken (subject to original state/distribution of vegetation).

5.6. Gas and Water Gathering Pipelines

The disturbance associated with the RoW for gas and water gathering lines will be dependent on the number of parallel pipelines within the RoW and ground-truthed constraints. Where reasonably practicable, the gathering network will be installed in areas of previous disturbance such as adjacent to existing infrastructure, access tracks, and property and fence boundaries where environmental impact is minimised.

Pipelines trenches will be backfilled and topsoil reinstated within three months after pipe laying. Reinstatement and revegetation of the pipeline RoW must commence within 6 months after cessation of petroleum activities for the purpose of pipeline construction as required by EA conditions (refer Table 1-1).

During backfilling of pipeline trenches, soils should be replaced so that the topsoil and subsoil are consistent with the immediately surrounding area, this will allow for natural regeneration. Following soil replacement, areas will be revegetated. Areas required for operational purposes (i.e. access tracks and areas above pipelines) should be revegetated with pasture grasses, or native grasses and ground cover species depending on the final land use. Remaining areas no longer required for operational activities or maintenance will be rehabilitated to the post-disturbance land use.

Final rehabilitation of the gas and water gathering lines will occur after decommissioning of both pipelines. Where it is practical and safe to do so, the pipelines will be abandoned and left in-situ in accordance with APGA Code of Practice Upstream Polyethylene Gathering Networks – CSG Industry Version 4.0 and Australia Standard (AS) 2885 section 10.6 and section 8 of the Australian Pipeline Industry Association Code of Environmental Practice. The pipelines will be left in-situ to avoid disturbing the re-established vegetation through excavation and removal. The overall objective is to leave the RoW in a condition that is as near as practical to pre-existing environmental conditions. When abandoning in place, the pipeline section shall be abandoned in such a way to ensure that ground subsidence and the risk of contamination of the soil or groundwater is minimized.

The pipelines are to be disconnected from all sources of hydrocarbons that may be present in other pipelines, processing plant, meter stations, control lines and other appurtenances, and shall be purged of all hydrocarbons and vapour with a non-flammable fluid and then capped. Disposal of the purging fluid shall meet all relevant environmental and safety requirements. The pipeline will be decommissioned in a manner that minimises potential impacts to the environment, land use and third parties and guidance should be taken from AS 2885. All above ground pipes and supports along the pipeline should be cut-off at a minimum depth of 750mm below the natural surface, or at pipeline depth as determined by AS 2885.3. These pipes should be removed and capped off below the surface. All aboveground signs and markers above the pipeline should be removed.

When abandonment is either unsafe or not practical, decommissioning will be undertaken via removal, and the removal methods should be considered similar to those for pipeline construction, and shall comply with the relevant requirements of AS 2885.1.

After decommissioning of the pipeline compacted hardstands, access tracks and stockpile areas should be ripped. The ripping of the soil will aid with binding of the soil layers, increase water retention, helping water infiltrate into the soil, and thus increase seed germination success. Seeding should then be undertaken on the remaining areas with an appropriate seed mix, depending on post-disturbance land use to be achieved.

5.7. Laydown, Hardstand and Stockpile Areas

Laydown, hardstand and stockpile areas will be used to accommodate the materials associated with developing the Atlas Project. These storage areas operate in the short and long-term depending upon their function and, as such, become available for rehabilitation at the end of useful or strategic function or at the completion of project operations. Constructing these areas generally does not involve topsoil stripping, although it can involve cut and fill to create a flat pad. Local material required for hardstand areas will generally be sourced from borrow pits/quarries in the area. Contouring may be required to divert clean runoff around the disturbed area.

Rehabilitation will be undertaken when the area is no longer required for operational activities. Gravel is generally removed from the hardstand and any areas of contamination remediated or excavated for disposal at an off-site licensed facility. Compacted areas should be ripped and the area seeded with a species mix determined by the post-disturbance land use.

5.8. Dams

Prior to decommissioning of dams, landholders will be given the option to retain the dams for their own water storage purposes. Any residue in the dam must be quantified and tested to demonstrate that it is safe and would have no ongoing adverse impacts on the landholder's use of the dam.

Where brine storage dams are to be decommissioned, any saline residue or salt resulting from reverse osmosis will be stored in a tank for off-site disposal to a regulated waste facility. Holding dams will have all water removed (e.g. through beneficial use options). Once any liquid is removed, dams will be rehabilitated to remove any source of potential contaminants and return the land to a useable form. The landform should be re-instated so that it is stable and will no longer function as a dam. The process for decommissioning and rehabilitation of the produced water holding and brine storage dams generally involve the following:

- Remove and recycle or dispose of synthetic liners.
- Assess any land contamination that may have occurred. In the case were some leakage of the liner system has occurred a contaminated land assessment should be undertaken as per the current National Environment Protection (Site Assessment) Measure.
- Remediate soils through in-situ treatment of contaminated soils, removal to a soil remediation area or dispose of the contaminated soils to an off-site licensed facility.
- Retain clay materials where clay has been used as part of the containment system for reuse if reasonably practicable.
- Rehabilitate the site by pushing in dam embankments and filling in depressions to re-contour landforms to match surrounding topography. Any retained subsoil could be used to infill dams and topsoil can be respread.
- Revegetate the area by direct seeding with appropriate species based on post-disturbance landform.

5.9. Water Bores

Any bore or hole that is to be permanently decommissioned is such a manner to prevent vertical movement of water in the bore, including water in the annular space surrounding the casing (which should be confined to the specific zone in which it originally occurred).

All test holes and test bores should be decommissioned by grout sealing as though they were a water bore, as soon as possible but no longer than 10 business days after commencing drilling or, alternatively, by complying with the mandatory construction requirements for water bores.

Supervision of this work by the relevant water authority may be required in some areas.

The sealing material shall consist of one or more of the following:

- Grout;
- Bentonite grout;
- Bentonite pellets/chips; and
- Cement.

Sealing materials should be placed to avoid segregation or dilution of material and unnecessary contamination of the aquifer zone, and set in impermeable strata immediately above and below each aquifer formation in the bore. Sealing material shall not pose any potential health risk, and fill material should consist of uncontaminated sand, coarse stone, clay, or drill cuttings.

For non-flowing bores, a minimum of 10 metres or grout plug shall be set in the seal.

For flowing bores the length of grout shall be:

- Sufficient to overcome the pressure and stop the discharge of groundwater;
- Not less than 20 metres unless the flow originates from less than 20 metres below the surface.

Complete and accurate records shall be kept of the entire decommissioning procedure and supplied to the state or territory water authority.

Regardless of the decommissioning method used, a cement or grout surface seal to a minimum depth of 5 metres should be installed in all decommissioned bores and/or holes. Where a native soil topping is required, the surface seal should be installed to 1.0 m below the surface, and the soil topping should be compacted and mounded to prevent ponding of surface water above the decommissioned bore.

For multi-port monitoring bores, aquifer isolation must be maintained at all times during operation. Decommissioning must take place within 7 working days of the removal of the isolation packers.

Work should be undertaken in consultation with the document, *Minimum Construction Requirements for Water Bores in Australia.*

5.10. Camps

Temporary camps and support facilities and services will be required during the infrastructure construction phase including accommodation blocks, site offices, ablution blocks, sewage treatment plants (including irrigation areas) and waste transfer areas.

Most campsite buildings will be constructed by locating modular transportable buildings on hardstand, powered by diesel generators, unless reticulated power is available. Temporary camp infrastructure will be transported off-site by contractors once no longer required. Remaining hardstand and any potentially contaminated areas will be rehabilitated as provided in Section 5.12.

5.11. Borrow Pits

Gravel for use on access tracks and drill pads, and sand and clay for lining dams may be extracted from borrow pits on the Atlas Project Area. Once material is no longer required to be extracted, borrow pits will be decommissioned and rehabilitated, if not agreed to be retained by the landholder. Re-grading or re-contouring of the borrow pit may be required to ensure the surface aligns as much as practicable with the natural contours of the existing landscape. Following the replacement of topsoil, direct seeding will be required as described in 4.5.3.

5.12. Contaminated Land

Contamination of land can result from handling, storage and transfer of oil, fuel and chemicals on the project area. Contamination of land can also result within bunded areas designed for these activities. Where contamination or potential contamination of land is thought to have occurred, a Stage 1 Preliminary Site Investigation contaminated land assessment should be undertaken to determine any requirement for remediation. Where remediation is required, contaminated soils will be further assessed and either:

- Treated on-site so that the contaminant is destroyed or the associated hazard is reduced to an acceptable level; or
- Disposed of off-site to an appropriate facility licensed to receive contaminated land.

Purpose built soil remediation areas may be established for the remediation of contaminated soil from various locations. Following the removal of contaminated soils from a site, visual inspections and contamination testing should be undertaken to confirm that all contaminated soil has been removed. Soil remediation strategies may include:

- Excavating contaminated soil and burying it at one location on site to reduce the area containing contaminated soil.
- Land farming volatile contaminants and reusing soil on-site where there are no sensitive receptors nearby.
- Land farming volatile contaminants at an off-site location then returning the soil to site.
- On-site or off-site treatment.
- In-situ biological or chemical treatments.

5.13. Nuisance Management

5.13.1 Dust Emissions During Rehabilitation

Dust emissions may occur at any point where soil, fill, earthen material or similar are removed, disturbed, traversed or exposed to windy conditions during rehabilitation.

Every reasonable effort shall be made to mitigate the impact of dust emissions in accordance with the Senex's complaint management process. Such measures may include (depending on the circumstances):

- dust suppression with water trucks or similar equipment;
- where practicable, seal surface roads and hardstand areas;
- covered loads on vehicles;
- mulching, vegetating and progressive rehabilitation of disturbed areas;
- appropriate scheduling of activities to avoid dust generation;
- effective planning to ensure that dust generating activities are down-wind of sensitive receptors; and
- minimising dust-generating activities during periods of high wind where there is the potential to impact upon dust-sensitive receptors.

Senex will undertake dust mitigation measures as a routine measure and as part of Senex's commitment to providing a safe workplace. Additionally, dust monitoring as required shall be undertaken in response to any dust-related complaints received from nearby sensitive receptors, or a direction from EHP to investigate an alleged complaint. Dust monitoring will be managed by the Atlas Environmental Management Plan.

5.13.2 Noise Emissions During Rehabilitation

Noise emissions from rehabilitation activities can have a considerable impact upon the surrounding environment and sensitive receptors.

Excessive noise emissions may have deleterious effects on sleep behaviour, social impacts and may infringe upon an individual's common law rights to quiet and peaceful enjoyment of their property.

As with all potential nuisance emissions, Senex has adopted a hierarchal approach to noise source management, and every reasonable effort shall be made to prevent or avoid noise impacts upon sensitive receptors.

Noise emissions shall be measured in accordance with the Queensland Environmental Management Plan and the EHP Noise Measurement Manual and the most recent version of AS1055 Acoustics – Description and measurement of environmental noise.

5.13.3 Light Nuisance During Rehabilitation

Nuisance light emissions are those that cause an unreasonable interference with an individual's quiet enjoyment of their property. Light nuisance may also impact upon an individual's sleep pattern and therefore have deleterious social impacts.

All work lighting that is utilised during the rehabilitation process should be installed and positioned in a manner that does not create a light nuisance to adjacent properties. Outdoor lights that must not be angled onto adjoining properties and shall comply with the requirements of Australian Standard 4282 – Control of the obtrusive effects of outdoor lighting.

5.13.4 Visual Amenity of Rehabilitated Areas

Visual aspects of rehabilitated areas can have a considerable impact upon the amenity of surrounding sensitive receptors. Senex will ensure, wherever practicable, that its petroleum activities do not adversely impact on visual amenity of current or future sensitive receptors, such as residential dwellings and other industrial activities.

- Senex shall consider the following impact mitigation measures:

- where possible, obscure rehabilitated areas with native vegetation or natural landforms; and
- for infrastructure that is authorised to remain intact, utilising neutral colour schemes to facilitate better integration into the surrounding landscape.

Where complaints have been received in relation to visual amenity, Senex shall endeavour to address the issue in a timely and cost-effective manner.

6. REHABILITATION COMPLETION

6.1. Acceptance Criteria

Acceptance criteria (also known as completion criteria) are a set of specific and measurable performance standards based on scientific evidence used in the assessment of the success or trajectory of rehabilitation development in achieving the post-disturbance land use, thereby allow for the surrender of tenure (CSIRO 1998; Erskine 2008). Acceptance criteria are developed from data from reference site/ predisturbance surveys (refer Section 3.4.2 and comprise an important component of the rehabilitation monitoring program. Results from monitoring nominated indicators (refer Section **Error! Reference source not found.**) are routinely assessed against acceptance criteria in order to determine that the rehabilitation site is trending toward a safe, stable, non-polluting and sustainable ecosystem (DES 2018).

The acceptance criteria and associated indicators in this plan have been developed for non-remnant grassland areas on the project area.

6.2. Indicators

The rehabilitation indicators developed for this plan and for which monitoring will be undertaken have been selected to best characterise the ecological and environmental values represented in the acceptance criteria, cognisant of the resources available to monitor those indicators (Dale 2001; Erskine 2008; CSIRO 1998). The indicators are:

- Easily measured, repeatable, auditable and are suited to long-term assessment;
- Receptive to stresses;
- Predictable;
- Responsive to corrective actions as a result of various stress factors; and
- Able to produce responses with low variability.

7. REHABILITATION MONITORING

7.1. Transitional Monitoring

7.1.1 Monitoring Program Development

Monitoring the success of site reinstatement should be undertaken for all significantly disturbed land that Senex is responsible for. The program design should reflect the type of land that has been disturbed, and the scale of infrastructure.

The monitoring program should:

- enable sufficient data to be collected, whilst ensuring each monitoring event is not ineffectually onerous.
- account for any land access
- other logistical constraints for ongoing monitoring events, such as fences, creeks, transporting weeds of landholder concern.

Monitoring sites should be selected to ensure that a good understanding of rehabilitation success can be determined. Rehabilitation monitoring sites selection should focus on areas of disturbed land in the landscape that have the potential to have poor success. This may include areas with: erodible soils; slopes >10%; infrastructure crossings at waterways, particularly those of stream order >3; areas where high risk weeds are prevalent; and where soils are unlikely to support vegetation re-establishing.

Additional monitoring sites should be selected to complement the 'potential high-risk areas' to ensure a range of soil/land/vegetation types will be monitored. This could include for example, remnant vegetation, non-remnant vegetation, clay and sandy soil types.

7.1.2 Transitional rehabilitation monitoring steps

The following steps should be completed on site, to ensure a representative result is obtained, and the result is comparable with previous site assessments. Information is to be recorded on the tablet (e.g. iPad) form, for efficient data recording and management.

1. Make a general description of the site for a 10m x 10m area making note of the landform, vegetative cover, stability and any signs of external impacts.
2. Inspect the area for erosion and subsidence. If present (yes) record the type of erosion/subsidence, the status, the depth, the possible cause/s.
3. Randomly place a quadrat within the survey area (10m x 10m), to assess the on disturbance vegetative cover. Record the estimated cover percentage (includes native perennial grass, native other grass, native forbs and other non-grass species, native shrubs and trees, non-native grass, forbs, shrubs).
4. Identify the dominant species (3-5) present in the quadrats and surrounding area.
5. Identify all the restricted weed species and their density.
6. Identify the percentage other groundcover within each quadrat of the following attributes:
   - Bark cover
   - Leaf litter
   - Rock cover
   - Fallen woody debris cover.
7. Identify the percentage of bare ground within each quadrat.
8. Repeat steps within the selected area, until data from three (3) randomly placed quadrats has been collected.

9. Assign a risk rating for the overall area (10m x 10m): high; medium; or low; by using the risk rating for each of the risk factors- erosion/subsidence, weed abundance and groundcover (Refer to Table 7-1).

Table 7-1 Site risk rating for site aspects

		Risk Rating		
		High	Medium	Low
Aspect	Erosion/subsidence	Occurring frequently, unstable	Present on site	Not occurring
	Restricted weed abundance	Parthenium or other restricted invasive plants present	Opuntia, lovegrass and/or other invasive weed species present	Not present
	Groundcover	<20%	20-50%	>50%

7.1.3 Transitional Rehabilitation Data Analysis and event reporting

For each monitoring site, an overall rating shall be assigned as high, medium or low using Table 7-1:

- High being triggered if any aspect scores 'high'
- Medium results where the highest score is a medium
- Low results where only low ratings are assigned.

The rating will then determine the frequency and timing of the next rehabilitation-monitoring period (Table 7-2).

Table 7-2 Monitoring Schedule and Action Timeframe based on Risk Rating

Rating	Inspection Schedule	Action Attention Timeframe
High	3 months	Within a week
Medium	6 months	Within two weeks
Low	6 months	Within two weeks

The Environment Team will provide a report for the Operations Manager and Field Superintendent outlining findings, particularly high-risk sites and any actions/maintenance arising from the inspection. The report will also be prepared to assure various stakeholders of site compliance.

7.1.4 Transitional monitoring frequency

The subsequent monitoring program for the project area should be undertaken annually, or sooner, to be have an adequacy so that erosion is captured, and preventative measures can be instated.

Monitoring can be undertaken after rainfall events to maximise plant identification, capture plant growth and identify high risk weeds germinating.

After site stability has been recorded for a project, pipeline or phase of development, transitional rehabilitation frequency can be reduced, however it should continue on any high-risk areas. Transitional rehabilitation monitoring will cease when either:

- the criteria provided by the landholder have been met
- the final rehabilitation criteria are considered likely to be met.

7.2. Final Rehabilitation Monitoring

The main purpose of undertaking final rehabilitation monitoring is to determine that the land meets the regulatory requirements for progressive rehabilitation or relinquishment.

7.2.1 Monitoring Activty

Final rehabilitation monitoring will be undertaken using the Biodiversity Values Form (SENEX-CORP-EN-REP-008), as final rehabilitation monitoring requires more detail than transitional rehabilitation. Site access should be planned at least two weeks (14 days) in advance of monitoring event to allow for land access requirements.

1. For each site (i.e. a well pad) and analogue site, data will be collected at five (5) monitoring points along a transect of 50m x 14m.The analogue site should be selected adjacent to the previously disturbed site, demonstrating comparable vegetation, soil, slope.
2. Undertake botanical surveys to assess biodiversity values on the disturbed areas and comparative analogue sites, selected to be representative of the vegetation prior to land disturbance. Record information on the Biodiversity Values Form (SENEX-CORP-EN-REP-008).
3. Using 1m x 1m quadrats along the transect, measure groundcover and species richness. Measure vegetation species from each stratum.
4. Take representative photographs of the subject vegetation. Record GPS location of photos and direction of photo (i.e, facing north, south, east or west).
5. At each location, conduct a meandering survey to assess erosion, land stability, signs of visible staining from land contamination, and record flora species, including weeds.

7.2.2 Final rehabilitation data analysis

For each final rehabilitation assessment, species richness assessments need to be undertaken. The average of each data aspect will be calculated and recorded. An overall average of all quadrats taken will be calculated for total native species and ground cover. Where the results indicate the criteria in the relevant environmental authority have been met, monitoring can cease.

7.2.3 Final rehabilitation reporting

A report will be required to be prepared from the monitoring assessment to submit to the regulator, as part of the relinquishment, completion process. A final rehabilitation report for the administering authority will be prepared, based on the monitoring report.

Where sites do not meet the relevant environmental authority conditions, monitoring will be required to be undertaken on the site, until the requirements are met.

8. DATA MANAGEMENT AND REPORTING

Information on site rehabilitation activities carried out on the project area will be recorded by the Site Supervisor and provided to the Environmental Manager upon completion of transition or final rehabilitation works.

Monitoring data recorded by Senex staff or external consultants will be provided to the Environmental Manager or delegate and stored in the Environmental Database. Monitoring data will be analysed to understand rehabilitation progression over time. Data collected will also inform financial assurance calculations and the content of Plans of Operations required for activities carried out under Petroleum Lease.

All documents including rehabilitation monitoring reports will be kept for a minimum of five years and will be made available to DES upon request, as required by EA conditions.

9. RESPONSIBILITY

The Environmental Manager or delegate will provide direction and instruction for all staff and contractors undertaking rehabilitation works, to ensure they are familiar with the content of this Plan and the rehabilitation program.

The Senex Site Supervisor will be responsible for undertaking on-site checks to ensure the procedures in this Plan are followed including implementation of erosion and sediment controls and weed controls.

10. REFERENCES

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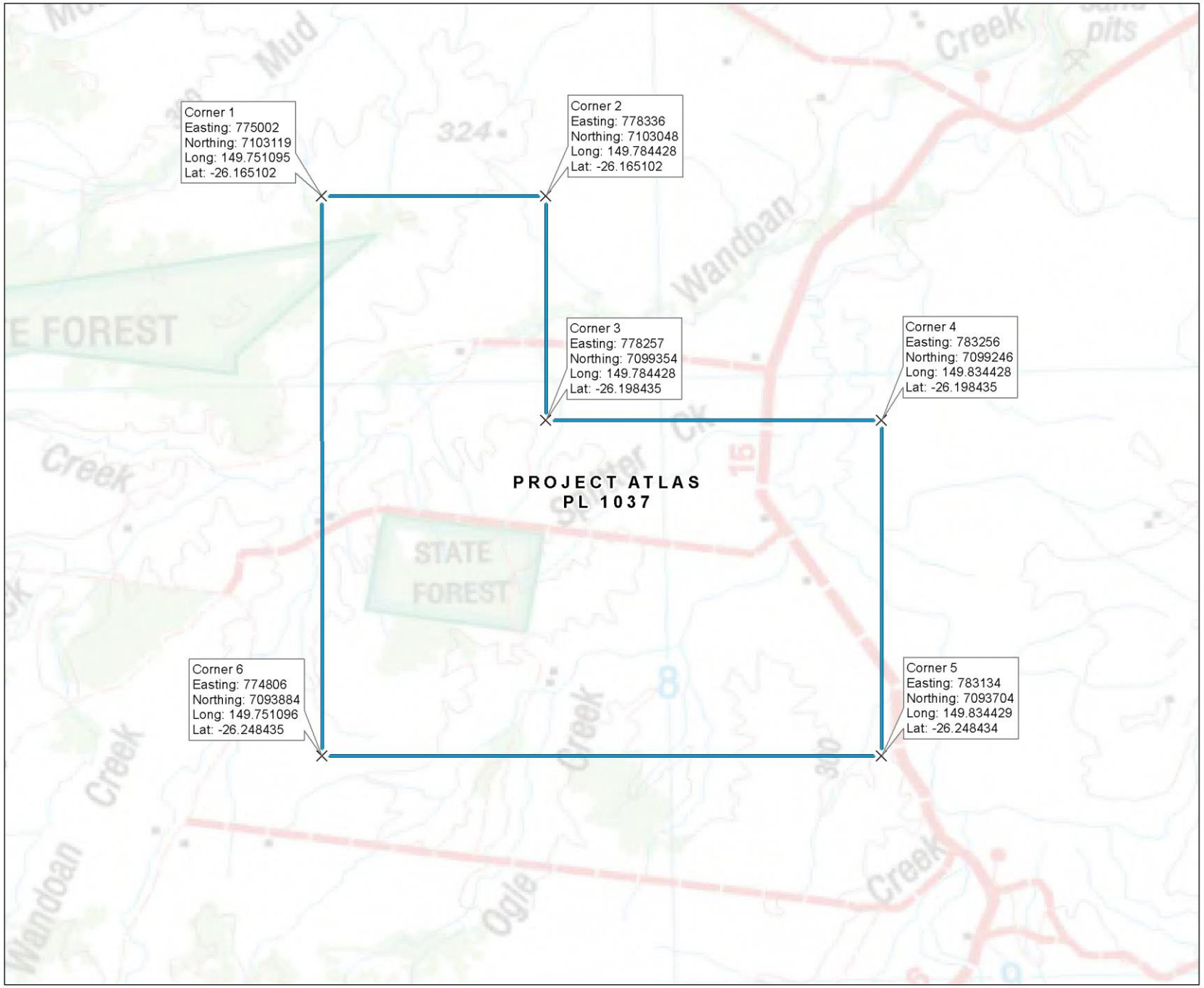

Senex
Senex Energy Limited

Title: Project Atlas Block Description

Date: 21/09/2018

Doc: SENEX-CORP-GI-MAA-132

Acknowledgements:

Mining Tenement S.A data © Department of Primary Industries and Resources 2018
Mining Tenement QLD data © Department of Mines and Energy 2018
Well Data / Pipeline info GPINFO 2018

Legend:

- Project Corners
- Senex Project

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Senex Energy Limited

Project Atlas Coal Seam Gas Water Management Plan

Document Number:

SENEX-ATLS-EN-PLN-006

Revision: 0

Position	Name	(tick one column only)		Signature	Date
		Approve	Review		
Environment Manager	s47F	☒	☐	s47F	30/10/2018

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REVISION HISTORY

Revision	Revision Date	Document Status	Revision Comments	Author	Approved By
A	18 September 2018	Issued for Review	Document creation	KCB	
B	27 September 2018	Draft	Revision	Senex / KCB	
C	11 October 2018	Final Draft	3rd party review / Senex comments addressed	Senex / KCB	
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1. INTRODUCTION

1.1. Project Atlas – Project Description

Senex Assets Pty Ltd (Senex) is planning to develop a coal seam gas field within Petroleum Lease (PL) 1037 (referred to as Project Atlas or the Project) in the central Surat Basin, an established gas-producing region. The development will produce gas exclusively for the domestic market.

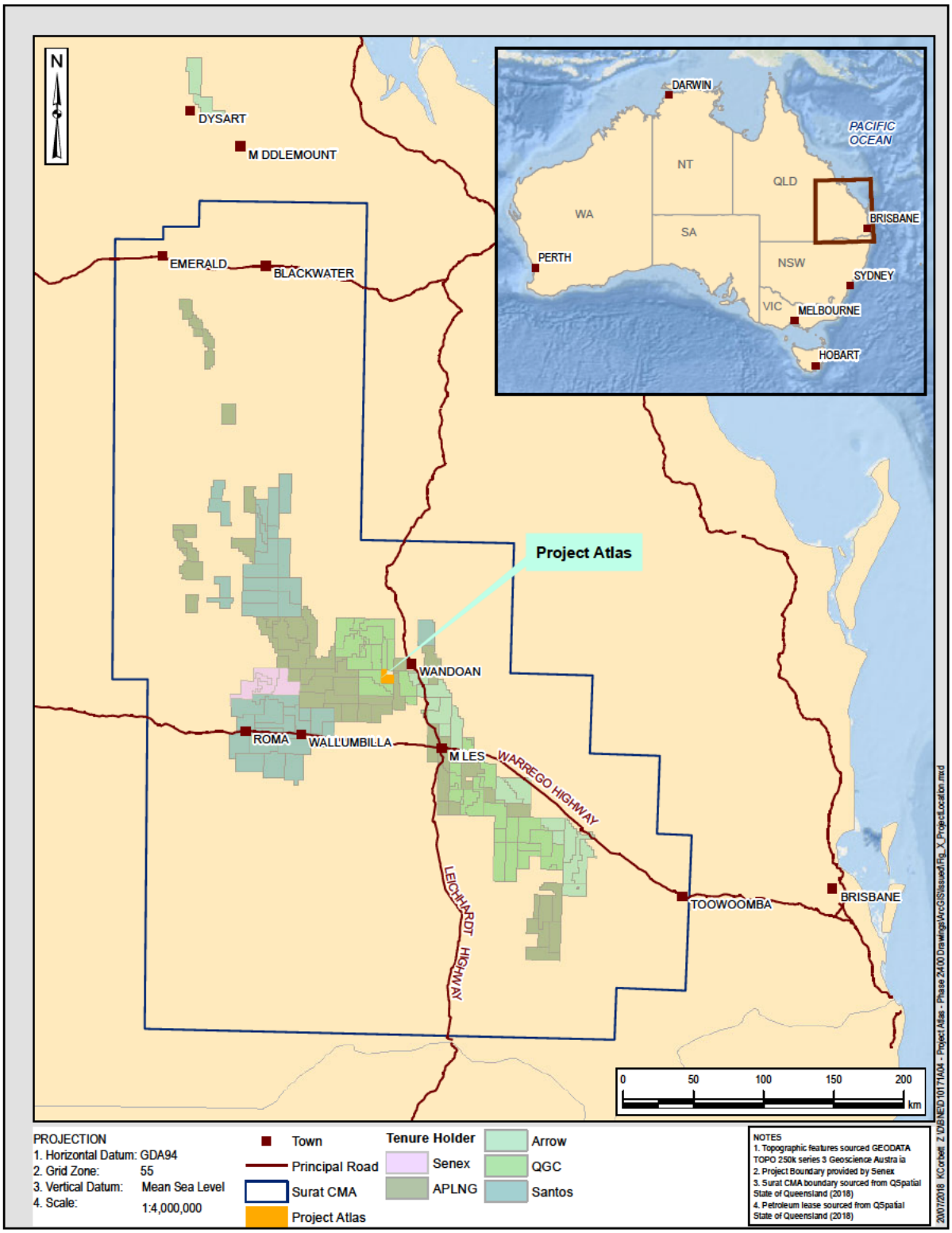
Project Atlas covers an area of approximately 58 km^2 and is located approximately 15 km southwest of the township of Wandoan. The location of Project Atlas is presented in Figure 1.1.

Proposed production activities and infrastructure are expected to include the following components:

- Up to 113 CSG production wells;
- Gas and water gathering lines;
- Water separation infrastructure;
- Water storage and water management facilities;
- Access roads and tracks;
- Maintenance facilities, workshop, construction support and administration buildings (during construction and operation);
- Temporary accommodation;
- Utilities – power generation, water supply;
- Communications; and
- Borrow pits.

Details of the project components, including location and size, will be progressively determined over the life of Project Atlas.

Figure 1.1: Location of Project Atlas within the Surat Cumulative Management Area (OGIA)



1.2. Aims and Objectives of the Plan

The Coal Seam Gas Water Management Plan (CWMP) covers all activities associated with managing produced water from the project area once the water has been recovered to the ground surface; including managing saline waste by-product (brine) from treating produced water.

The aim of the CWMP is to provide a tool to assist Senex personnel with the management of produced water. The plan sets objectives to maximise the beneficial use of water and identify any potential impacts that may require mitigation. Other key objectives of the CWMP include:

- Providing a transparent document outlining Senex's philosophy and approach to water management;
- Demonstrating adherence to regulatory policy;
- Documenting the risks and challenges in relation to CSG water management;
- Providing a strategic management tool adaptive to changes in:
  - Source water quantity and quality;
  - Demand location and volume;
  - Technology;
  - Environmental receptors/constraints; and
  - Community concerns, and regulatory requirements.
- Allowing for continual improvement and implementing good practice CSG water management.

The CWMP will consider managing CSG water for the life of the project and will be updated as required so that the most appropriate and effective management approach is applied.

1.3. Definitions and Acronyms

BOM	Bureau of Meteorology
CSG	Coal seam gas, where gas is stored within coal deposits or seams
CWMP	Coal Seam Water Management Plan (SENEX-ATLS-EN-PLN-006)
E&A	Exploration and Appraisal
EA	Environmental Authority
EV	Environmental Value
Petroleum Act	The *Petroleum Act 1923* (Qld), the *Petroleum Gas (Production and Safety) Act 2004* (Qld)
PL	Petroleum lease granted under the *Petroleum Act 1923* (Qld) or the *Petroleum Gas (Production and Safety) Act 2004* (Qld)
Project Area	means the coal seam gas field, approximately 58 km^2 on PL1037
Surat Basin	means the sedimentary geological basin of Jurassic to Cretaceous in southern Queensland and northern New South Wales
TD	Total Depth
WCM	Walloon Coal Measures (the target gas production unit)
WSA	Water Supply Agreement

2. REGULATORY FRAMEWORK

This CWMP has been prepared in accordance with key policies and legislation in Queensland for managing CSG produced water. A summary of the key policies and legislation relevant to development of Project Atlas is provided in the following sections.

2.1. Petroleum and Gas (Safety and Production) Act 2004

The *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017a) is an Act relevant to exploring for, recovering and transporting by pipeline, petroleum and fuel gas and ensuring the safe and efficient undertaking of those activities. The key purpose of this Act is to facilitate and regulate the undertaking of responsible petroleum activities and the development of a safe, efficient and viable petroleum and fuel gas industry.

The Act identifies underground water rights for petroleum tenure holders, and states that the holder of a petroleum tenure may take or interfere with underground water in the area of the tenure if the taking or interference happens during the course of, or results from, the carrying out of an authorised activity for the tenure. There is no limit to the volume of water that may be taken under the underground water rights and the tenure holder may use associated water for any purpose within, or outside, the area of the tenure.

2.2. Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)* (Commonwealth of Australia 2016) is the central piece of environmental legislation at the Commonwealth level. It provides for the protection of environmental values, including matters of national environmental significance (MNES). Actions that are likely to have a significant impact on MNES are subject to the assessment and approval process under this Act. Amendments to the *EPBC Act* have resulted in water resources being a MNES in relation to large coal mining and CSG development projects. As a result, project may have potential for impacts on water resources and has been referred to the Department of the Environment and Energy (DoEE).

The regulatory guideline relevant to Project Atlas, developed from the amendment to the EPBC Act identifying water resources as being a MNES is the *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoEE 2013).

2.3. Water Act 2000

The *Water Act 2000* (State of Queensland 2018b) is intended to provide for the sustainable management of water and the management of impacts on underground water, among other purposes. The Act provides a framework for the following:

- The sustainable management of Queensland's water resources by establishing a system for the planning, allocation and use of water;
- The sustainable and secure water supply and demand management for the south-east Queensland region and other designated regions;
- The management of impacts on underground water caused by the exercise of underground water rights by the resource sector; and

- The effective operation of water authorities.

The Act includes water in a watercourse, lake or spring, underground water (or groundwater), overland flow water, or water that has been collected in a dam.

The *Water Act 2000* provides for managing impacts on underground water caused by the exercising of underground water rights by resource tenure holders, which are regulated under the *Petroleum and Gas (Production and Safety) Act 2004*. The Act also outlines the requirements for make good agreements, associated with impacts to underground water.

2.4. Environmental Protection Act 1994

The *Environmental Protection Act 1994* (State of Queensland 2018a) has an objective to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

Table 2.1 presents the primary requirements for the management of CSG water from the *Environmental Protection Act 1994* and identifies the sections in this CWMP to address each requirement.

Table 2.1: Environmental Protection Act 1994 (State of Queensland 2018a) Requirements (S126) and Sections addressed in this report

EP Act 1994 S126 – Requirements for site-specific applications-CSG activities			**CWMP Section Reference**
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;	Section 3.1
	b)	The flow rate at which the applicant reasonably expects the water will be generated;	Section 3.1
	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;	Section 3.2 & Section 5.4
	d)	The proposed management of the water including, for example, the use, treatment, storage or disposal of the water;	Section 4
	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; (ii) Protection of the environmental values affected by each relevant CSG activity; (iii) The disposal of waste, including, for example, salt, generated from the management of the water;	Section 6 Section 5 & Section 6 Section 6
	f)	The action proposed to be taken, if any, if the management criteria are not complied with, to ensure the criteria will be able to be complied with in the future.	Section 6
2)	The proposed management of the water cannot 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 following: (i) Best practice environmental management for managing the CSG water; and (ii) Alternative ways for managing the water; and	Not relevant as no CSG evaporation dams are proposed.

EP Act 1994 S126 – Requirements for site-specific applications-CSG activities		CWMP Section Reference
b)	The evaluation shows there is no feasible alternative to a CSG evaporation dam for managing the water.	

2.4.1 Environmental Protection (Water) Policy 2009

Under the *Environmental Protection Act 1994,* the *Environmental Protection (Water) Policy 2009* (State of Queensland 2016) was established as subordinate legislation to achieve the objective of the Act in relation to Queensland Waters. The purpose of the *Environmental Protection (Water) Policy 2009* is achieved by:

- Identifying environmental values (EVs) and management goals for Queensland waters;
- Stating water quality guidelines and water quality objectives to enhance or protect the environmental values;
- Providing a framework for making consistent, equitable and informed decisions about Queensland waters; and
- Monitoring and reporting on the condition of Queensland waters.

Further details on EVs are provided in Section 5.5.

2.4.2 CSG Water Management Policy 2012

The CSG Water Management Policy 2012 (DEHP 2012) primary objective is with the management and use of CSG water under the *Environmental Protection Act 1994*. The role of the policy is to:

- Clearly state the government's position on the management and use of CSG water;
- Guide CSG operators in managing CSG water under their environmental authority; and
- Ensure community understanding regarding the government's preferred approach to managing CSG water.

3. CSG WATER PRODUCTION

This section of the CWMP describes the anticipated volume and quality of water expected to be produced as part of Project Atlas.

3.1. CSG Water Production

CSG water will be produced as a by-product of depressurisation of coal seams to produce CSG for Project Atlas. The target coal seams are the Walloon Coal Measures (WCM).

Produced water volumes and rates have been modelled using Senex's analytical reservoir model, with probabilistic distributions applied to several key reservoir parameters (i.e. permeability, porosity and net coal) to generate well type curves and water production forecasts. Some uncertainty is inherent in any analytical model, and reservoir models can initially over-predict water production due to factors including sensitivity to assumed porosity. Further certainty will be gained as CSG wells are drilled and tested as part of pilot / appraisal programs and as field development proceeds. As Senex acquires more production data, the model will be enhanced with historical matching of actual production data, resulting in revised production forecasts being produced. These revised production forecasts will be incorporated into the water balance model along with the actual observations of water disposal volumes, rainfall and dam levels.

Senex has confidence that this integrated and iterative approach will ensure that produced water is managed responsibly, and beneficial use optimised. Type curves will be updated throughout the life of the project as more information becomes available.

Figure 3.1 presents the CSG water production profile forecast for Project Atlas. Peak CSG water production is expected to occur in November 2025.

Figure 3.1: Project Atlas Forecast Water Production

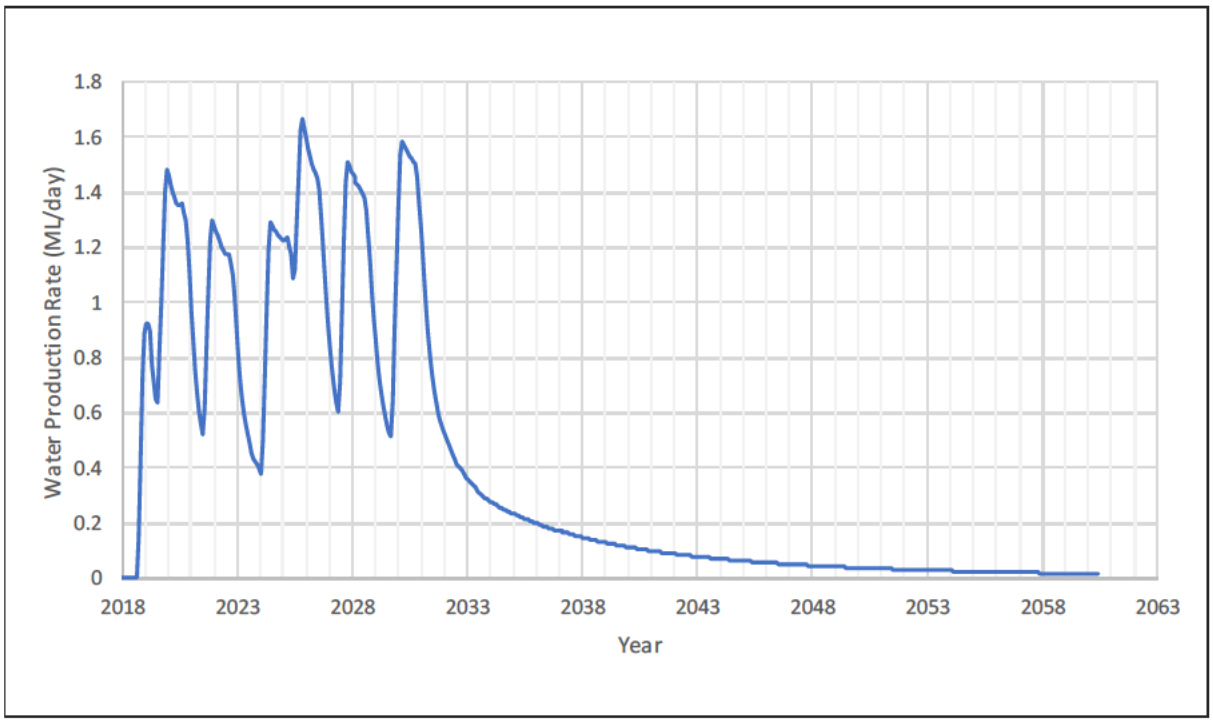
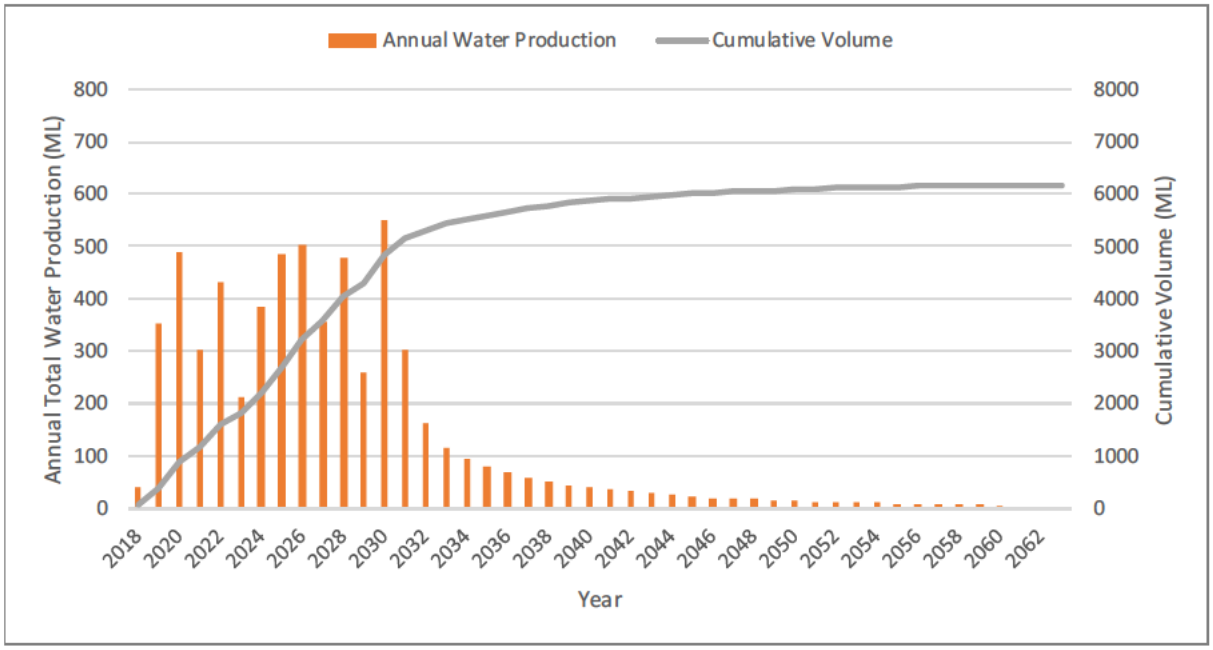


Figure 3.2 presents the annual water production forecast and cumulative water production. The total volume of water forecast to be produced over the development lifetime (~41 years) is approximately 6.2 GL.

Figure 3.2: Annual Water Production



3.2. CSG Water Quality

There is no current water quality data for the WCM from the Project Atlas area. Data related to the site-specific water quality will become available as CSG wells are drilled as part of pilot/appraisal programs and into production. A summary of the regional characteristics associated with the WCM are provided below.

The produced water quality from the WCM can vary from fresh to saline. OGIA (2016a) indicate that in general, the total dissolved solids (TDS) of the WCM within the Surat Cumulative Management Area (CMA) ranges from 30 to 18,000 mg/L, with a mean TDS of 3,000 mg/L. OGIA (2016a) also report that available samples from existing CSG bores in the Surat CMA at significant depth show distinct characteristics with negligible concentrations of calcium, magnesium and sulphate, and higher concentrations of sodium and fluoride, compared with the other formations.

Analysis results are available from the groundwater database (GWDB) for 24 WCM samples within 25 km of the Project area. The majority of these samples are from third-party groundwater bores located to the north of the Project area.

Table 3.1: Summary of WCM Water Quality from Available GWDB Samples within 25 km of Project

Parameter	Unit	Count	Min	Max	Median	Average
EC	µS/cm	12	1,900	13,400	8,010	7,310
pH	-	15	5.5	8.8	7.7	7.7
Sodium Adsorption Ratio (SAR)		24	7.6	171	81	81
Total Dissolved Solids	mg/L	18	883	17,733	5,176	5,645
Sodium	mg/L	24	262	6,860	2,024	2,651
Potassium	mg/L	4	4.3	16.3	5.9	8.1
Calcium	mg/L	24	7.9	344.3	33.5	81.1
Magnesium	mg/L	24	2.9	162.9	10.7	31.4
Bicarbonate (HCO_3)	mg/L	16	30	862	512.0	512.3
Carbonate (CO_3)	mg/L	12	15	343.2	198.8	168.1
Chloride	mg/L	24	375	11,454	2,904	4,014
Fluoride	mg/L	15	0.2	2.2	0.8	0.9
Sulphate	mg/L	16	1	57	4.0	8.7

4. CSG WATER MANAGEMENT

4.1. CSG Water Management Strategy

The CSG water management for the project has been developed based on the DEHP (now DES) Prioritisation Hierarchy. The DEHP Hierarchy is presented in the Coal Seam Gas Water Management Policy (DEHP 2012). The prioritisation hierarchy for managing and using CSG water is:

Priority 1 – CSG water is used for a purpose that is beneficial to one or more of the following:

- The environment;
- Existing or new water users; or
- Existing or new water-dependent industries.

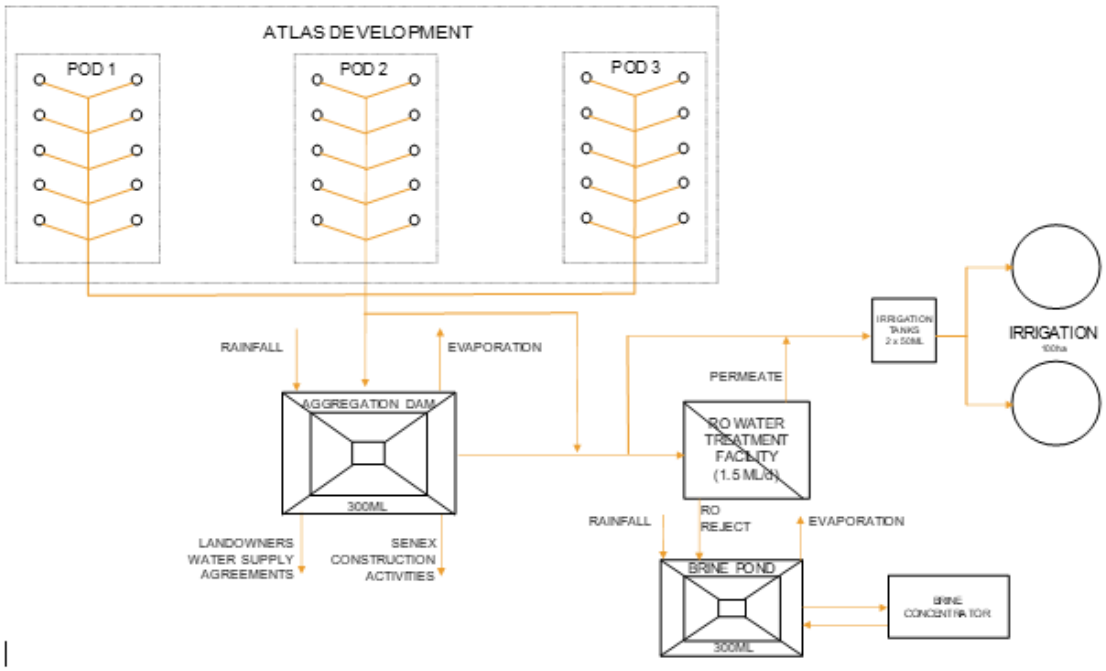
Priority 2 – After feasible beneficial use options have been considered, treating and disposing of CSG water in a way that firstly avoids, and then minimises and mitigates, impacts on environmental values.

4.2. Water Management Infrastructure

4.2.1 Overview

This section provides an overview of the infrastructure proposed to manage CSG produced water. A schematic of the water management infrastructure is presented in Figure 4.1, with each component summarised in the following sections.

Figure 4.1: Water Management Infrastructure Schematic



4.2.2 Infrastructure Location Planning

The exact locations of water management infrastructure within the Project area are not yet known, however to avoid, minimise and manage potential impacts across the Project area, and to support well field layout for all surface infrastructure, including wells and gathering pipelines, Senex will implement the 'Environmental Protocol for Field Development and Constraints Analysis' (Senex 2018a; SENEX-QLDS-EN-PRC-019) (the Constraints Protocol). The Constraints Protocol aims to ensure that infrastructure siting:

- Considers biodiversity values and environmental constraints, such as sensitive receptors, when selecting preferential locations; and aligning with planning principles to avoid, minimise, mitigate and then manage potential environmental impacts; and

- Identifies any additional external environmental approvals required and that those are secured prior to the commencement of construction activities.

The Constraints Protocol also recognises that, in addition to environmental constraints, landholder, engineering and cultural heritage constraints must be considered during infrastructure siting.

The process involves a desktop constraints analysis, site surveys, post-survey environmental constraints analysis and preparing a report that includes a list of site specific environmental conditions and associated constraints maps. These are included in the final Access to Work (ATW) documentation, issued upon sign-off by the Project Manager to relevant staff and contractors prior to commencing construction.

4.2.3 CSG Production Wells, Water Gathering and Distribution System

CSG water production is required as part of the CSG extraction process. Groundwater is abstracted (pumped) from CSG production wells to depressurise the target production coal seams. Depressurisation generates gas flow and sustains a groundwater flow from the well to maintain the target producing operational pressure for each CSG production well.

Flow from the well is separated into water and gas by either:

- Wellbore separation (where water is pumped up the tubing and produced gas flows to the surface in the annulus of the well); or

- Where wellbore separation is ineffective, a surface separator may be installed that will separate any hydrocarbons from the produced water. Each well will have a wellhead gas and water metering package to achieve real-time continuous gas and water metering.

CSG production wells will be drilled and constructed in accordance with the 'Code of Practice for constructing and abandoning coal seam gas wells and associated water bores in Queensland' (DNRME 2018).

Gas and water from the wellsite will be delivered to gas and water processing facilities via separate underground High-Density Polyethylene (HDPE) pipelines operating as low pressure gas and water gathering systems. Gathering systems shall be designed and installed in accordance with APGA Code of Practice Upstream Polyethylene Gathering Networks – CSG Industry Version 4.0 (APGA 2016).

All produced water will initially be collected from the water gathering systems into an aggregation dam(s) (Section 4.2.4).

4.2.4 Operational Water Storage Facilities

CSG produced water dams proposed for the Project include:

- Aggregation dam(s) for storing untreated CSG produced water;
- Irrigation dams located adjacent to dedicated irrigation areas;
- Brine storage dams; and
- Temporary tanks or dams for the appraisal program.

It is proposed that the aggregation dam will be located centrally within the petroleum lease area. The aggregation dam will be a purpose-built earthen dam comprising an impervious liner of approximately 300 ML capacity. Additional aggregation dam capacity may be required and will range from pre-engineered above ground tanks to purpose built earthen dams with impervious liners.

CSG water storage dams will be designed and assessed using the '*Manual for Assessing Hazard Categories and Hydraulic Performance of Structures'* prepared by DES (DES 2016a). If a dam is identified to be in the 'significant 'or 'high-hazard' category, it is considered a regulated dam and detailed dam design reports must be submitted to DES following granting of the EA (that provides in principle approvals of dam construction).

The following will apply with respect to any regulated dams required for the project:

- Senex will design dams in accordance with relevant legislation and Queensland standards and DES guidelines;
- Senex will submit dam designs separately and specifically for registration;
- An independent third party will be engaged to certify dams to ensure design, construction and hydraulic performance meet the design plan;
- Dams will be constructed under the supervision of a suitably qualified and experienced person and in accordance with the relevant DES schedule of conditions relating to dam design, construction, inspection and mandatory reporting requirements;
- Senex will implement a seepage monitoring program for water storage dams and tanks, where required. The seepage monitoring program will identify infrastructure and procedures that are in place to detect loss of containment as early as possible;
- Senex will routinely monitor water quality in dams, and in the respective dam's shallow groundwater monitoring bores, installed as part of the seepage monitoring program;
- Senex will monitor dam levels to provide early warning of overtopping and / or unidentified water losses; and
- Senex will monitor the integrity and assess the available storage of dams annually.

Any low-hazard dams required for CSG water storage will be designed in accordance with accepted engineering standards. The dams will be designed with a floor and sides comprising material capable of containing the water for the life of the project.

4.2.5 Water Management Process

The following water management process for the produced water is planned:

- Water from the Project Atlas gathering system will be transferred to the centrally located aggregation dam (approximately 300 ML capacity).
- A water treatment facility (WTF) consisting of pre-filtration and softening pre-treatments, membrane filtration, and post-treatment pH adjustment will treat water from the dam. The WTF will have a treatment capacity of approximately 1.5 ML/d, with approximately 75% recovery.
- Treated water (permeate) will be transferred to the irrigation dam (approximately 50 ML). Additional untreated water will be blended into permeate in the irrigation dam to provide water of a suitable quality for irrigation.
- An alternative to treatment of the produced water may be blending with fresh water sourced from a third party, to provide water of a suitable quality for irrigation.
- Blended water from the irrigation dam will be utilised on pivot and fixed irrigators on pasture grass or crops.
- Brine from the water treatment process will be stored in a brine dam (up to 300 ML, depending on water quality - expected capacity is 100 ML), from where it will be further concentrated via solar and mechanical evaporation to a concentrated slurry or solid salt. Salt or salt slurry will be trucked from site and disposed of at a Regulated Waste Facility. Further detail related to brine and salt management is included in Section 4.4.

4.3. Water Management Options

The water management strategy for the Project (Figure 4.1), has been developed to maximise the beneficial use of water. This includes providing produced water for the following activities:

- Project activities, such as drilling and completions, dust suppression, etc; and
- Landowner Water Supply Agreements (WSA), including water for irrigation and stock watering.

4.3.1 Project Activities

Where practical, Senex will use untreated produced water to support ongoing development / construction activities such as: dust suppression; drilling; well completions and workovers; facilities construction; hydro-testing gathering networks; and landscaping and rehabilitation.

Any untreated produced water used as part of project activities will be undertaken in accordance with the:

- *'General beneficial use approval: Associated water (including coal seam gas water)'* (DEHP 2014b) or subsequent version

- the *'Streamlined Model Conditions for Petroleum Activities'* (DES 2016b)

- Senex's Environmental Authority, particularly Schedule G (water) and Schedule B (waste), which provides specific conditions related to beneficial use for irrigation, dust suppression and construction.

The approvals establish the criteria for using untreated produced water for dust suppression, construction, and landscaping and vegetation requirements. Compliance with state regulation provides a robust compliance framework to ensure potential adverse impacts from managing produced water. Appropriate water quality criteria are required to be adhered to, for the use of untreated produced water for landscaping and vegetation; dust suppression and construction. These measures will be implemented through Senex's 'Environmental Management Plan' (SENEX-ATLAS-EN-PLN-001), which enables continuous improvement.

The expected uses, and anticipated range of volumes, for produced water from the Project are provided below:

- Dust suppression – up to 30 ML/yr (or 0.1 ML/d)

- Construction of Wells and Facilities – up to 180 ML/yr (or 0.5 ML/d) during periods of construction only.

By implementing the identified Queensland regulatory requirements, each activity has been assessed to be unlikely to be a significant impact against the Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments, (DoEE 2013).

4.3.2 Landowner Water Supply Agreements

Senex anticipates further utilising the CSG produced water for beneficial use by establishing Landowner Water Supply Agreement (WSAs). An estimate of current groundwater use in the vicinity of the Project area is ~1,345 ML/year (see Section 5.4.2), which includes groundwater abstraction for town water supply, stock and domestic and agricultural purposes (OGIA 2017c).

Senex also plan to dispose of a portion of the CSG produced water volume from the Project by sustainable irrigation practices. Senex is aware that agricultural users have different water demand profiles and water requirements, with some requiring water for stock watering and others for irrigation. For these reasons, Senex plan to adopt a portfolio management approach to water management, identifying the opportunity to address beneficial use demands with anticipated produced water volumes.

Prior to undertaking any irrigation, Senex will address the requirements of the *'Streamlined Model Conditions for Petroleum Activities'* (DES 2016b), and the Environmental Authority.

4.4. Brine and Salt Management

The DEHP Hierarchy within the CSG Water Management Policy (DEHP 2012) also provides a prioritisation hierarchy for managing saline waste, which comprises:

- Priority 1 – Brine or salt residues are treated to create useable products wherever feasible.

- Priority 2 – After assessing the feasibility of treating the brine or solid salt residues to create useable and saleable products, disposing of the brine and salt residues in accordance with strict standards that protect the environment.

The management of brine is addressed through the State Environmental Authority requirements in Schedule B (waste) and Schedule I (dams). These schedules also address spills, leaks, and seepage monitoring and management. Senex's approach to any brine management will remain consistent with industry accepted practice.

Treatment of produced water via reverse Osmosis (RO) will produce treated water (permeate) and RO reject (brine). Brine will be transferred from the water treatment plant to the brine storage dam, which will be located taking consideration of the Queensland requirements for buffers around watercourses, MNES, matters of state environmental significance (MSES) and environmentally sensitive areas (ESAs).

Based on a median salt concentration of 5,176 mg/L TDS (*Table 3.1*), it is anticipated that approximately 5 tonnes of salt per ML of produced water will be generated. Brine requires specific considerations for storage and disposal, and will be stored in an engineered dam, constructed to contain the entire production of brine from the project. The brine dam will be designed and constructed under the supervision of a suitably qualified and experienced person and in accordance with the relevant DES schedule of conditions relating to dam design, construction, inspection and mandatory reporting requirements.

Stored brine will undergo both solar and mechanical evaporation resulting in a highly concentrated slurry or solid salt for transfer to a Regulated Waste Facility for disposal. Senex will continue to investigate cost effective and / or commercial saline disposal uses.

Site rehabilitation requirements are addressed in Schedule J (Rehabilitation) of the Environmental Authority. Senex will be responsible for the rehabilitation of any dams or infrastructure under the approval, ensuring no legacy issues develop following the cessation of Project production.

4.5. Water Balance

A water balance model has been developed in GoldSim (GoldSim 2018) to determine timing for the long-term water management strategy for Project Atlas. The model uses water production forecasts and dam storage volumes, with estimated inflows and outflows, including:

- Rainfall and evaporation – based on BOM historical rainfall data, pan evaporation data and dam surface area;

- Construction use and dust suppression – based on predicted offtake volumes; and

- Irrigation use – based on site-specific predicted offtake volumes for planned irrigation areas which is reduced by 50% if a daily rain event of 5-10 mm occurs and reduced by 100% if a daily rain event of >10 mm occurs.

A stochastic rainfall generator uses ~107 years of daily rainfall records from the Roma Airport (station number 43091) to generate multiple rainfall scenarios by sampling annually aligned

rainfall records of 41 years (the development lifetime) from the rainfall record. This monitors the resilience of the model under different rainfall scenarios.

The water balance model is based on a daily timestep and considers the changing volume over time in the aggregation dam as well as up to two irrigation dams. Storage curves are referenced to determine the changing free water surface and corresponding daily evaporation rate, with BOM pan factor evaporation rates considered in each time step.

Understanding of well performance will improve as the project progresses and more production data becomes available. The water balance model will be updated accordingly.

The water balance model provides a prediction of stored water volumes over time using the water production forecast, and the timing that additional storage or beneficial use applications may be required.

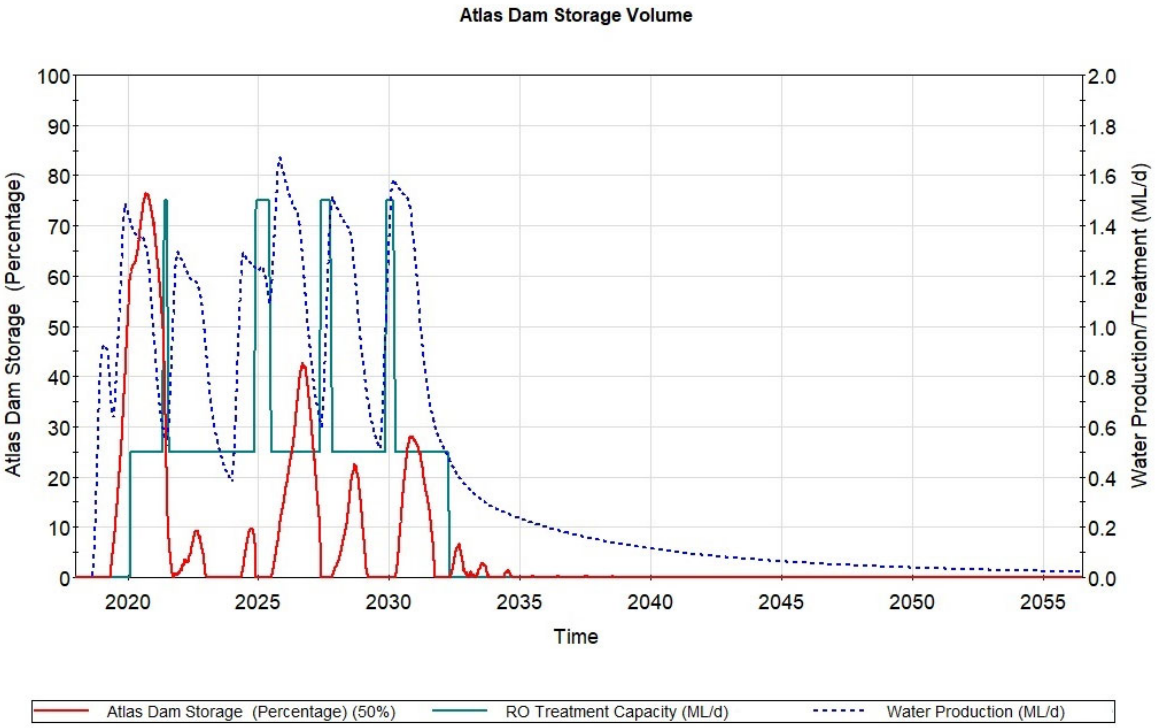
Senex does not currently propose to discharge to watercourses and would pursue an amendment to the EA and necessary approvals, appropriately supported with site specific studies, should this disposal option be required at any time in future.

Outcomes of the modelling, using 100 rainfall scenarios, are provided in Figure 4.2 and

Figure 4.3.

Results from water balance modelling conclude that the selected water management plan and infrastructure capacities adopted are sufficient to contain the predicted volume of water to be produced as part of the development even under a 95% rainfall wet season.

Figure 4.2: Water Balance Model Results – Water Treatment (50th and 95th Percentile)



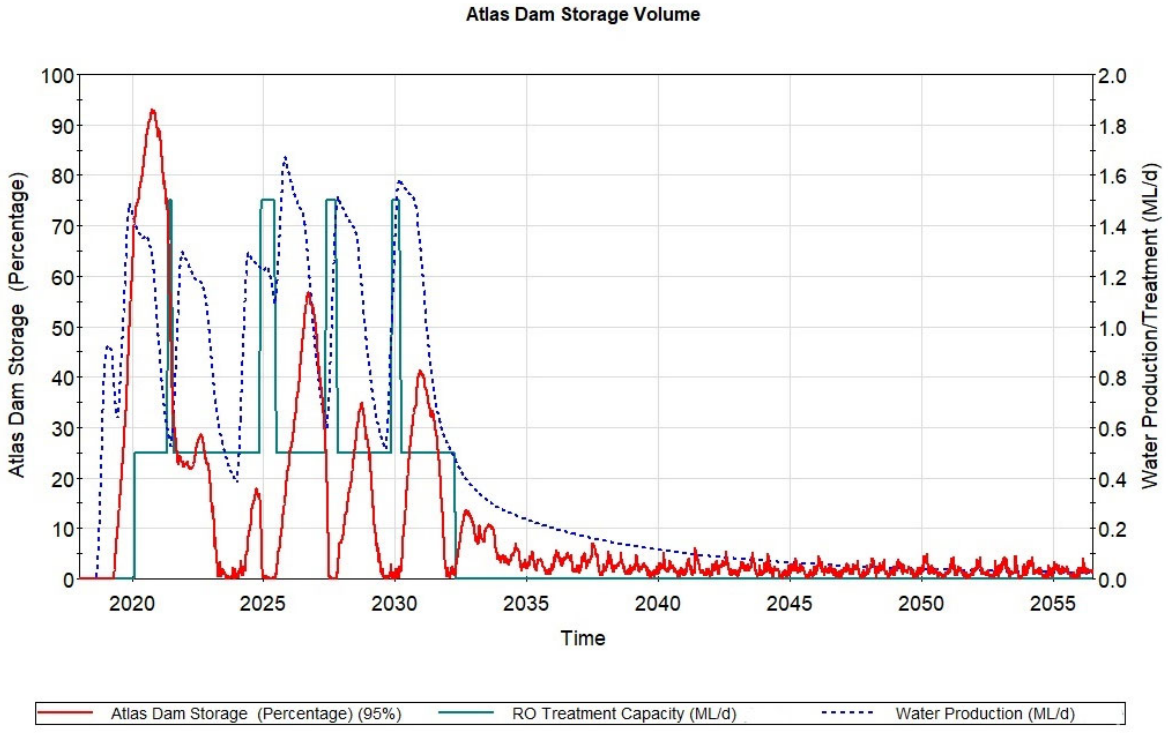
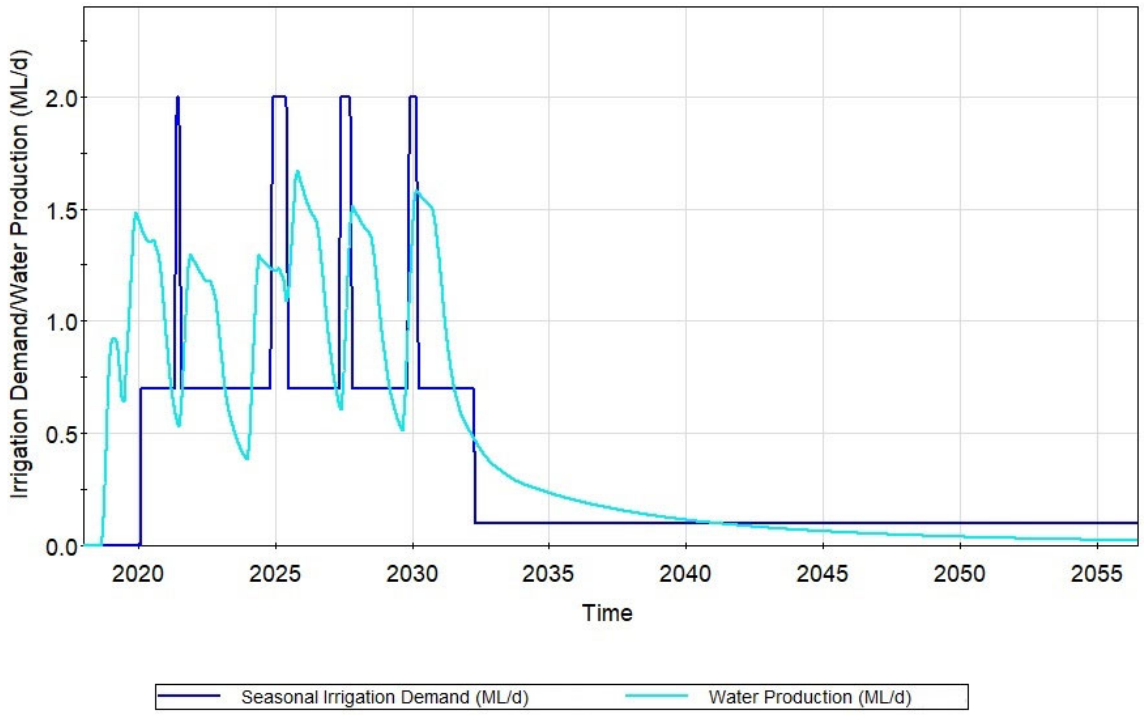


Figure 4.3: Water Balance Model Results – Beneficial Reuse (Irrigation)



5. EXISTING ENVIRONMENT AND ENVIRONMENTAL VALUES

5.1. Climate

The climate of the Project area is classified as subtropical with no dry season, using the modified Köppen classification system (BOM 2005).

A summary of the climate statistics sourced from the Bureau of Meteorology (BOM) are detailed below for the climate station at Roma Airport[1] (43091), with rainfall statistics for Wandoan Post Office (35014):

- Mean maximum temperatures range between ~34°C in the summer months and 20°C in the winter months. Mean minimum temperatures range between ~20°C in the summer months and ~4°C in the winter months.
- Daily evaporation rates are generally high and exceed rainfall throughout the year.
- The highest rainfall occurs during December to February, with the lowest rainfall occurring during April to September.

5.2. Land

5.2.1 Topography and Drainage

The landscape of PL1037 is predominantly composed of undulating to moderately undulating landforms. There are small level floodplain areas associated with minor streams (1% slopes), and some steeper areas. Slopes average approximately 2% with maximum slopes of up to 11% across the area.

The topography of the Project Atlas area is presented in Figure 5 2. Elevations across the area range between 250 mAHD and 360 mAHD. Topographic highs are located towards the south of the Project area, where the catchment divide between the Fitzroy River Basin and the Murray Darling Basin (Condamine-Balonne River-Basin) is located. Project Atlas is located within the Upper Dawson River sub-basin, which is part of the Fitzroy River Basin.

5.2.2 Regional Geology

Project Atlas overlies two distinct, but interconnected geological basins, the Permo-Triassic Bowen Basin and the Jurassic-Cretaceous Surat Basin. The Surat Basin occupies approximately 180,000 km^2 of southeast Queensland and is connected to the Eromanga Basin in the west, the Clarence-Moreton Basin in the east and Mulgildie Basin to the northeast (KCB 2016).

The Surat Basin comprises predominantly Jurassic to Cretaceous aged alternating sandstone, siltstone and mudstone layers. This sequence, at its maximum, is more than 2,500 m thick in the Mimosa Syncline to the west of Project Atlas. The Project targets the WCM; a thick sequence of siltstone, mudstone and fine-to-medium-grained sandstone that contains the main CSG producing coals in the Surat Basin. While the total thickness of the WCM can be

[1] Temperature and Evaporation data not available for Wandoan Post Office climate station

up to 650 m, the average thickness of this unit is approximately 300 m and the total coal thickness is generally less than 30 m (OGIA 2016a).

5.2.3 Land Use

Land use within and surrounding PL1037 is predominantly focused on primary agricultural resources. Rural/agricultural production associated with cattle grazing and feed-lotting along with petroleum activities are the dominant land uses within the region. The majority of PL is currently freehold (approximately 89%).

The Juandah State Forest is located within the PL, comprising an area of approximately 398 ha. In addition, the eastern extent of the Hinchley State Forest (25 ha) is located within the northern extent of the Petroleum Lease. State Forests account for approximately 7% of the tenure area.

The Jackson Wandoan road passes through the PL, which is also a travelling stock route. A small reserve is located adjacent to the stock route.

The tenure is surrounded by existing petroleum tenures held by Shell (QGC) and Australia Pacific LNG. There are a range of mining projects present in the greater region, which are at varying stages of development, as well as an exploration permit for greenhouse gas over the PL.

Approximately 51% of the PL is mapped as Strategic Cropping Area (SCA), an "area of regional interest" under the Regional Planning Interests Act 2014 (RPI Act). There are no other areas of regional interest located within the PL. Senex will comply with the requirements of the RPI Act.

5.2.4 Environmentally Sensitive Areas

Within the Production Area, there are Category B and C Environmentally Sensitive Areas (ESA) (DEHP 2016c). These areas are summarised in *Table 5.1*.

Table 5.1: Environmentally Sensitive Areas within the Production Area

ESA Matter	Comment
Category B ESA that are 'endangered' regional ecosystems	There are areas of remnant and regrowth vegetation that are endangered regional ecosystem (biodiversity status) within the Production Area. The majority of these areas are located within the Hinchley and Juandah State Forest.
Category C ESA that are 'essential habitat', 'essential regrowth habitat', or 'of concern' regional ecosystems	There are 'of concern' regional ecosystems (biodiversity status) within the Production Area. The majority of 'of concern' regional ecosystems are associated with riparian areas. There are no mapped essential habitat or essential regrowth habitat mapped within the Production Area.
Category C ESA that are 'state forests' or 'timber reserves'	There are two state forests that overlap the Production Area – Juandah State Forest and Hinchley State Forest (in part). Some of these areas are associated with riparian areas. There is no timber reserve mapped within the Production Area.

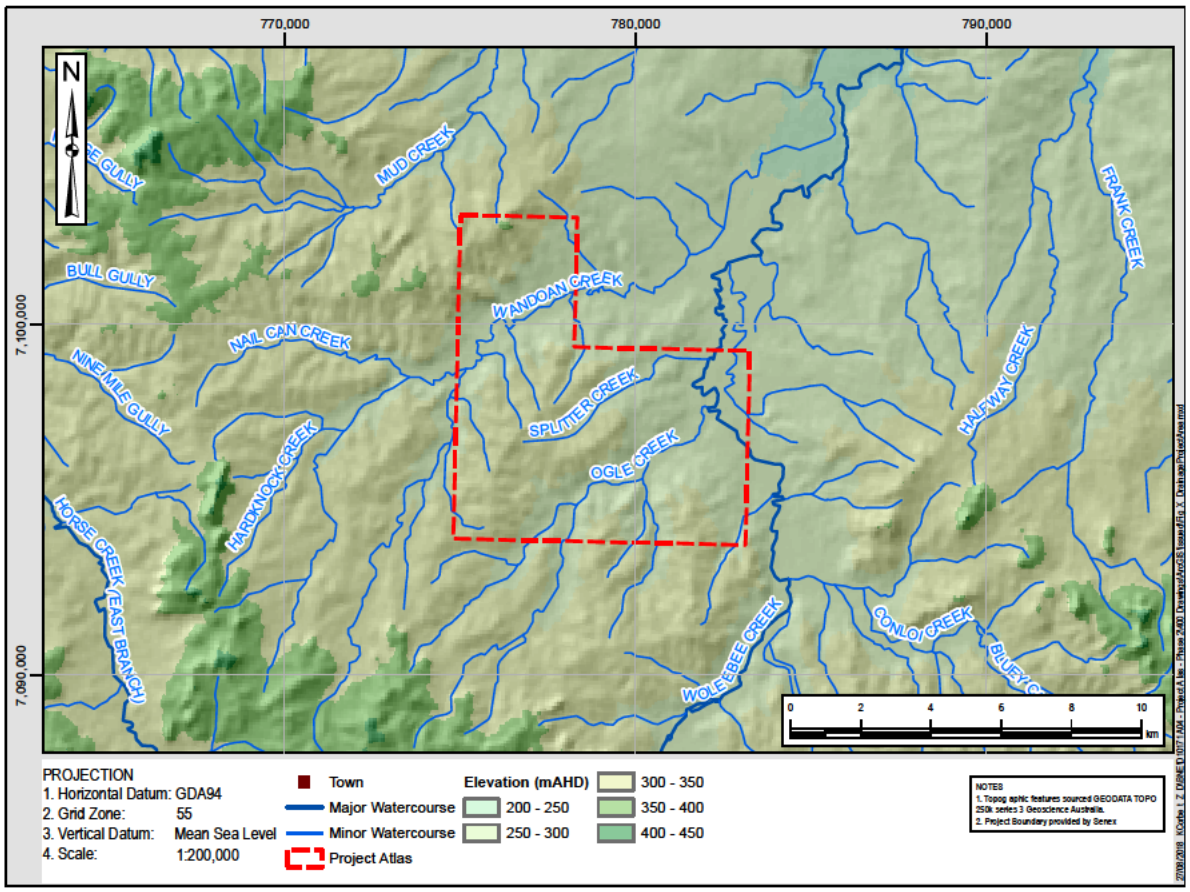
5.3. Surface Water

The Project is located within the Upper Dawson River sub-basin, which is part of the Fitzroy River Basin. Key watercourses within the vicinity of the Project include Woleebee Creek, which flows north from its headwaters flanking the eastern boundary of the Project to join Juandah Creek to the northeast. Smaller headwater tributaries of Woleebee Creek that occur within the Project area include Wandoan Creek, Splitter Creek and Ogle Creek (*Figure **5.1***). The Project Atlas lease is located almost entirely within the sub-catchment of Woleebee Creek.

The watercourses across the Project area are characteristically ephemeral and typically flow only during significant runoff events. This is likely a result of the Project area being located in the upper most reaches of the catchments with limited runoff area. Watercourses within the Project area are classified as Stream Orders 1 to 5 using the Strahler method, with the majority being Stream Order 1 (minor streams) (DNRM 2010). Reaches of Stream Order 5 (major streams) are associated with Woleebee Creek to the east of the Project area.

Catchments within the Upper Dawson River sub-basin are influenced by anthropogenic activities including land use, riparian management, water infrastructure and point source releases.

Figure 5.1: Drainage within the Project Area



5.3.1 Aquatic Ecology

Aquatic ecology identified in the Project area was associated with a series of disconnected remnant pools. The aquatic species associated with these pools are common and widespread in central Queensland streams. The aquatic ecosystems in the area are already impacted by grazing and cropping land uses with disturbed riparian areas and elevated sediment and nutrient inputs. However, the aquatic habitat in the Project area has local value on a tributary scale, with persistent waterholes providing important refugia for aquatic fauna and flora during dry conditions. These refugia are sensitive to impacts, given the inability for biota to move to better conditions during dry periods, and they already experience high levels of suspended sediments and nutrient inputs from existing land uses.

5.4. Hydrogeology

The Project is located within the geographical extent of the Surat Basin, a basin of Jurassic-Cretaceous age, which is underlain by the Permo-Triassic Bowen Basin. Cenozoic-age formations are present overlying the Surat Basin formations. The surface geological map within the vicinity of the Project is shown in Figure 5.2.

The Surat Basin forms part of the Great Artesian Basin (GAB), which is comprised of several aquifers and confining aquitards. Aquifers of the Surat Basin are a significant source for water

used for stock, public water and domestic supply. OGIA (2016b) presents hydrostratigraphy of the Surat and Bowen Basin, included as Figure 5.3.

The main aquifers within the GAB, from the deepest to the shallowest, are the Precipice Sandstone, Hutton Sandstone, Springbok Sandstone, Gubberamunda Sandstone, Mooga Sandstone and Bungil Formation. These aquifers are typically laterally continuous, have significant water storage, are permeable and are extensively developed for water supply. However, in some areas, they have more of the character of aquitards than aquifers (OGIA 2016b). The major aquitards are the Evergreen Formation, Eurombah Formation, Westbourne Formation, Surat Siltstone and Griman Creek Formation (Figure 5.3). WCM is the target formation for CSG production for the Project.

The Project is situated in an area where the Orallo Formation, Gubberamunda Sandstone and Westbourne Formation outcrop. The WCM outcrop is mapped as occurring ~25 km north of the Project.

North-south and west-east oriented cross sections are presented in Figure 5.4, with the section locations provided on Figure 5.2. These sections show the hydrostratigraphic units dipping from the outcrop towards the south. Generally, all units are laterally extensive and continuous across the Project area.

Quaternary-age alluvium has been mapped as occurring within the Project area and is associated with Wandoan, Woleebee and Ogle Creeks, as shown Figure 5.2. The alluvium is mapped as relatively thin across the Project lease, with increased lateral extent towards the north as Wandoan and Ogle Creeks flow into Woleebee Creek.

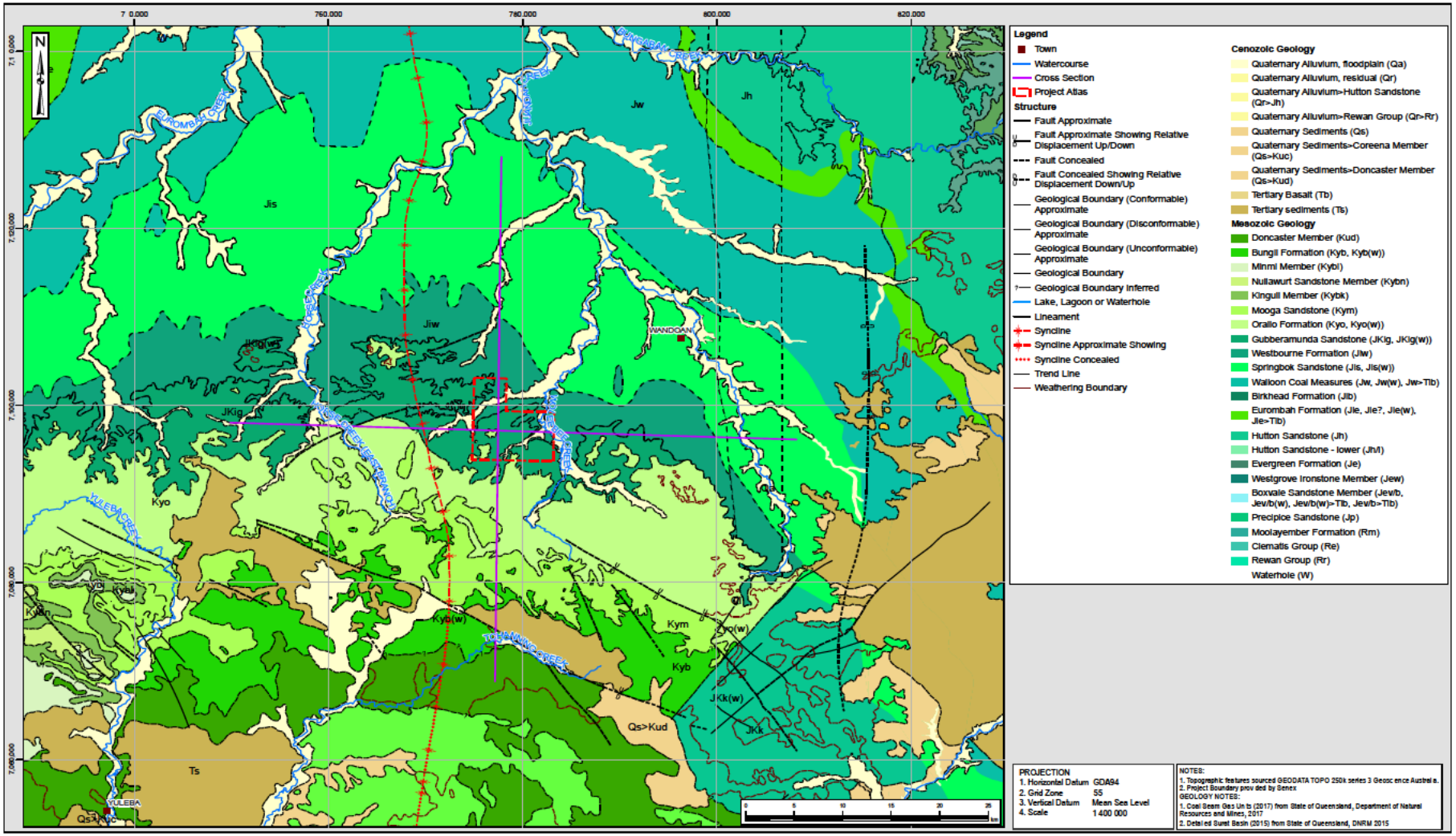


Figure 5.2: Regional Surface Geology Map

Figure 5.3: Regional Hydrostratigraphy (after OGIA 2016b) with Relevant Hydrostratigraphic Units Indicated

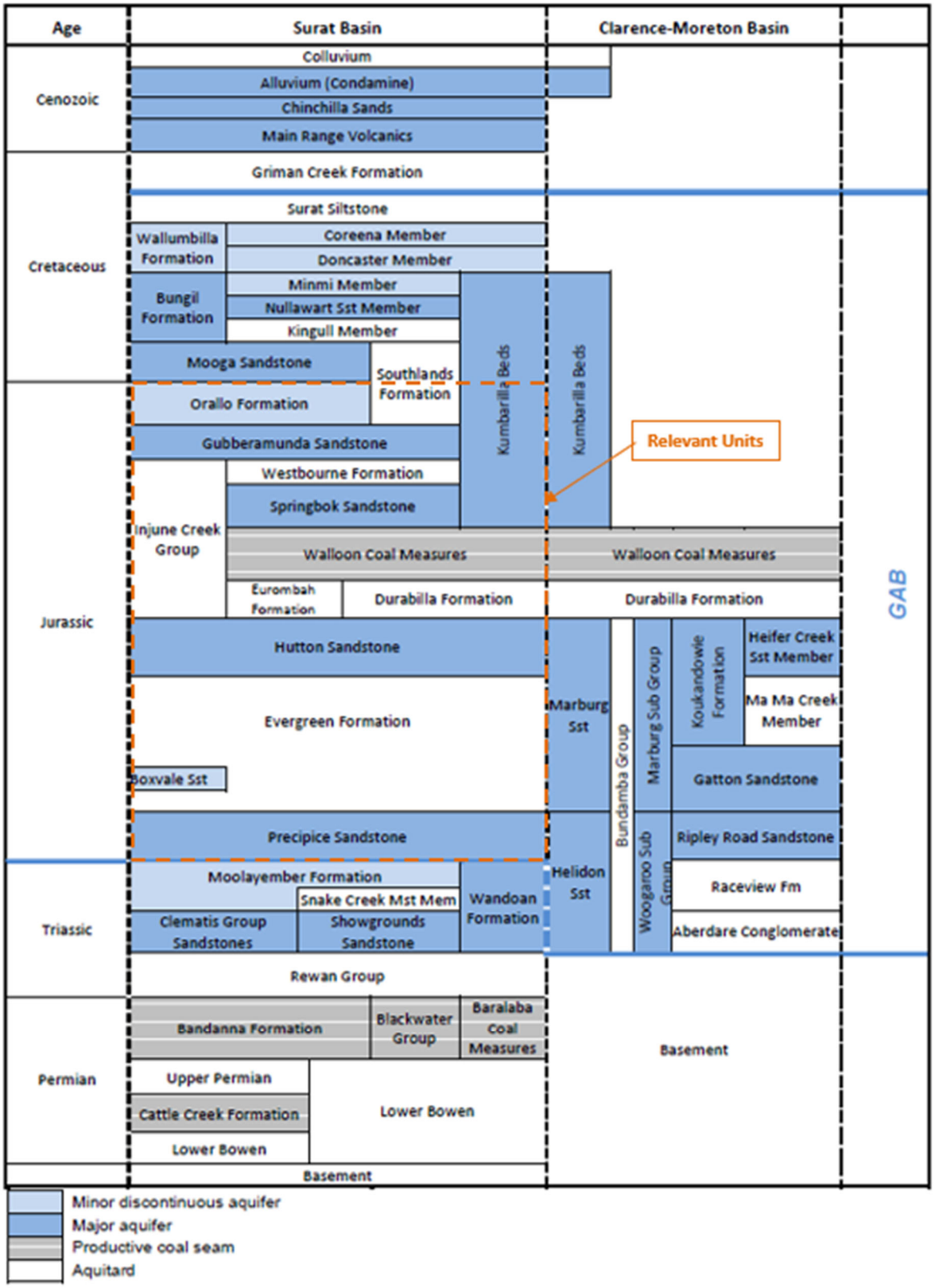
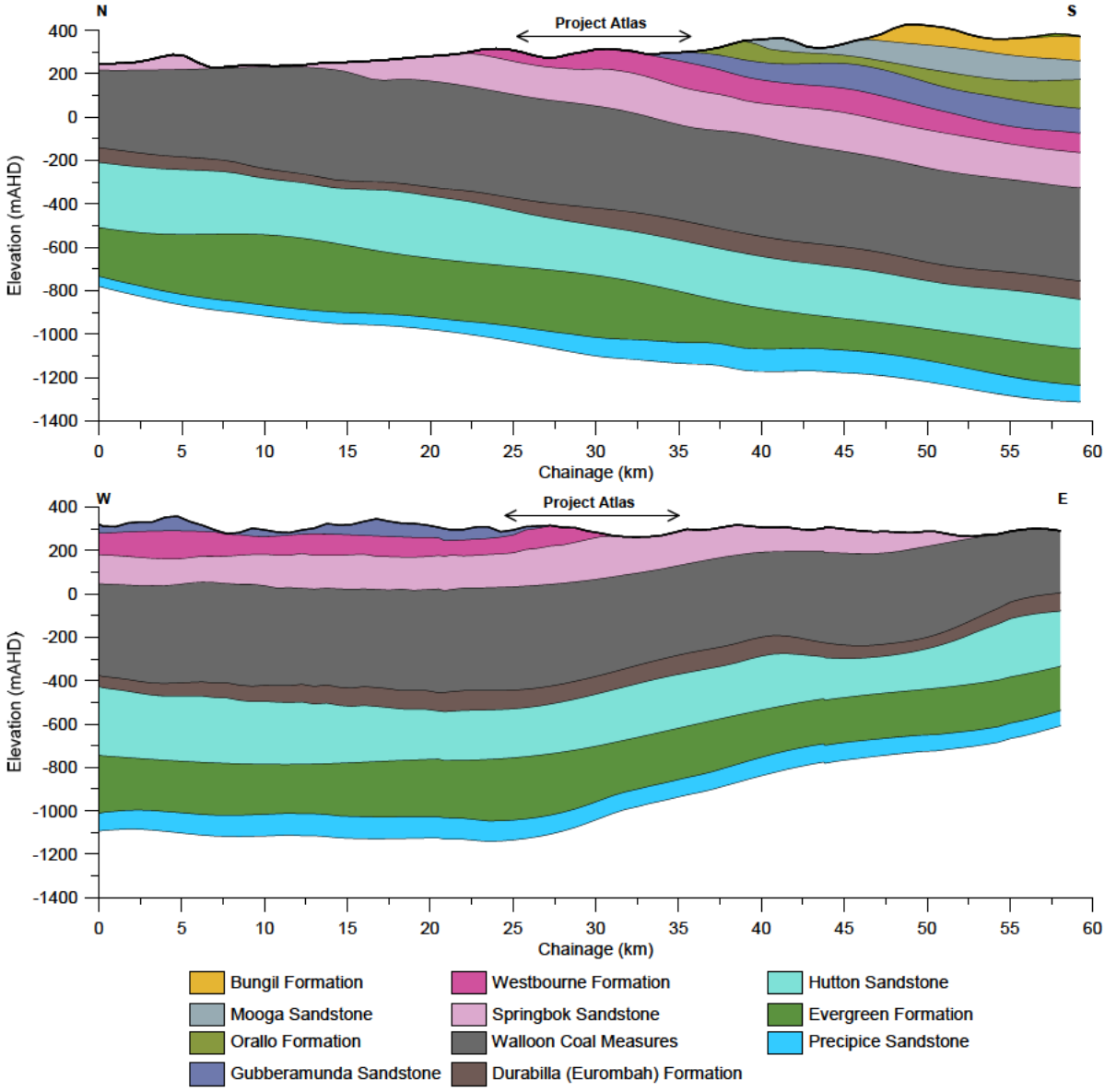


Figure 5.4: Geological Cross Sections (Surat CMA Geological Model (OGIA 2017a))



5.4.1 Groundwater Quality

Table 5.2 presents a summary of the regional groundwater chemistry associated with each hydrostratigraphic unit occurring within the Project Atlas area from OGIA (2016c). Generally, Total Dissolved Solids (TDS) is used as an indicator of salinity and displays a broad range across the Basin.

Table 5.2 Summary of Regional Groundwater Chemistry for Each Hydrostratigraphic Unit

Hydrostratigraphic Unit	**OGIA** (2016a) **Description**
Orallo Formation	Fresh to saline conditions with TDS ranging from 75 to 20,000 mg/L, mean of 1,700 mg/L.
Gubberamunda Sandstone	Fresh to brackish water. Mean TDS of 450 mg/L with a range of between 70 and 7,500 mg/L. Mean TDS ranges between 480 to 1,160 mg/L, depending on location category.
Westbourne Formation	Characterised by fresh to saline groundwater (TDS mean of 1,500 mg/L), ranging from 150 to 19,000 mg/L.
Springbok Sandstone	Fresh to brackish water quality, with a mean TDS of 1,000 mg/L (ranging between 200 and 7,000 mg/L).
WCM	Fresh to saline groundwater, TDS ranges from 30 to 18,000 mg/L, with a mean TDS of around 3,000 mg/L.
Hutton Sandstone	TDS ranges from 70 to 16,000 mg/L, with a mean TDS of around 1,600 mg/L, low-salinity calcium and magnesium bicarbonate type water in the recharge areas, to a relatively high-salinity sodium-chloride type water in discharge areas.
Evergreen Formation	Low salinity (TDS) and concentrations of sodium and chloride, TDS ranges from 80 to 670 mg/L, with a mean TDS of around 260 mg/L
Precipice Sandstone	Precipice Sandstone has the freshest groundwater in the Surat CMA, salinity ranges from 50 to 850 mg/L with a mean salinity (TDS) of 193 mg/L

5.4.2 Groundwater Use

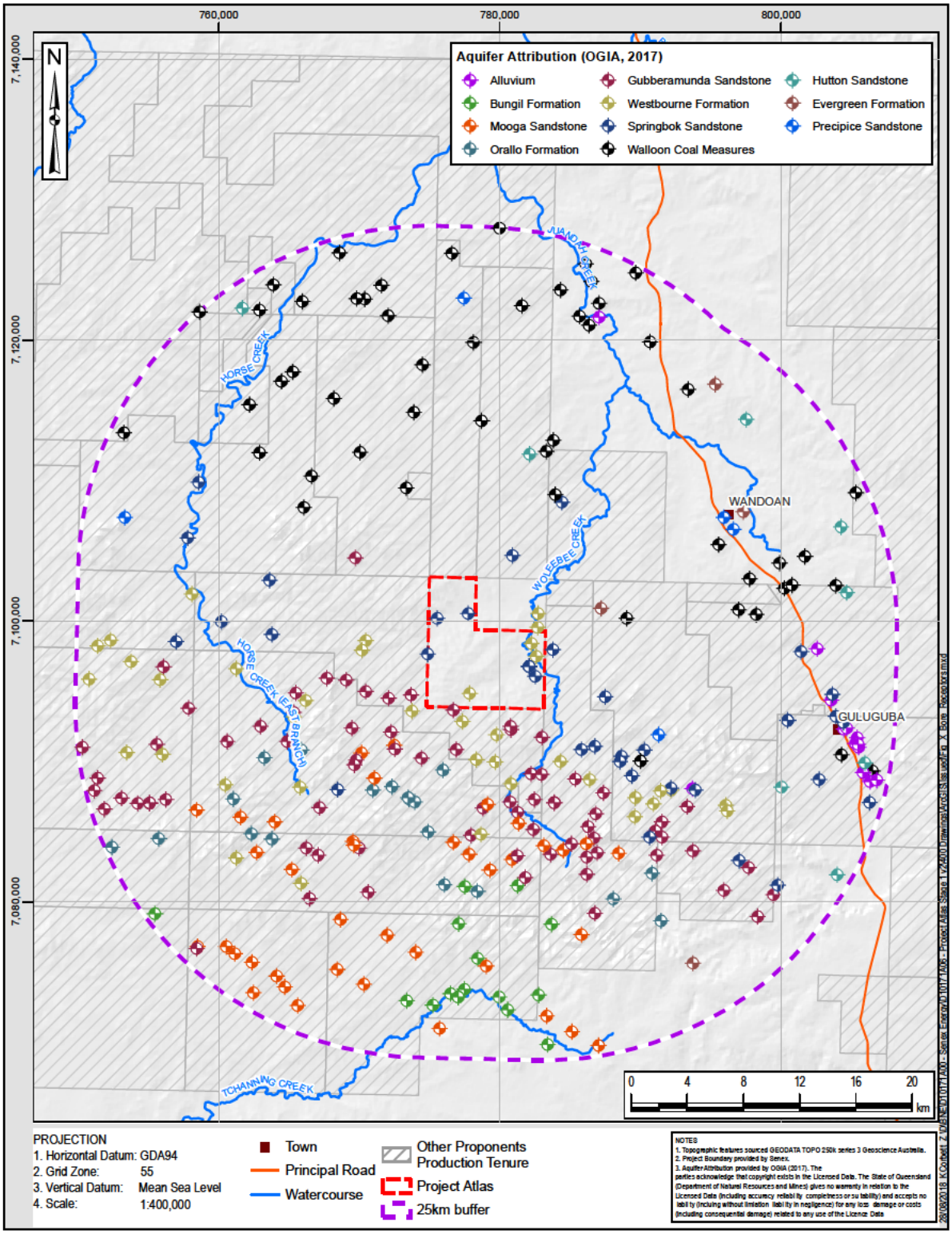
Groundwater occurring within the vicinity of Project Atlas is associated with aquifers of the Surat Basin, which forms part of the GAB. Groundwater is utilised within the vicinity of the Project site for stock and domestic (S&D); agriculture and town water supply purposes.

Groundwater in the GAB is managed within the *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017* (State of Queensland 2017b), under the *Water Act 2000*.

There are 317 registered third-party groundwater bores[2] that have been identified (within a 25 km radius of Project Atlas) as being used for water supply purposes (OGIA 2017c). The location of these bores is shown on *Figure 5.5*. OGIA estimate that 1,345 ML/year is abstracted from these bores (OGIA 2017c), with the majority of the abstracted water attributed to the Hutton and Precipice Sandstone from a limited number of bores.

[2] Screened across Alluvium or Surat Basin units (Bowen Basin units not included).

Figure 5.5: Location of Groundwater Users within the vicinity of Project Atlas



5.4.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are defined by DoEE (2015) as:

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

- ecosystems dependent on surface expression of groundwater,
- ecosystems dependent on subsurface presence of groundwater,
- subterranean ecosystems.'

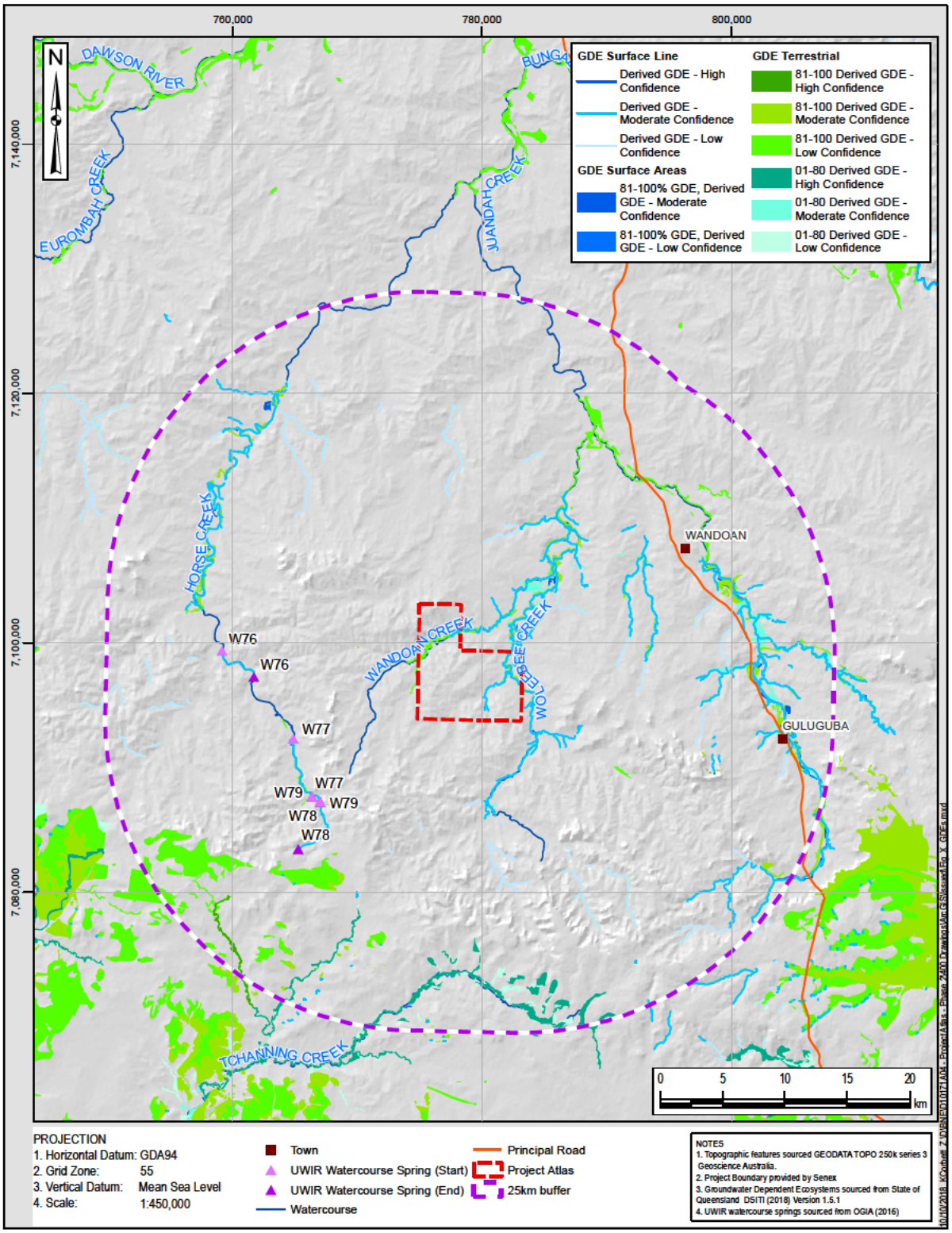
Potential surface expression GDEs and subsurface GDEs are mapped by DES (2018) as potentially being present in the vicinity of Project Atlas (*Figure **5.6***). These generally correspond with the location of the mapped alluvium associated with Wandoan and Woleebee Creeks within the Project area and Horse Creek and Juandah Creek further afield.

Four GAB watercourse springs are located within the vicinity of the Project, as identified in the Surat CMA Underground Water Impact Report (UWIR) (OGIA 2016b). These are shown on *Figure **5.6*** and are considered to source groundwater from the Gubberamunda Sandstone (W76), and Mooga Sandstone / Orallo Formation (W77, W78, W79).

Woleebee Creek was identified by OGIA as being a potentially gaining stream (OGIA 2017b). Field verification was undertaken as part of this assessment (KCB 2018). The field verification identified that there is unlikely to be significant baseflow provided to this creek, however it is likely that during some periods, groundwater levels in the alluvium will rise into the sandy base of the creek. The field verification also concluded that based on the difference between the alluvial groundwater and surface water major ion chemistry signatures, and groundwater chemistry signatures from the Surat Basin units, groundwater within the alluvium is not considered to be sourced by the underlying Surat Basin unit (Westbourne Formation).

Terrestrial GDEs mapped in the vicinity of the Project (DES 2018) are also considered to source groundwater from the shallow alluvium, rather than the underlying Surat Basin units.

Figure 5.6: Location of UWIR Watercourse Springs and Mapped Potential GDEs (OGIA 2016b; DES 2018)



5.5. Environmental Values and Water Quality Objectives

5.5.1 Environmental Values – Water

The *Environmental Protection Act 1994* (State of Queensland 2018a) defines an Environmental Value (EV) as:

- a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

Under the *Environmental Protection Act 1994,* the *Environmental Protection (Water) Policy 2009* (State of Queensland 2016) is established as subordinate legislation to achieve the object of the Act in relation to Queensland Waters. The purpose of the *Environmental Protection (Water) Policy 2009* is achieved by:

- identifying environmental values and management goals for Queensland waters; and
- stating water quality guidelines and water quality objectives to enhance or protect the environmental values; and
- providing a framework for making consistent, equitable and informed decisions about Queensland waters; and
- monitoring and reporting on the condition of Queensland waters.

The *Environmental Protection (Water) Policy 2009* provides defined EVs and water quality objectives (WQOs) for the Dawson River sub-basin under Schedule 1 of the policy and are detailed in DEHP (2011). EVs for the Upper Dawson are presented in Table 5.3 and includes both the values for surface water and groundwater. The WQ1308 plan (DEHP 2013) that accompanies the policy indicates that the Project area is located on the southern tributaries of the Upper Dawson. EVs for the wider area, are also included in Table 5.3.

Table 5.3: Environmental Values for the Dawson River Sub-Basin waters within the vicinity of the Project Atlas (DEHP 2011)

Water	Environmental Values											
	Aquatic Ecosystem	Irrigation	Farm Supply / Use	Stock Water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
Upper Dawson—Taroom area (WQ1308)												
Upper Dawson main channel (downstream of Hutton Creek junction)—developed areas, including Glebe Weir	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Northern upland tributaries—developed areas	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Central tr butaries—developed areas	✓		✓	✓		✓	✓	✓	✓	✓		✓
Southern tributaries—developed areas	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Groundwater	✓	✓	✓	✓			✓		✓	✓	✓	✓
Undeveloped areas	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓

✓ denotes the EV is selected for protection. Blank indicates that the EV is not chosen for protection.

5.5.1.1. Water Quality Objectives

WQOs for groundwater are also outlined by DEHP (DEHP 2011) to protect EVs. A summary of the WQOs for groundwater in the Upper Dawson are provided below:

- WQOs for aquatic ecosystems applicable to groundwater where groundwater interacts with surface water, the groundwater quality should not compromise identified EVs and WQOs for those waters.
- For drinking water, local WQOs exist which relate to before and after water treatment and are based on a number of guidelines / legislation including the Australian Drinking Water Guidelines (NHMRC 2011).
- WQOs to protect or restore indigenous and non-indigenous cultural heritage should be consistent with relevant policies and plans.
- For irrigation, WQOs exist for metals, pathogens and other indicators in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000).
- For stock watering, objectives exist for faecal coliforms, total dissolved solids, metals, and other objectives based on guidelines presented in ANZECC & ARMCANZ (2000).
- For farm use / supply, objectives are as per the guidelines in ANZECC & ARMCANZ (2000).

WQOs for surface water are also outlined by DEHP (2011) to protect EVs. A summary of the relevant WQOs for surface water in the Upper Dawson are provided below:

- Where the aquatic ecosystem has high ecological value the WQO is to maintain the existing water quality, habitat, biota, flow and riparian areas.
- For the upper Dawson River sub-basin waters and main trunk the aquatic ecosystem is described as moderately disturbed and specific water quality guidelines have been produced (Table 2 of DEHP 2011).
- For the protection for human consumption, objectives as per the Australian drinking water guidelines (ADWG) (NHMRC 2011) and Australia New Zealand Food Standards Code (Commonwealth of Australia 2017).
- For suitability for industrial use there are no WQOs as water quality requirements vary within the industry.
- For secondary contact and visual recreation, objectives as per NHMRC (2011).
- For drinking water, local WQOs exist which relate to before and after water treatment and are based on a number of guidelines / legislation including the ADWG (NHMRC 2011).
- WQOs to protect or restore indigenous and non-indigenous cultural heritage should be consistent with relevant policies and plans.

- For irrigation, WQOs exist for metals, pathogens and other indicators in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000).
- For stock watering, objectives exist for faecal coliforms, total dissolved solids, metals, and other objectives based on guidelines presented in ANZECC & ARMCANZ (2000).
- For farm use / supply, objectives are as per the guidelines in ANZECC & ARMCANZ (2000).
- For primary contact recreation objectives as per NHMRC (2011) and for fresh water objectives exist for cynobacteria / algae.

5.5.2 Environmental Values – Other

There are no declared environmental values relating to land for the Production Area. The environmental values of the land, relevant to CSG water management within the Production Area to be protected or enhanced are:

- the integrity of undisturbed land and ecosystems within the Production Area;
- the integrity of the topsoil as a resource to be used in rehabilitation;
- the stability of disturbed land and ensuring it is non-polluting;
- the integrity of soil stability and structure for erosion protection;
- the suitability of the land for continued agricultural use post-closure;
- the integrity of regional ecosystem communities and the habitat values they provide within the Production Area;
- the integrity of habitat for endangered, vulnerable, near threatened and special least concern species;
- the integrity of Category B and C ESAs; and
- the integrity of movement corridors provided by riparian zone vegetation.

6. MANAGEMENT, COMPLIANCE AND MONITORING

6.1. Management and Compliance

Senex will implement all produced water and brine management strategies in accordance with the applicable EA conditions and in a manner that ensures protection and maintenance of all relevant EVs.

The *Environmental Protection Act 1994* requires that a site-specific application for a CSG activity must include measurable criteria (termed 'management criteria'), against which the applicant will monitor and assess the effectiveness of the management of all produced water and saline waste associated with the activity. Senex has developed criteria that addresses this requirement (the criteria has been developed following guidance outlined in the DES factsheet ‘CSG water management: Measurable criteria’ (DES 2013).

The management criteria addresses:

- The quantity and quality of the water:
  - used,
  - treated,
  - stored, or
  - disposed of;
- Protection of EVs affected by each relevant CSG activity; and
- The disposal of waste generated from the management of water.

Table 6.1: Project Atlas Water Management Criteria

Objective	Environmental Values	Tasks	Performance Indicator
No unauthorised disturbance of environmentally sensitive areas due to CSG water management activities	▪ Land ▪ Surface water	Secure disturbance approvals by implementing the 'Environmental Management Plan' (SENEX-ATLAS-EN-PLN-001) and Environmental Constraints Protocol for Planning and Field Development' (SENEX-QLDS-EN-PRC-019). Finalise infrastructure locations to identify area and location of disturbances. Comply with EA conditions related to disturbance, biodiversity values and environmentally sensitive areas.	Site specific Ecology Assessment Reports Site specific Desktop Constraints Reports Compliance with extent of approved disturbance
No unauthorised releases to the environment from the gathering network	▪ Groundwater ▪ Surface water	Select gathering routes by implementing the 'Environmental Constraints Protocol for Planning and Field Development' (SENEX-QLDS-EN-PRC-019). Implement the Environmental Management Plan' (SENEX-ATLAS-EN-PLN-001) Develop and implement operation and maintenance plans for gathering networks. Ensure plans includes: ▪ operational procedures for infrastructure associated with isolation, leakage detection and venting / draining for the CSG production wellhead and gathering network; and ▪ monitoring procedure for wellhead and gathering network infrastructure. Implement Senex Incident Reporting and Investigation Procedures.	Recorded volume of unauthorised leaks / spills Recorded number of incidents and associated investigations

Objective	Environmental Values	Tasks	Performance Indicator
No unauthorised releases to the environment from non-regulated structures storing CSG water	▪ Groundwater ▪ Surface water	Tanks – construction and maintenance in accordance with EA conditions; install remote monitoring equipment for water levels; and implement leak detection monitoring and site inspections. Ponds – implement site inspection / leak detection monitoring program in accordance with EA requirements (surface water and groundwater seepage). Implement Senex Incident Reporting and Investigation Procedures	Recorded volume of unauthorised leaks / spills Recorded detection of unauthorised leaks (i.e. groundwater level rise, groundwater quality changes) Recorded number of incidents and associated investigations
No unauthorised releases to the environment from regulated structures storing CSG water	▪ Surface water ▪ Groundwater	Design, construct and operate all regulated structures in accordance with the requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES 2016a) Develop and maintain a regulated structure register. Develop and implement a monitoring program to assess structure integrity and groundwater seepage. Develop and implement a rehabilitation plan for specific regulated structures, including, if required, a brine and salt management plan. Undertake assessment and reporting in accordance with EA requirements	Recorded volume of unauthorised releases from regulated structure Compliance with requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES 2016) Recorded detection of unauthorised leaks (i.e. groundwater level rise, groundwater quality changes) Recorded number of incidents and associated investigations

Objective	Environmental Values	Tasks	Performance Indicator
Maximise the beneficial use of CSG water	▪ Groundwater ▪ Surface water ▪ Land	Maintain the analytical reservoir model to predict the quantity and quality of water over the duration of Project Atlas development. Develop and maintain a project water balance model to optimise the size of water management infrastructure and predict changes in water quality to support the water management strategy. Prioritise water use in accordance with the hierarchy defined in the *CSG Water Management Policy* (DEHP 2012). Develop and implement a Water Quality Monitoring Program to confirm if water is fit for beneficial use. Determine requirement for a Water Treatment Facility.	Proportion of untreated CSG water beneficially used Proportion of treated CSG water beneficially used Monitoring data which are within the appropriate guidelines for relevant water quality objectives for the designated beneficial use
Optimise CSG water and brine management	▪ Groundwater ▪ Surface water	Maintain the analytical reservoir model to predict the quantity and quality of water over the duration of Project Atlas development. Develop and maintain a project water balance model to optimise the size of water management infrastructure and predict changes in water quality to support the water management strategy. Continue to investigate opportunities for CSG water and brine management and prioritise these options in accordance with the *CSG Water Management Policy* (DEHP 2012). Undertake ongoing assessments of optimisation options for CSG water and brine management.	Results from the project water balance identifying the preferred CSG water and brine management options.

6.2. Monitoring

6.2.1 CSG Water and Treated CSG Water Quality Monitoring

Untreated produced water quality will be monitored on a quarterly frequency. The water quality data will be used to:

- Inform the water treatment facility design and operation; and
- Ensure the water quality is suitable for the designated beneficial use and in accordance water quality objectives in the 'General beneficial use approval' (DEHP 2014b) and conditions provided in the 'Streamlined Model Conditions for Petroleum Activities' (DES 2016b) that are aligned with the general beneficial use approval.

Treated produced water quality will be monitored on a weekly frequency. The water quality data will be used to:

- Ensure the water quality is suitable for the designated beneficial use or water supply arrangement and in accordance water quality objectives in the 'General beneficial use approval' (DEHP 2014b); and
- Confirm the water treatment method is effectively treating the CSG water.

6.2.2 Water Storage Dam Monitoring

Senex will undertake inspections and monitoring associated with the water storage dams to assess integrity of the structures and monitor any potential impacts to EVs. The monitoring requirements are provided in Table 6.2. Event-based monitoring will also be undertaken as and when required.

Table 6.2: Water Storage Dam Monitoring Requirements

Activity	Frequency	Reporting
Monitoring and Inspections		
Seepage Monitoring Program and dam water quality	Water and quality levels – quarterly	Any evidence of seepage reported in accordance with EA conditions.
Regulated structure water quality monitoring	Annually	Provided to DES in accordance with relevant EA conditions and Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES 2016a)
Dam embankments and spillways inspection	Annually	Any evidence of deterioration reported in accordance with relevant EA conditions
Dam compliance inspection	Either a less extensive annual inspection checking dam status, defects and unsafe conditions or a more extensive 5 yearly inspection covering the above as well as full operational check of all equipment, surveillance	Inspection report submitted to DES in accordance with relevant EA conditions

Activity	Frequency	Reporting
	data, function check and maintenance inspection.	
Documentation		
Regulated structure register	Completed as dams are constructed	Regulated structure register

6.2.3 Groundwater Monitoring

6.2.3.1. Seepage Monitoring Program (Shallow Groundwater)

Shallow groundwater surrounding water storage dams will be monitored for dam seepage in accordance with the relevant EA conditions, and *'Streamlined Model Conditions for Petroleum Activities'* (DES 2016b). This will be conducted in conjunction with monitoring the water quality within the water storage pond. The monitoring program will be designed to:

- Be undertaken by a suitably qualified person, and in accordance with 'Groundwater Sampling and Analysis – A Field Guide' (Sundaram et al. 2009) and the 'Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES 2018).
- Ensure all water quality samples are analysed / tested at a laboratory with NATA accreditation;
- Identify water quality associated with the water stored within the dam;
- Provide information to develop trigger levels and detection limits associated with dam seepage.

Monitoring programs will also be developed for other project activities, such as irrigation, as required.

6.2.3.2. Regional (Deep) Groundwater Monitoring

Regional groundwater monitoring in relation to CSG water production is undertaken through the Surat CMA UWIR Water Management Strategy, however this is not relevant to the scope of this CWMP in relation to the management of CSG water.

6.2.4 Land and Soils Monitoring

Senex will undertake land and soil monitoring where CSG water management activities have the potential to significantly impact on EVs.

6.3. Reporting

6.3.1 Monitoring Results

An annual review of the monitoring undertaken in accordance with the CWMP and EA conditions will be completed.

Water quality results will be reviewed following sampling events against the relevant water quality guidelines and EA conditions and reported to the appropriate administering authority as required.

6.3.2 Reviews

A review and update of the CWMP will be periodically undertaken to capture changes to the project description that influences the management of CSG water and / or optimisation of the CSG water and brine management.

7. REFERENCES

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Table of comparative Coal Seam Gas projects in Queensland

Coal seam gas field projects under EPBC Act assessment or approved since the water trigger (22 June 2013) as at 2 January 2019

EPBC	Project	Wells	Basin	Fracking	Impact area	Expansion	Issues	Controlling provisions	Status
2018/8276	Surat North CSG Project, QGC	740	Surat	Not clear in referral information	62 ha	Yes	Species- Impacting at least 62 ha of score 8 Koala habitat, and potentially at least 6 other species and three TEC's. Water- Proponent considered it would not have a significant impact, OWS considered there was limited information in the referral to support the proponent's conclusions.	Species Water	PD Referral decision CA 15/11/2018 Under assessment
2015/7469	Western Surat Gas Project, Stuart Petroleum Cooper Basin Gas Pty Ltd (Senex subsidiary)	425	Surat	No	232 ha	No	Referral was for over 1,000 wells, was to be a bi-lateral. Project varied down to 425 wells. 5 species. 55 landholder bores predicted to undergo greater than five metres drawdown and nine to have a 4 to 5 m drawdown over the duration of the project. Water quality management and monitoring plans, chemical risk assessment and OMP provided for assessment. Conditioned to implement Water management plans, OMPs, provide updated WMMP's by 5 years after commencement and provide updated chemical risk assessment if new high risk compounds are being used.	Wetlands Species Migratory Water	PER Approved 10/08/2018
2017/7902	Alfredson Block CSG Project, 40 km south of Miles, Australia Pacific LNG Pty Limited	68	Surat	Yes	208 ha	Yes	Potential habitat for Dulacca Woodland Snail and Brigalow Woodland snail, 6.1 ha to be cleared, no surveys done at referral. Triggered due to lack of survey. Brigalow TEC present, likely to impact 5.4 ha in fragmented patches, not considered significant. Surveys carried out June 2017 found no listed snail present. Information provided on chemicals used in drilling inadequate for assessment.GA considered	Species Water	PD Referral decision 24/04/2018 Under Assessment

EPBC	Project	Wells	Basin	Fracking	Impact area	Expansion	Issues	Controlling provisions	Status
							uncertainty in the parameters used to model groundwater drawdown impacts, the major impacts beyond lease boundary unlikely however cumulative impacts should still be considered. Landspraying untreated extraction water but no characterisations for the components of by-products provided.		
2017/7881	Spring Gully North-West and North East CSG developme nt, north-east of Roma, referred by Origin on behalf of Australia Pacific LNG Pty Limited	114	Bowen	No	601 ha	Yes	The project is the second of three proposed extensions of existing operations. The first (EPBC 2016/7720, 11 wells) was an NCA. This and the planned third extension are hydraulically separate, targeting different coal measures. Potential impacts on at least White-throated Snapping Turtle, Koala, Squatter pigeon. Water- Existing infrastructure will be used for re-injection. Modelled maximum drawdown of 0.13 m for bores during peak water production. Contribution to cumulative impacts in the Bowen Basin and possibly the Surat Basin. Potential impacts on GDE's, re-injection may inundate springs. Insufficient information provided on drilling chemicals being used to enable assessment of potential risk.	Species Water	PD Referral decision 6/04/2017 Under Assessment, Final PD submitted, proposed approval being prepared
2015/7463	Anya, 30 km west of Dalby,QGC	25	Surat	No?	54 ha	Yes	Species: Koala, Kogan wax flower, Five-clawed Worm-Skink and Dunmall's Snake. Had not undertaken comprehensive surveys. Water- did not provide sufficient information concerning how groundwater drawdown for the proposal was determined, so that it was not possible to assess if the model was accurate. OWS concluded that there was unlikely to be significant impacts on GDE's or surface water or availability because of the small scale of the project, particularly compared to the larger Arrow project (2012/6377)	Species	PD Approved 17/03/2017

EPBC	Project	Wells	Basin	Fracking	Impact area	Expansion	Issues	Controlling provisions	Status
							which is adjacent. GA considered it would be impossible to distinguish the impacts of the project compared with existing CSG projects in the Surat.		
2016/ 7720	Spring Gully CSG Field extension, north east of Roma Australia Pacific LNG	11	Bowen , Surat	No	38 ha	Yes	Project will contribute to drawdown in the Bowen Basin, and possibly Surat. Potential impacts on surface water localised and low-flow interruptions to first and second order streams only. Unlikely to cause measurable impacts to water quality in downstream watercourses. OWS considered impacts to GAB springs community (two within 30km and 25km of the project) will be low due to the small scale. Department considered the cumulative impact of 11 wells is unlikely to add substantially to the existing impacts from CSG extraction with the area.	None	Not Controlled Action 12/07/2016
2012/ 6615	Santos	6,100	Bowen	Yes	15,738 ha	Yes	47 species, 6 TEC's, 5 migratory species Conditioned to provide water quality and monitoring plans, chemical risk assessment, OMP, updated constraints protocol, species impact mitigation measures.	Wetlands Species Migratory Water	Bilateral Minister approved 22/03/2016
2013/ 7047	Wandoan, 400 wells, GQC	400	Surat	Yes	105.9 ha	Yes	Conditioned to provided Water management and monitoring plan, and chemical risk assessment for fracking fluids	Species Water	PD Approved 17/12/2014
2012/ 6377	Arrow Energy	4,000	Bowen	Yes	871 ha	No	Discharge to the Isaac river Fracking Not all of the project area is in the Surat CMA region. Arrow has to undertake modelling for areas outside. Conditioned to provide species management plans, groundwater monitoring and management plans.	Species Water Migratory	Bilateral Approved 27/10/2014
2010/ 5344	Arrow Surat Project, 6,500 wells	6,500	Surat	No	4,400 ha	Yes	28 species and 6 TEC's. Conditioned to provided OMP and SSMP prior to each stage of commencement.	Species Migratory Water	Bilateral Approved by the Minister 19/12/2013

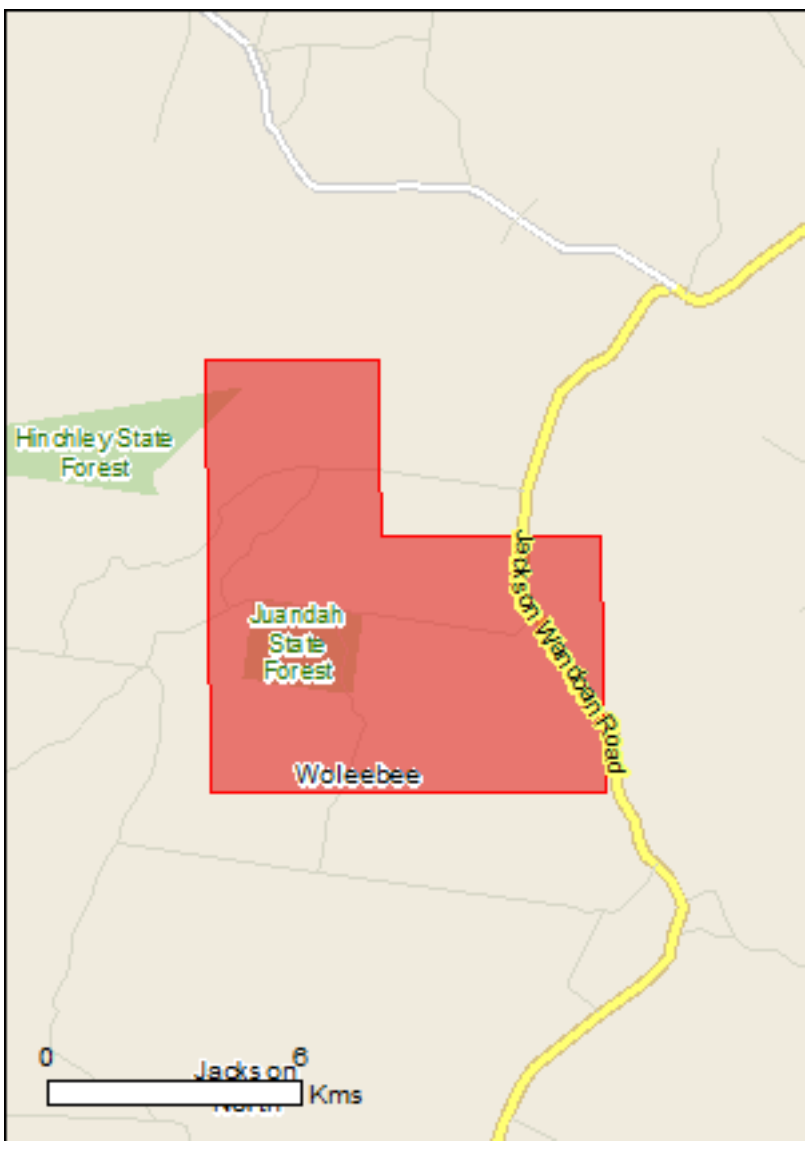
EPBC	Project	Wells	Basin	Fracking	Impact area	Expansion	Issues	Controlling provisions	Status
	in the Surat Basin						Water management and monitoring plan not submitted during assessment, conditioned to submit prior to commencement		

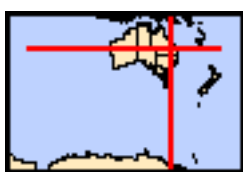
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

2018/8329 Referral ERT 7 January 2019

Report created: 07/01/19 12:07:04





Summary

Matters of National Environment Significance

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Threatened Ecological Communities:	3
Threatened Species:	21
Migratory Species:	11

Other Matters Protected by the EPBC Act

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None
EPBC Act Referrals:	10
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
FISH		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
OTHER		
Adclarkia dulacca Dulacca Woodland Snail [83885]	Endangered	Species or species habitat likely to occur within area
PLANTS		
Acacia curranii Curly-bark Wattle [3908]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat may occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
REPTILES		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat may occur within area

Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area

EPBC Act Referrals [Resource Information]

Further details about the referral or advice - including its current status if still active - are available in its PINK report; click on the title.

Referral			
Title	Reference	Referral Outcome	Assessment Status
High Voltage Transmission line Development	2007/3230	NCA	Referral Decision Made-Completed
Wandoan Coal Project - Coal Seam Methane Water Supply South	2008/4287	CA	Approval Decision Made-POST-APPROVAL/COMPLIANCE
Development of Existing Coal Seam Gas Fields	2008/4398	CA	Approval Decision Made-POST-APPROVAL/COMPLIANCE
Expansion of Coal Seam Gas Fields	2009/4974	CA	Approval Decision Made-POST-APPROVAL/COMPLIANCE
Construct and operate 447km high pressure gas transmission pipeline	2009/4976	CA	Approval Decision Made-POST-APPROVAL/COMPLIANCE
Development of an underground longwall coal mine	2011/6129		Withdrawn-Completed
Reedy Creek to Glebe Weir Pipeline Project	2011/6181	CA	Approval Decision Made-POST-APPROVAL/COMPLIANCE
Santos GLNG Gas Field Development Project, QLD	2012/6615	CA	Condition variation being considered-Post-Approval
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	NCA	Referral Decision Made-Close
Project Atlas CSG Project, between Wollumbilla and Wandoan, Qld	2018/8329	RD	Referral Published-Publish Case

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environment and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-Forestry Corporation of NSW
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Senex Energy Limited

Queensland Environmental Protocol for Field Development and Constraints Analysis

Document Number:

SENEX-CORP-EN-PRC-019

Revision: 1

Position	Name	(tick one column only)		Signature	Date
		Approve	Review		
Environment Manager	s47F	☒	☐	s47F	11/1/2019

Contents

1 REVISION HISTORY

Revision	Revision Date	Document Status	Revision Comments	Author	Approved by
0	10/10/2017	Issued for Use	New document	s47F	
1	11/1/2019	Issued for Use	Incorporating Project Atlas Dulacca snail requirements		

2 DEFINITIONS

Biodiversity values– *environmentally sensitive areas, prescribed environmental matters and wetlands.*

Constraints checklist – used for quality assurance purposes to ensure all relevant environmental constraints are considered as early in the infrastructure siting process as possible.

Constraints maps – created and updated by the WSGP Technical Officer, the maps will assist in initial environmental desktop constraints analysis for proposed infrastructure locations. Information includes (as required):

- Aerial imagery;
- Flood plains;
- Elevation data (Lidar and/or contours);
- Ecological and watercourse/wetland constraints;
- Areas of Regional Planning Interest (e.g. Strategic Cropping Land);
- Existing infrastructure;
- Native title;
- Cultural heritage;
- Sensitive receptors; and
- Landholder status.

Ecology Survey Report – report detailing the findings of the ecological surveys undertaken as part of the environmental site assessment.

Invasive plant – as defined under the *Biosecurity Act 2014.*

MNES – matter of national environmental significance under the *Environmental Protection and Biodiversity Protection Act 1999.*

MSES – *matter of state environmental significance under the Environmental Offset Act 2014.*

Significant disturbance to land – defined in Schedule 12 of the *Environmental Protection Regulation 2008* as land that has been disturbed and human intervention is needed to rehabilitate it to a condition required under the relevant environmental authority, or to the condition it was in immediately before the disturbance.

Site-specific environmental conditions and maps – conditions and restrictions (and associated maps) governing how construction activities on site should be carried out to ensure compliance with Environmental Authority conditions and regulatory requirements.

Strategic cropping area – an area of regional interest defined under the *Regional Planning Interests Act 2014.*

3 PURPOSE

The Environmental Protocol for Field Development and Constraints Analysis (the Protocol) aims to ensure that infrastructure siting:

- Considers biodiversity values and environmental constraints when selecting preferential locations, aligning with planning principles to avoid, minimise, mitigate and then manage potential environmental impacts
- Is compliant with Environmental Authority (EA) conditions and State and Federal regulatory requirements
- Identifies any additional external environmental approvals required and that those are secured prior to the commencement of construction activities
- Avoids important populations of the threatened Dulacca Woodland snail (*Adclarkia dulacca*), if it is found to occur within Project Atlas, and limits the potential to fragment or isolate populations should they occur within the disturbance area or adjacent areas.

The Protocol also recognises that, in addition to environmental constraints, landholder, engineering and cultural heritage constraints must be considered during infrastructure siting. These constraints are assessed through processes aligned with this Protocol.

4 SCOPE

This Protocol applies to site selection and approvals for across all Senex's infrastructure projects where construction will involve significant disturbance to land. This includes but is not limited to:

- Well lease pads;
- Access tracks;
- Compression facilities;
- Dams and water management facilities;
- Pipelines;
- Seismic surveys;
- Camps and associated laydowns and hardstand areas; and
- Borrow pits.

The Protocol is triggered by the initiation of a work program by the Project Infrastructure Development Team and involves the steps described in Section 5 and as shown in Figure 5-1.

5 PROTOCOL STEPS

1. Desktop environmental constraints analysis

Upon development of a work program a desktop constraints analysis will be completed. This analysis involves review of GIS mapping layers relating to the proposed infrastructure location(s). The GIS mapping layers generally comprise publicly available State and Federal Government data supplemented by site-specific GIS data gathered during survey activities.

The desktop constraints analysis results in the production of constraints map(s) for internal review.

Depending on the specific nature of any environmental or other constraint(s) identified during the desktop assessment, the proposed infrastructure location may be revised and the new location selected to avoid or minimise the impacts on the constraining environmental values where possible. The constraints maps and associated analysis checklist are retained on file for quality assurance purposes.

2. Site surveys

Once a preferred infrastructure location is defined through the desktop constraints analysis and consultative process, site surveys are undertaken to confirm the suitability of the location. This includes, in general chronological order:

1. Discussions with landholders to identify on-ground constraints (e.g. stock routes) and to confirm preferred location(s);
2. Survey of infrastructure locations by engineering staff to confirm constructability;
3. Environmental surveys of infrastructure locations to ground-truth mapped constraints including protected vegetation, fauna habitat, watercourses, prescribed environmental matters to trigger environmental offsets, invasive weeds, areas of regional interest etc.
4. Cultural heritage clearance of infrastructure locations.

Outcomes of 1 and 2 above refine the scope of the environmental survey. The primary environmental survey undertaken is ecological ground-truthing to confirm the likelihood of habitat for protected fauna, the occurrence of protected flora, regional ecosystems and ecological communities, prescribed environmental matters, and validation of mapped watercourses. The survey will be based on field methods to collect data using the Queensland Biodiversity Values Field Assessment Form (SENEX-CORP-EN-FRM-008).

Where required, additional species specific, targeted, field based surveys will be undertaken by suitably experienced ecologists within areas identified as potential habitat to further understand the impact of the project on a species, Surveys will be required for *Nature Conservation Act* Flora trigger plants in a trigger area or where disturbance is proposed within or adjacent to potential Dulacca snail habitat in Project Atlas. Species specific surveys for species such as Koala or Yakka skink may also be undertaken to assist managing the site for a particular species.

The results are documented in a report based on the report template (SENEX-CORP-EN-TEM-001 Biodiversity Values Report Template).

Should site surveys locate constraints not identified through the desktop environmental constraints analysis, infrastructure locations may be modified or revised, returning to step 1 above.

3. Post-survey environmental constraints analysis

The results of the site surveys are used to further refine the proposed infrastructure locations. The environmental survey results and in particular the content of the Ecological Survey Report is used to:

- Identify areas within the disturbance footprint or directly adjacent supporting potential habitat for threatened species or significant species and avoid the field validated habitat where possible.

- Where there is evidence of threatened or significant species occurrence, identify if there is flexibility in the design to avoid important populations, and limit the potential for fragmentation and isolation of populations, should they occur within the disturbance area or adjacent areas. Important populations of the Dulacca snail will be avoided within Project Atlas, if they occur.
- Define limited or no-access areas (e.g. to protect mature habitat trees, areas of declared weed infestation etc);
- Determine whether any secondary approvals (e.g. protected plant clearing permits) need to be secured prior to commencing construction activities;
- Determine whether any environmental offsets at the State or Federal level will be triggered against environmental offset approvals;
- Determine other construction-related environmental requirements such as design considerations for watercourse crossings that constitute waterway barrier works and requirements to address strategic cropping areas.

Key environmental restrictions for infrastructure siting or construction activities arising from the environmental surveys and desktop constraints analysis feed into the Preliminary Access to Work documentation to allow Conduct and Compensation Agreements to be negotiated with relevant landholder(s). Any additional approvals required are then sought.

4. Environmental constraints reporting

Once any additional approvals are secured, an Environmental Constraints Report is prepared formally documenting:

- That infrastructure siting complies with relevant environmental approval conditions including planning considerations and disturbance/clearing limits;
- That infrastructure siting complies with requirements of relevant regulations and secondary approvals;
- The estimated disturbance area for any MNES or MSES to be debited from the approved disturbance limit in the relevant approval;
- Identifies where environmental offsets will be triggered and the estimated disturbance area to be debited from the relevant offset plan; and
- Site-specific or construction-related environmental considerations.

The report includes a list of Site-specific Environmental Conditions and associated maps that are included in the final Access to Work documentation, issued upon sign-off by the Project Manager to relevant staff and contractors prior to commencing construction. The Environmental Constraints Report is used to demonstrate compliance with relevant regulations, as part of the overarching Senex Environmental Compliance Management System. The disturbance data in the report is used to update the land disturbance GIS layer that manages aspects for total disturbed area and environmental offsets required for external environmental annual reporting.

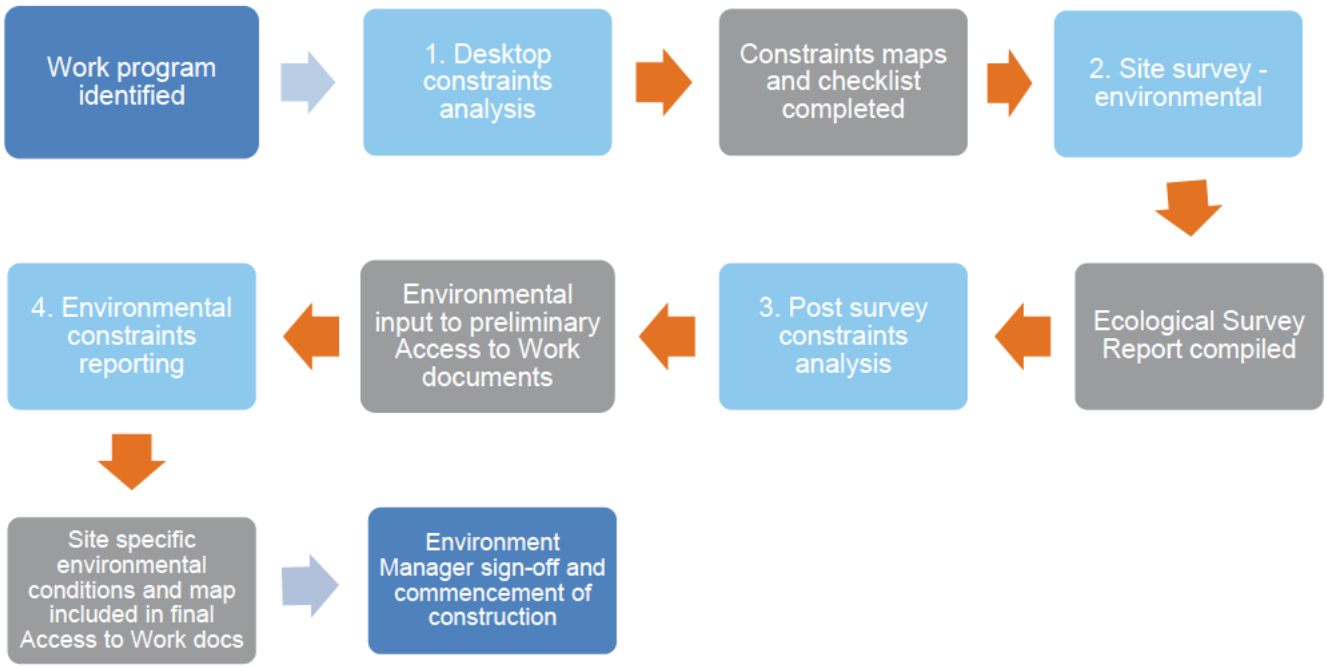


Figure 5-1 Key steps in the Protocol

6 DELIVERY

Key deliverables, timing and roles and responsibilities are detailed in Table 6-1 below.

Table 6-1 Deliverables, roles and responsibilities

Step	Deliverable	Timing (estimate)	Role (WSGP)
1. Desktop environmental constraints analysis	Constraints mapping and completed checklist.	2 weeks	Senex Environmental Adviser
2. Site surveys - environmental	Ecology Survey Report (or similar for other environmental considerations.	4 weeks (from completion of landholder discussions and constructability surveys)	Undertaken by Senex and/ or third party ecologist (consultant)
3. Post-survey environmental constraints analysis	Key environmental restrictions included in preliminary Access to Work documentation for CCA negotiation.	2 weeks	Senex Environmental Advisor
4. Environmental constraints reporting	Environmental Constraints Report. Site-specific Environmental Conditions and associated maps for inclusion into final Access to Work documentation.	2 weeks	Senex Environmental Advisor and approved by the Environment Manager

Senex Energy Limited

Project Atlas
Water Monitoring and Management Plan

Document Number:
SENEX-ATLS-EN-PLN-004

Revision: 2

Position	Name	(tick one column only)		Signature	Date
		Approve	Review		
Environment Manager	s47F	☒	☐	s47F	15/1/2019

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REVISION HISTORY

Revision	Revision Date	Document Status	Revision Comments	Author	Approved By
A	Sept-2018	Draft	Drafted	KCB	
B	Sept-2018	Draft v2	Revised with Senex comments	KCB	
C	Oct-2018	Final	Revised with WSP comments	KCB	
0	24 October 2018	Rev 0	Issued for Use	KCB, Senex	s47F
1	7 January 2019	Rev 1	Revised Reporting section 4.4.2	Senex	
2	15 January 2019	Rev 2	Revised reporting section 4.4.2	Senex	

1. INTRODUCTION

Senex Assets Pty Ltd, on behalf of its wholly-owned subsidiary Senex Energy Limited (Senex) (ACN 008 942827), is currently authorised to conduct petroleum exploration activities in accordance with its Environmental Authority (EA) 0001207, within petroleum lease (PL) 1037. Petroleum Lease 1037, identified as Project Atlas (the Project), is located 15 km southwest of Wandoan in southern Queensland.

Senex propose to develop a coal seam gas (CSG) field within PL1037 to produce gas exclusively for the domestic market. The Project will include up to 113 CSG production wells and supporting infrastructure.

Proposed production activities for the Project include installing up to 113 CSG production wells and their connection to gas and water gathering lines; ancillary activities to operate the field; and water management facilities, including aggregation dams, brine storage and irrigation.

1.1. Aim and Objectives of the Plan

CSG water production is required as part of the CSG extraction process. Groundwater is removed (pumped) from CSG production wells to depressurise the CSG target production coal seams. This depressurisation generates gas flow and sustains a groundwater flow to maintain the target producing operational pressure of each production well.

The removal of groundwater for this purpose is regulated under the *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017), where petroleum tenure holders can exercise underground water rights. The Act identifies underground water rights for petroleum tenures, and states that the holder of a petroleum tenure may take or interfere with underground water in the area of the tenure if the taking or interference happens during the course of, or results from, the carrying out of another authorised activity for the tenure.

Abstraction of groundwater as part of CSG production may cause a drawdown in groundwater levels / pressure and therefore may impact existing water-dependent assets within the vicinity of the Project, such as groundwater bores, or groundwater dependent ecosystems.

This CSG Water Monitoring and Management Plan (CWMMP) has been prepared to outline Senex's proposed monitoring, management and mitigation measures to specifically address impacts to groundwater from the Project.

1.2. Regulatory and Policy Framework

1.2.1 Project Atlas Approval Status

Key State and Commonwealth legislation relevant to the Project include:

- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth of Australia 2016)
- *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017)
- *Environmental Protection Act 1994* (State of Queensland 2018a)
- *Water Act 2000* (State of Queensland 2018b)

A summary of Project Atlas's current approval status under these Acts is provided in Table 1.1.

Table 1.1: Summary of Project Atlas Approval Status under State and Commonwealth Legislation

Act / Policy	Approval Status
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth of Australia 2016)	This plan is submitted to accompany a referral for Project Atlas under the *EPBC Act*.
Petroleum and Gas (Production and Safety) Act 2004 (State of Queensland 2017a)	A Petroleum Lease has been granted by Queensland Department of Natural Resources, Mines and Energy (DNRME) in December 2017.
Environmental Protection Act 1994 (State of Queensland 2018a)	Exploration activities are authorised under Environmental Authority (EA) EA0001207. Senex will apply for an amendment of the EA (EA0001207) to authorise production activities.
Water Act 2000 (State of Queensland 2018b)	Project Atlas is located within the Surat Cumulative Management Area (CMA) and will be included in the next version of the Underground Water Impact Report (UWIR), to be published in 2019. The Office of Groundwater Assessment (OGIA) will provide Senex with obligations required to comply with the Surat CMA UWIR.

1.2.2 Surat Cumulative Management Area Underground Water Impact Report

Under the *Water Act 2000* (State of Queensland 2018b), where there is an area of concentrated development, a CMA can be declared. Project Atlas is located within the Surat CMA, which was declared in 2011.

The OGIA was established under the *Water Act 2000* and is responsible for predicting regional impacts on water pressures in aquifers; developing water monitoring and spring management strategies; and assigning responsibility to individual petroleum tenure holders for implementing specific parts of the strategies within CMAs. Specific to the Project, these predictions, strategies and responsibilities are set out in the Surat CMA UWIR, prepared and maintained by OGIA.

The Surat CMA UWIR was first published by Queensland Water Commission (QWC) in 2012 (QWC 2012) to assess the cumulative impacts to the Surat and southern Bowen Basin, as a result of the expansion of CSG production by multiple, adjacent developers. An updated UWIR was published by the OGIA in September 2016 (OGIA 2016b).

OGIA will provide Senex with obligations to comply with the Surat CMA UWIR Water Monitoring Strategy (WMS). These obligations may include:

- For groundwater monitoring: the location, type of facilities, target aquifer and frequency of monitoring required; and
- For baseline assessment: details of bores that are required to be included in a baseline assessment.

2. PROJECT DESCRIPTION

2.1. General Description

Project Atlas covers an area of approximately 58 km^2 and is located approximately 15 km southwest of the township of Wandoan. The Project is located within PL1037 as shown in Figure 2.1. The CSG target coal seam for the Project is the Walloon Coal Measures (WCM).

The Project is also located adjacent to other tenure holders, including:

- QGC's Northern Development Area, which is located to the west and north of Project Atlas, and commenced CSG production between 2008 and 2014 (OGIA 2016c); and
- Origin's Ramyard gas field located to the south and the Sandpit gas field located to the northeast, both planned to commence between 2020 and 2025; and the Woleebee gas field located to the east, planned to commence between 2025 and 2035 (OGIA 2017c).

Gas field production activities, planned to commence in 2019, will include the following activities:

- Drilling, installation, operation and maintenance of up to 113 CSG production wells (all vertical), targeting the WCM, over an estimated 41-year Project life;
- Installation, operation and maintenance of gas and water gathering flowlines;
- Installation, operation and maintenance of associated supporting infrastructure (e.g. temporary workforce accommodation, access roads, power and communication systems, laydowns, stockpiles and storage areas);
- Decommissioning and rehabilitation of infrastructure and disturbed areas; and
- Installation, operation and maintenance of water storage and water management facilities, including brine storage.

Details of the project components, including location and size, will be identified progressively over the life of the Project.

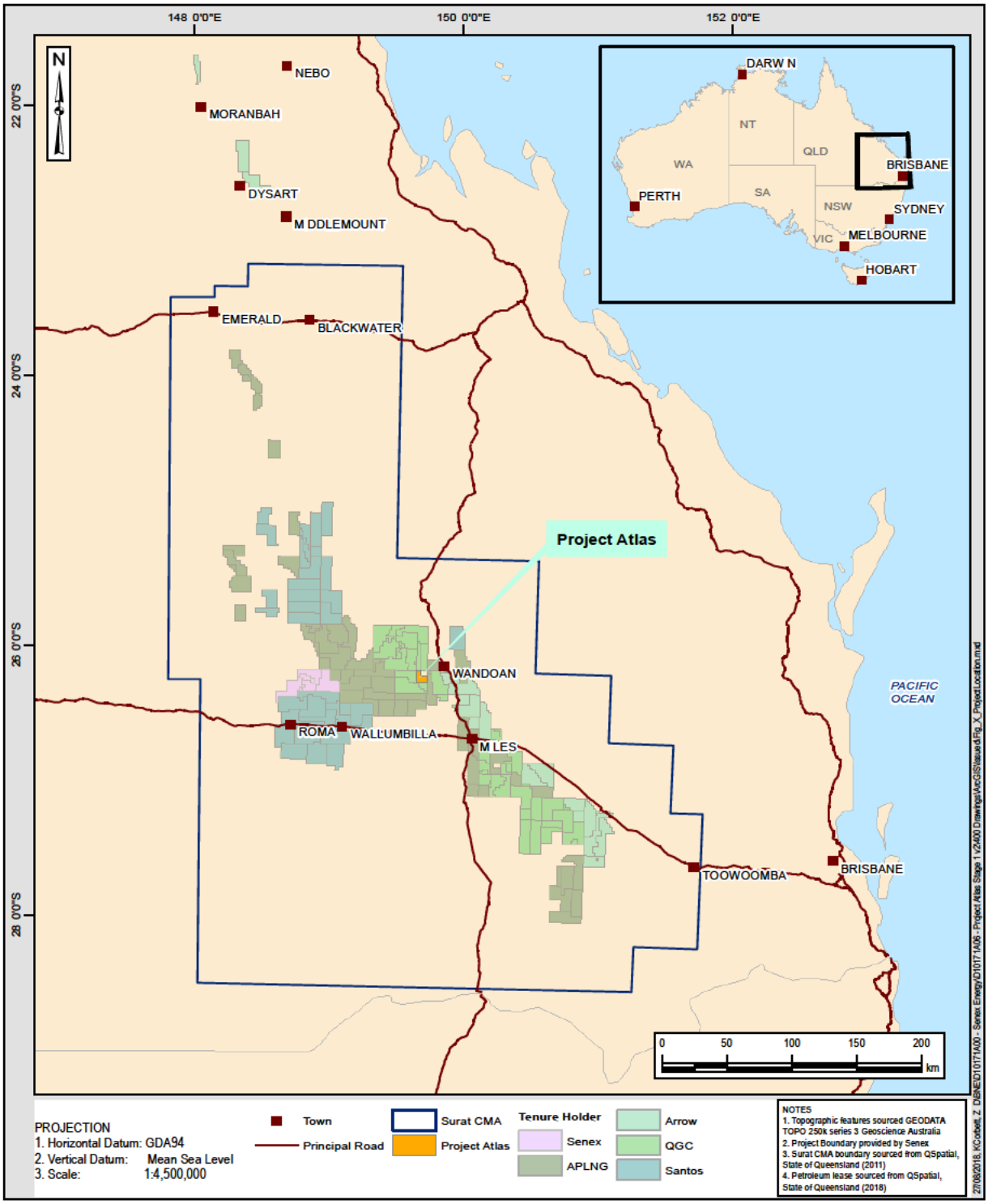

Figure 2.1: Location of Project Atlas

2.2. CSG Water Production

CSG water production is required as part of the CSG extraction process. Groundwater is abstracted (pumped) from CSG production wells to depressurise the target production coal seams. Depressurisation generates gas flow and sustains a groundwater flow from the well to maintain the target producing operational pressure for each CSG production well. A summary of the proposed CSG production wells is provided in the following:

- CSG production wells will be drilled and constructed in accordance with the '*Code of Practice for construction and abandonment of coal seam gas and petroleum wells, and associated bores in Queensland Version 1'* (DNRME 2018). This code outlines mandatory requirements and good practice to reduce the risk of environmental harm.
- Hydraulic fracturing is not expected be undertaken as part of the Project.
- Water and gas will be produced from all CSG production wells.
- Subject to relevant approvals, gas production and its associated water extraction will commence after July, 2019, with all wells commissioned by 2029.
- The operating life of individual CSG production wells is anticipated to be between 20 and 30 years. CSG production (water and gas) is planned to cease by 2060.

Produced water volumes and rates are predicted using an analytical modelling tool, developed by Senex, with probabilistic distributions applied to several key reservoir parameters (i.e. permeability, porosity and net coal). These predictions generate a production profile (type curve), which are used in field development planning to provide a water forecast. Type curves are updated during the life of the project as more information becomes available.

Figure 2.2 presents the predicted water extraction rate for the Project. Peak CSG water production is predicted to occur towards the end of 2025 at a rate of ~1.7ML/d. The estimated annual total CSG water production for the life of the Project, as well as the cumulative water production volume, is presented in Figure 2.3. It is estimated that ~6,200 ML of groundwater will be abstracted during the Project life.

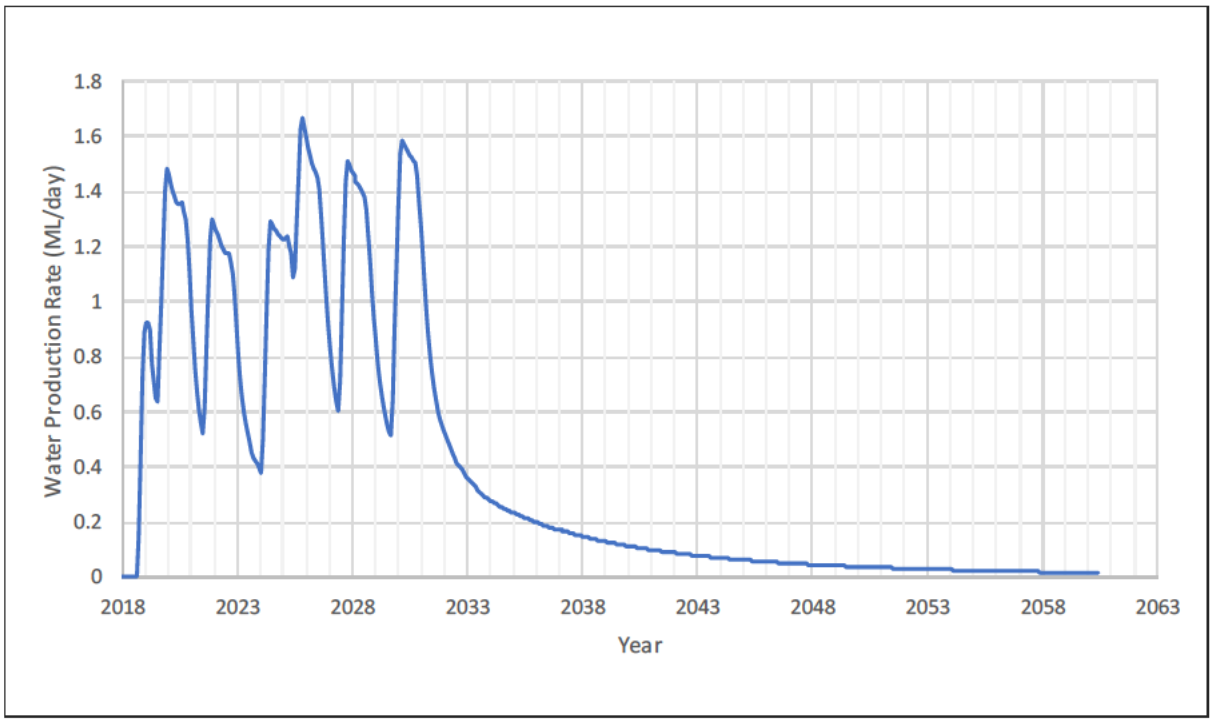

Figure 2.2: Proposed CSG Water Production Rate for Project Atlas (113 CSG Production Wells – 2018 to 2060)

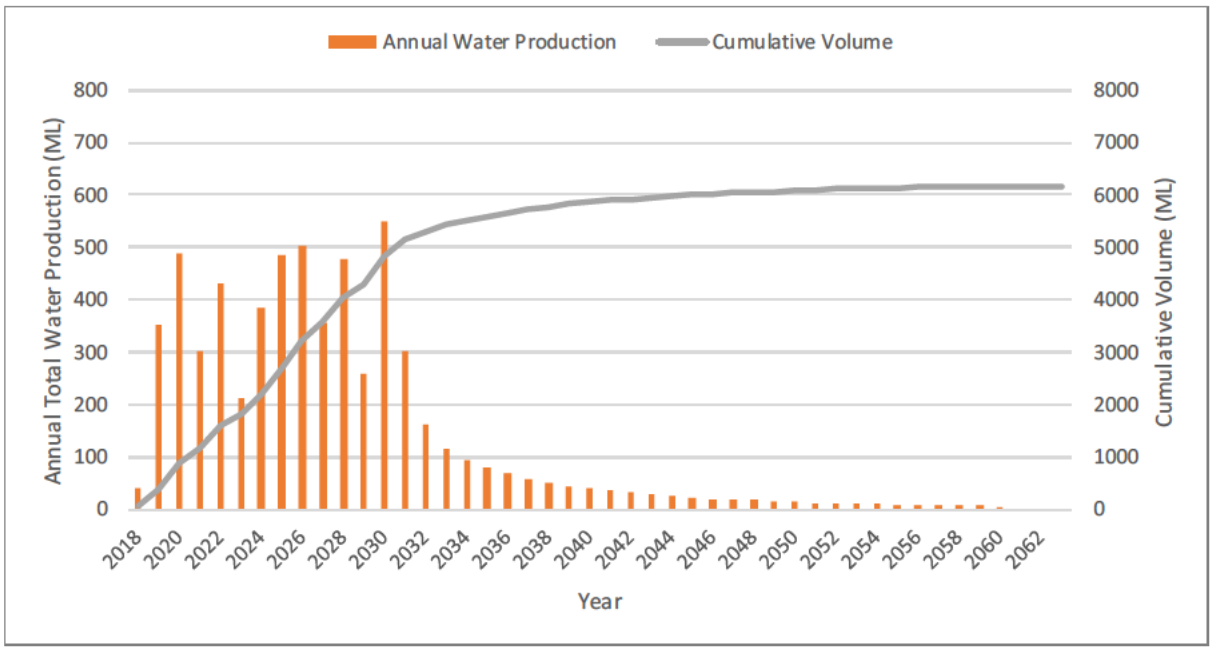

Figure 2.3: Proposed Annual CSG Water Production and Cumulative Volume for Project Atlas (113 CSG Production Wells – 2018 to 2060)

2.3. CSG Water Management

CSG produced water from the Project will be collected via water gathering systems. The Project will include water storage facilities, comprising:

- Aggregation dam(s) for storing untreated CSG produced water;
- Irrigation dams located adjacent to dedicated irrigation areas;
- Brine storage dams; and
- Temporary tanks or dams for the appraisal program.

The infrastructure and flow process associated with water management is provided in Figure 2.4.

Senex's strategy for CSG water management for the Project has been developed based on the Department of Environment and Science[1] (DES) Prioritisation Hierarchy (DEHP 2012). The water management options have been developed to maximise beneficial use of water.

The Project Atlas CSG Water Management Plan (SENEX-ATLS-EN-PLN-006) provides further information relating to the management of CSG water and associated water storage.

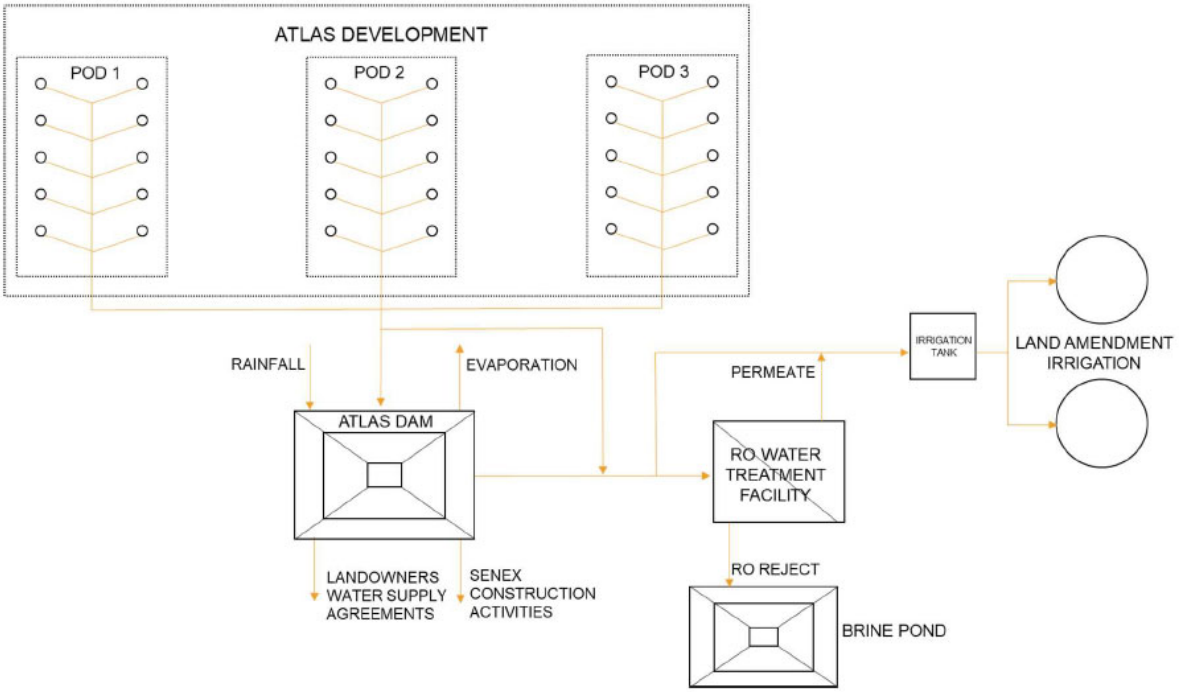

Figure 2.4: Water Management Infrastructure Schematic

[1] Formerly the Department of Heritage and Environment Protection (DEHP)

3. GROUNDWATER AND PROJECT ATLAS

3.1. Hydrogeological Overview

The Project is located within the geographical extent of the Surat Basin, a basin of Jurassic-Cretaceous age, which is underlain by the Permo-Triassic Bowen Basin. Cenozoic-age formations are present overlying the Surat Basin formations. The surface geological map within the vicinity of the Project is shown in Figure 3.1.

The Surat Basin forms part of the Great Artesian Basin (GAB), which is comprised of several aquifers and confining aquitards. Aquifers of the Surat Basin are a significant source for water used for stock, public water and domestic supply. OGIA (2016) presents hydrostratigraphy of the Surat and Bowen Basin, included as Figure 3.2.

The main aquifers within the GAB, from the deepest to the shallowest, are the Precipice Sandstone, Hutton Sandstone, Springbok Sandstone, Gubberamunda Sandstone, Mooga Sandstone and Bungil Formation. These aquifers are typically laterally continuous, have significant water storage, are permeable and are extensively developed for water supply. However, in some areas, they have more of the character of aquitards than aquifers (OGIA 2016b). The major aquitards are the Evergreen Formation, Eurombah Formation, Westbourne Formation, Surat Siltstone and Griman Creek Formation (Figure 3.2). WCM is the target formation for CSG production for the Project.

The Project is situated in an area where the Orallo Formation, Gubberamunda Sandstone and Westbourne Formation outcrop. The WCM outcrop is mapped as occurring ~25 km north of the Project.

North-south and west-east oriented cross sections are presented in Figure 3.3, with the section locations provided on Figure 3.1. These sections show the hydrostratigraphic units dipping from the outcrop towards the south. Generally, all units are laterally extensive and continuous across the Project area.

Quaternary-age alluvium has been mapped as occurring within the Project area and is associated with Wandoan, Woleebee and Ogle Creeks, as shown Figure 3.1. The alluvium is mapped as relatively thin across the Project lease, with increased lateral extent towards the north as Wandoan and Ogle Creeks flow into Woleebee Creek.

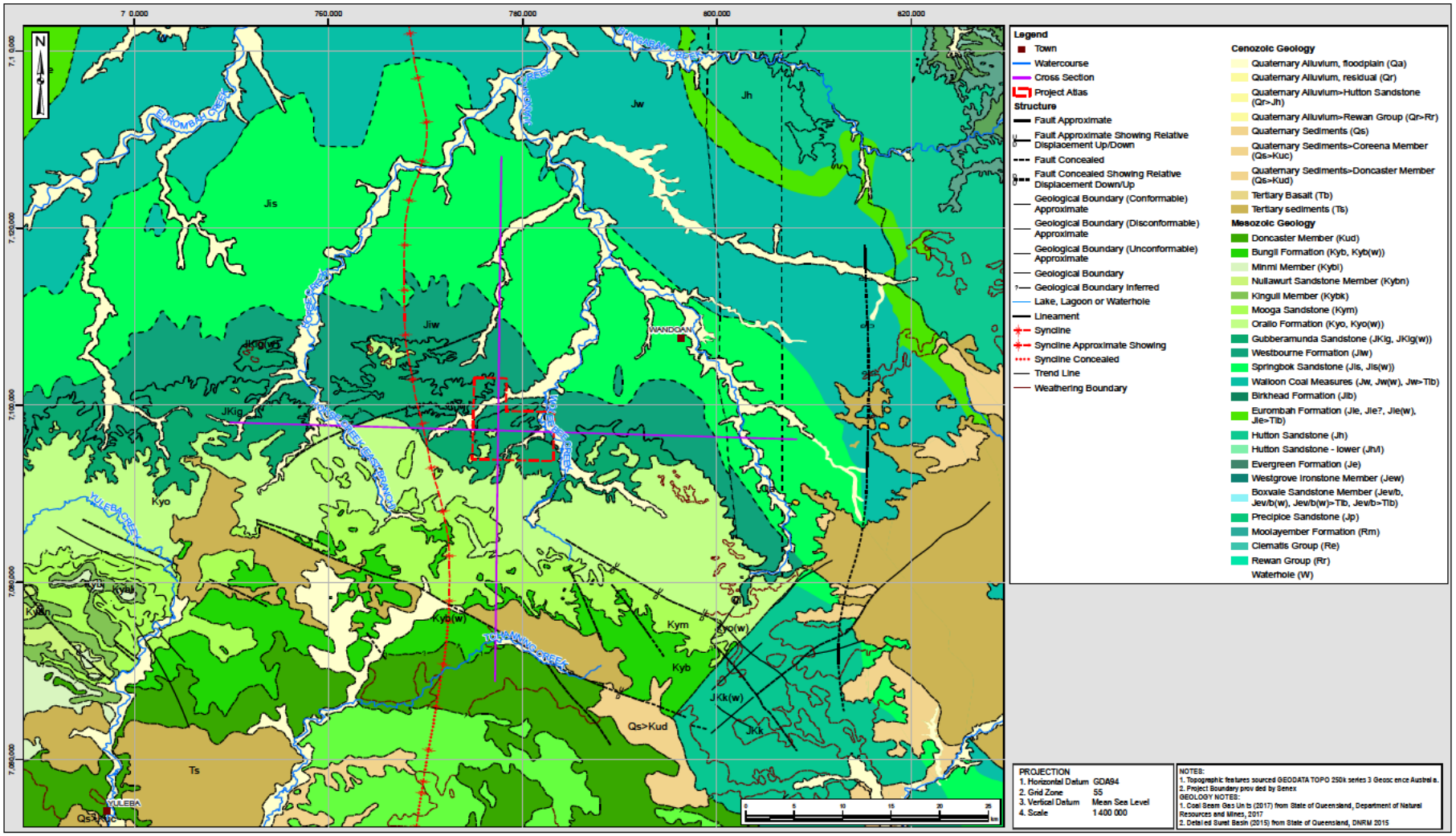

Figure 3.1: Regional Surface Geology Map

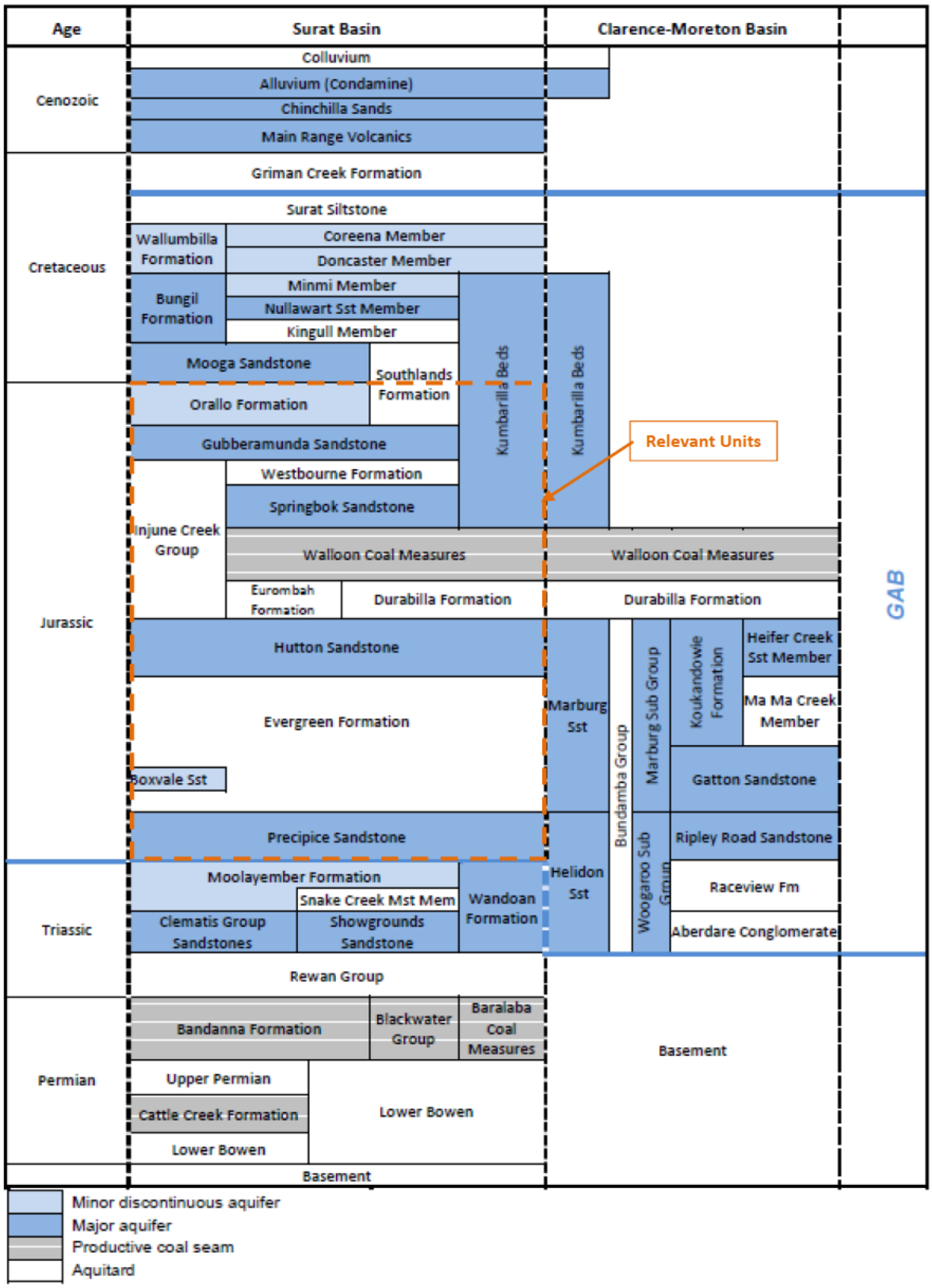

Figure 3.2: Regional Hydrostratigraphy (after OGIA 2016c) with Relevant Hydrostratigraphic Units Indicated

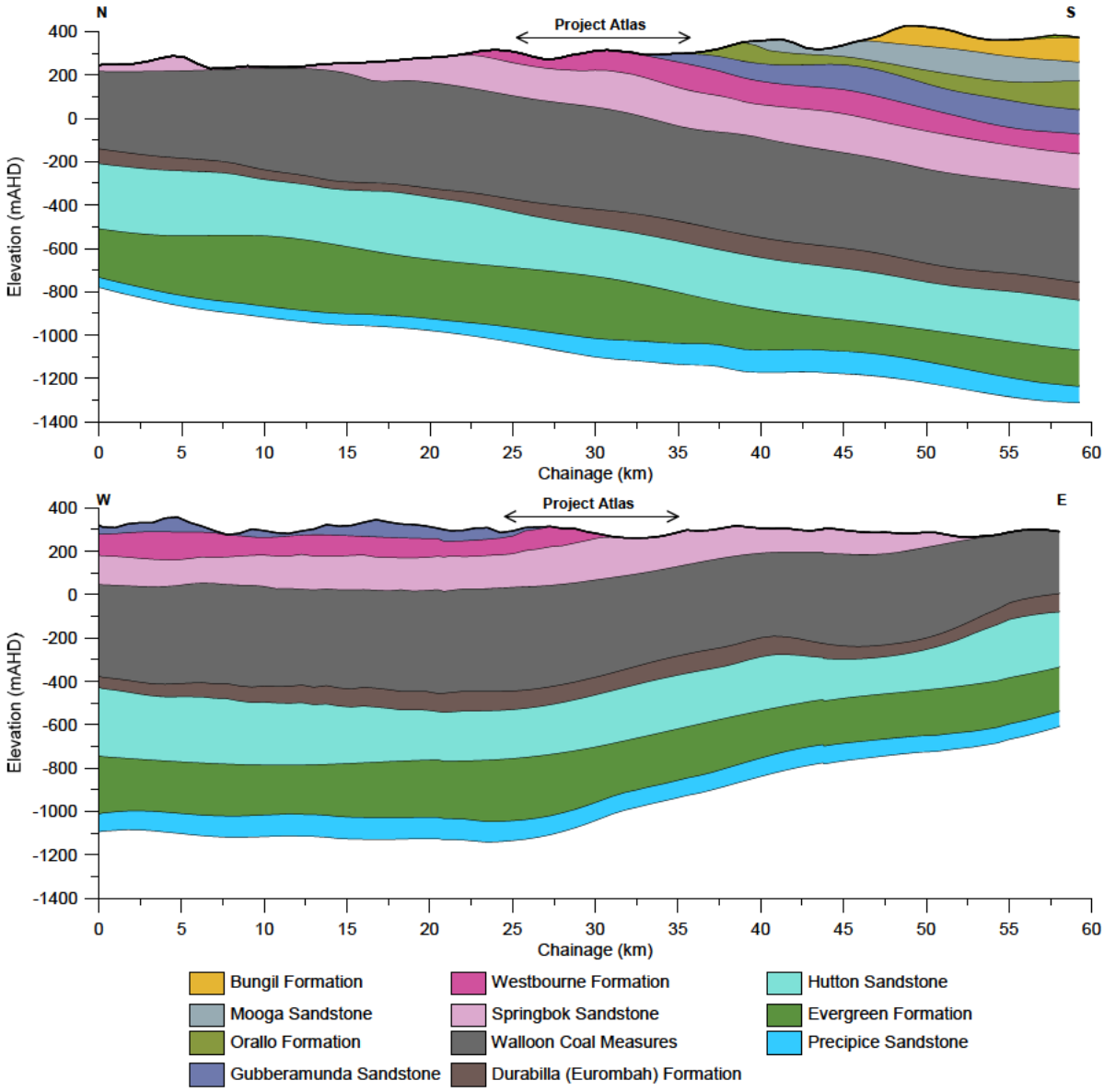

Figure 3.3: Geological Cross Sections (Surat CMA Geological Model (OGIA 2017a))

3.2. Groundwater Dependent Assets

3.2.1 Groundwater Bores

Within the vicinity of the Project (within PL1037 and a 25 km buffer beyond the lease), there are 496 registered groundwater bores recorded in the DNRME Groundwater Database (GWDB), as of May 2018 (DNRM 2017b). Of these registered bores, 412 are existing bores, including water supply or monitoring bores, with the remainder either abandoned or decommissioned. A summary of registered bores is presented in Table 3.1, with their type and status, as derived from GWDB.

Table 3.1: GWDB Registered Bore Statistics for Project Atlas and a 25 km Buffer (DNRM 2017a)

Type		Abandoned and Destroyed (AD)	Abandoned but Usable (AU)	Existing (EX)	Total
Artesian	Condition Unknown (AB)	-	-	1	1
	Ceased to Flow (AC)	1	-	5	6
	Controlled Flow (AF)	1	-	9	10
Sub-Artesian		81	1	397	479
Total		**83**	**1**	**412**	**496**

AB: artesian condition unknown; AF: bores that are under artesian pressure and capped to control free flow; AC: bores that have been artesian in the past but have now become sub-artesian due to a reduction in artesian pressure; SF: bores which do not flow under any condition and where active pumping is required to abstract water.

Under the *Water Act 2000*, petroleum tenure holders are required to undertake baseline assessment of water bores prior to commencing production. A baseline assessment program within the Project tenure was undertaken in July 2018. The assessment was undertaken to obtain information including:

- bore status, type and purpose;
- information related to the construction of the bore, including depth installed, screen interval and source aquifer;
- groundwater level and quality and field gas measurement; and
- bore equipment including pump depth, pumping frequency and flow rate.

Assessments were undertaken in accordance with the 'Baseline Assessment Guideline' (DES 2017a).

To date baseline assessments have been completed for eight bores out of the 13 bores identified within the Project Atlas Tenure. Of the remaining 5 bores, three were confirmed by the relevant landholder as not existing on the property and two bores have not been assessed due to land access constraints. The location of the bores is presented on Figure 3.4.

There are 318 registered third-party groundwater bores[2] that have been identified (within a 25 km radius of Project Atlas) as being used for water supply purposes (OGIA 2017d). The location of these bores is shown on Figure 3.5. OGIA estimate that 1,345 ML/year is abstracted from these bores (OGIA 2017d), with a large proportion of the abstracted water (684 ML) attributed to the Hutton and Precipice Sandstone from a limited number of bores used for town water supply. The remaining groundwater is utilised for stock and domestic (S&D) and agricultural purposes. Figure 3.6 presents the location of the bores and their estimated purpose.

[2] Screened across Alluvium or Surat Basin units (Bowen Basin units not included).

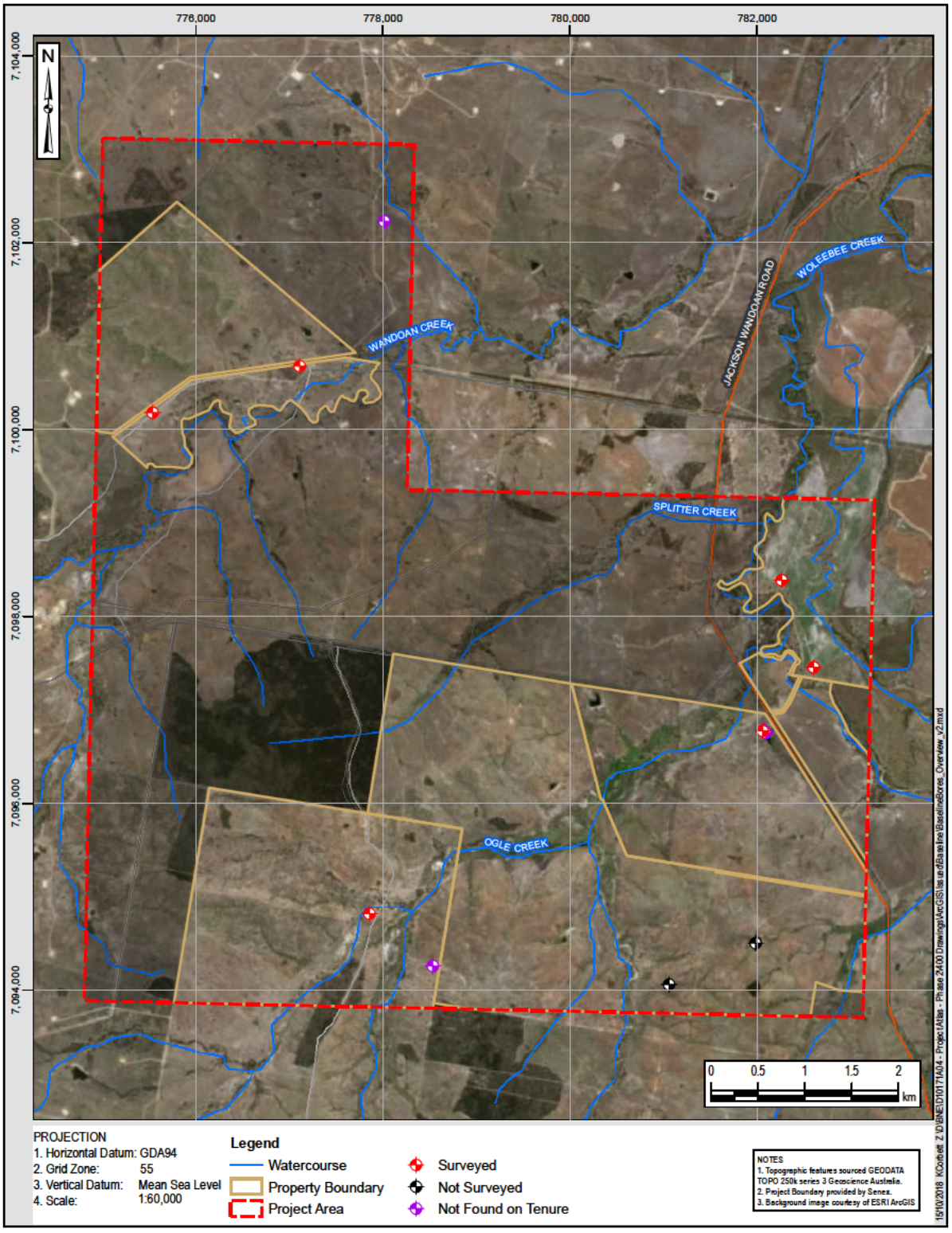

Figure 3.4: Location of Bores included in the Baseline Assessment

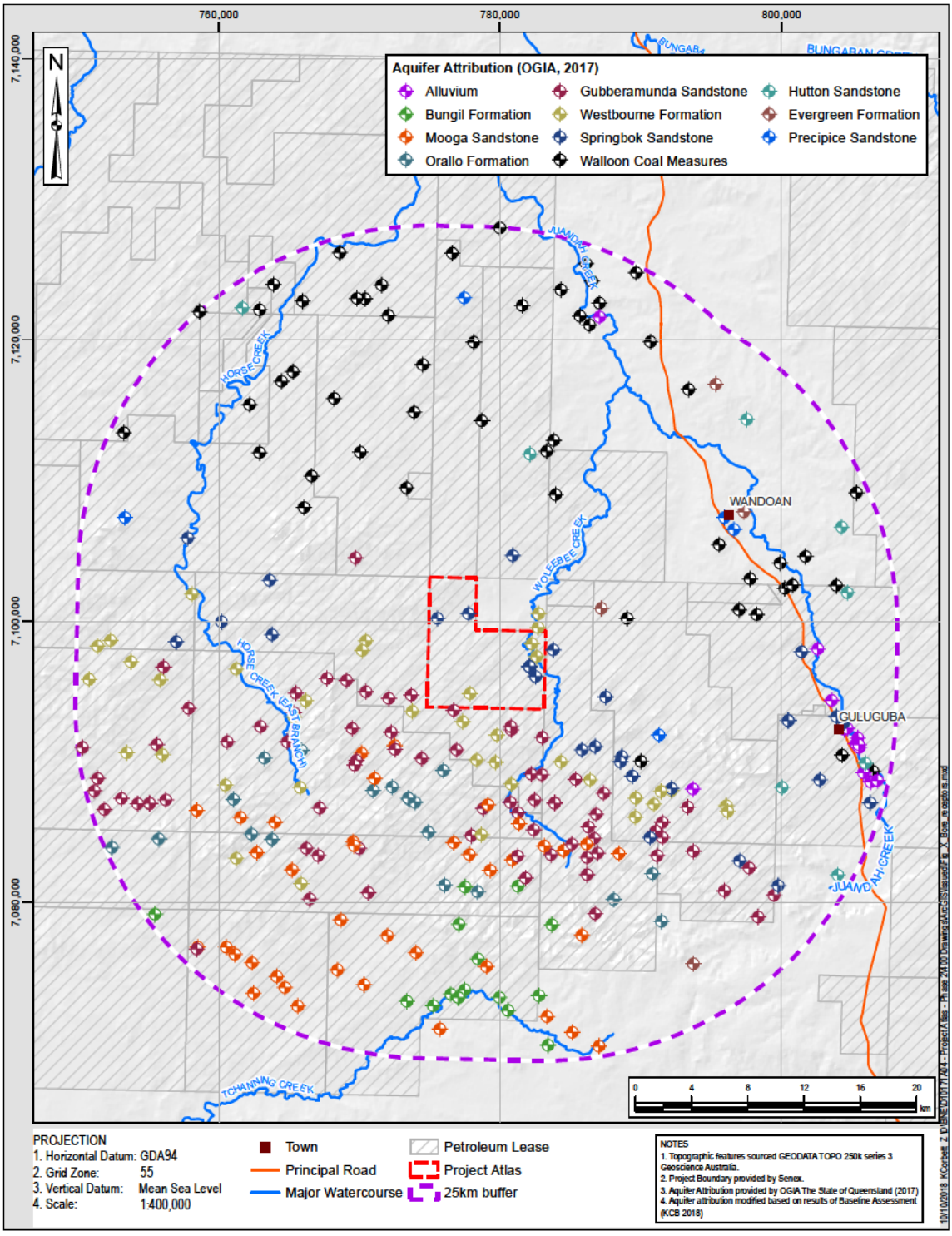

Figure 3.5: Location of Existing Registered Groundwater Bores within the vicinity of Project Atlas

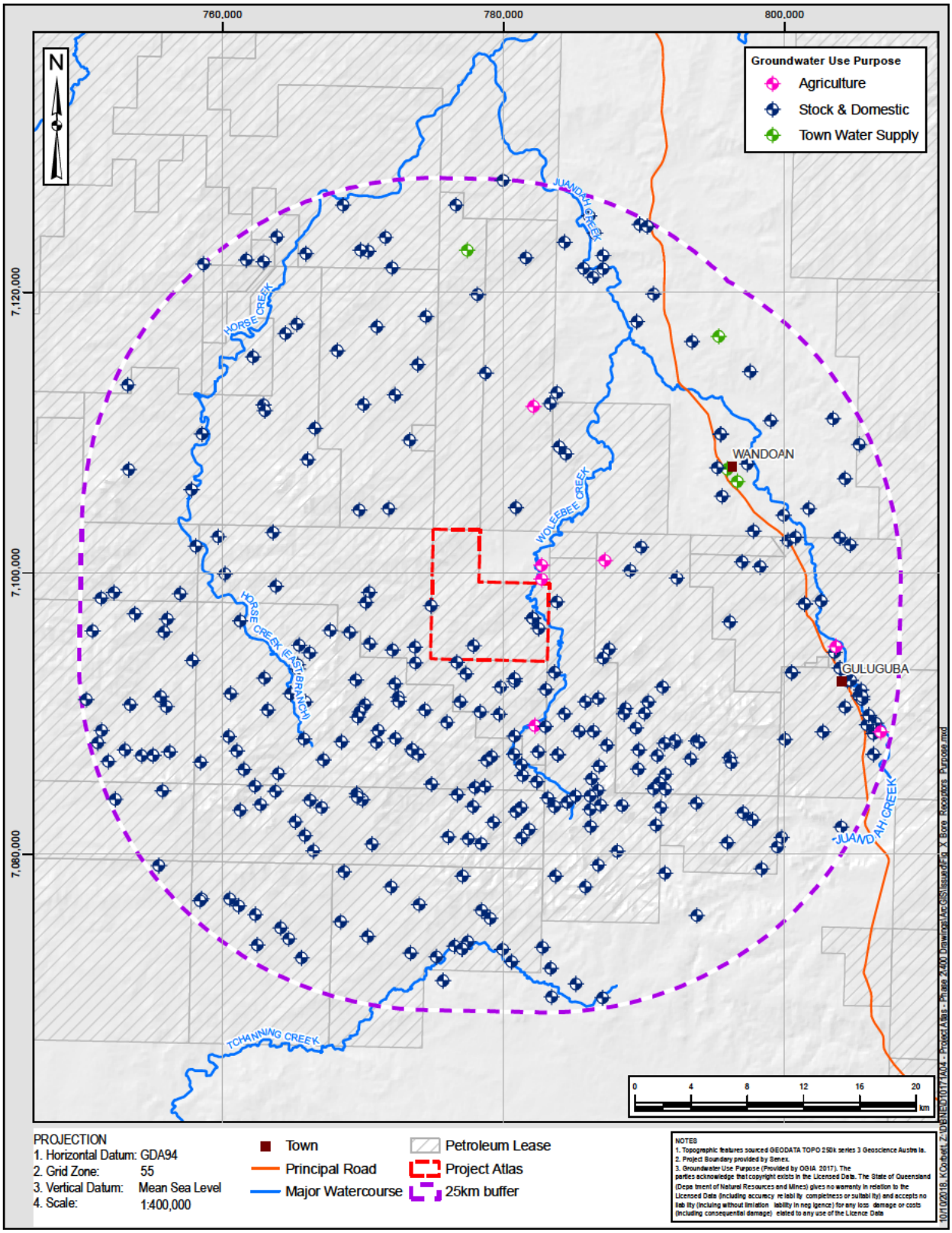

Figure 3.6: Location of Groundwater Users and Purpose of Use

3.2.2 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are defined by DoEE (2015) as:

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

Potential surface expression GDEs and subsurface GDEs are mapped by DES (2018b) as potentially being present in the vicinity of the Project (Figure 3.7). These generally correspond with the location of the mapped alluvium associated with Wandoan and Woleebee Creeks within the Project area and Horse Creek and Juandah Creek further afield.

Four GAB watercourse springs are located within the vicinity of the Project, as identified in the UWIR (OGIA 2016b). These are shown on Figure 3.7 and are considered to source groundwater from the Gubberamunda Sandstone (W76), and Mooga Sandstone / Orallo Formation (W77, W78, W79).

Woleebee Creek was identified by OGIA as being a potentially gaining stream (OGIA 2017b). Field verification was undertaken as part of this assessment (KCB 2018). The field verification identified that there is unlikely to be significant baseflow provided to this creek, however it is likely that during some periods, groundwater levels in the alluvium will rise up into the sandy base of the creek. The field verification also concluded that based on the difference between the alluvial groundwater and surface water major ion chemistry signatures, and groundwater chemistry signatures from the Surat Basin units, groundwater within the alluvium is not considered to be sourced by the underlying Surat Basin unit (Westbourne Formation) at the locations assessed.

A terrestrial GDE assessment was undertaken to verify the potential terrestrial GDEs mapped within the Project area (DES 2018b). The assessment indicated that the mapped GDEs along Wandoan and Woleebee Creek may be groundwater dependent, as they are mapped within the area of an alluvial system (associated with the creeks) and the ecosystem is associated with stream lines. These GDEs are also considered to source groundwater from the shallow alluvium, rather than the underlying Surat Basin units.

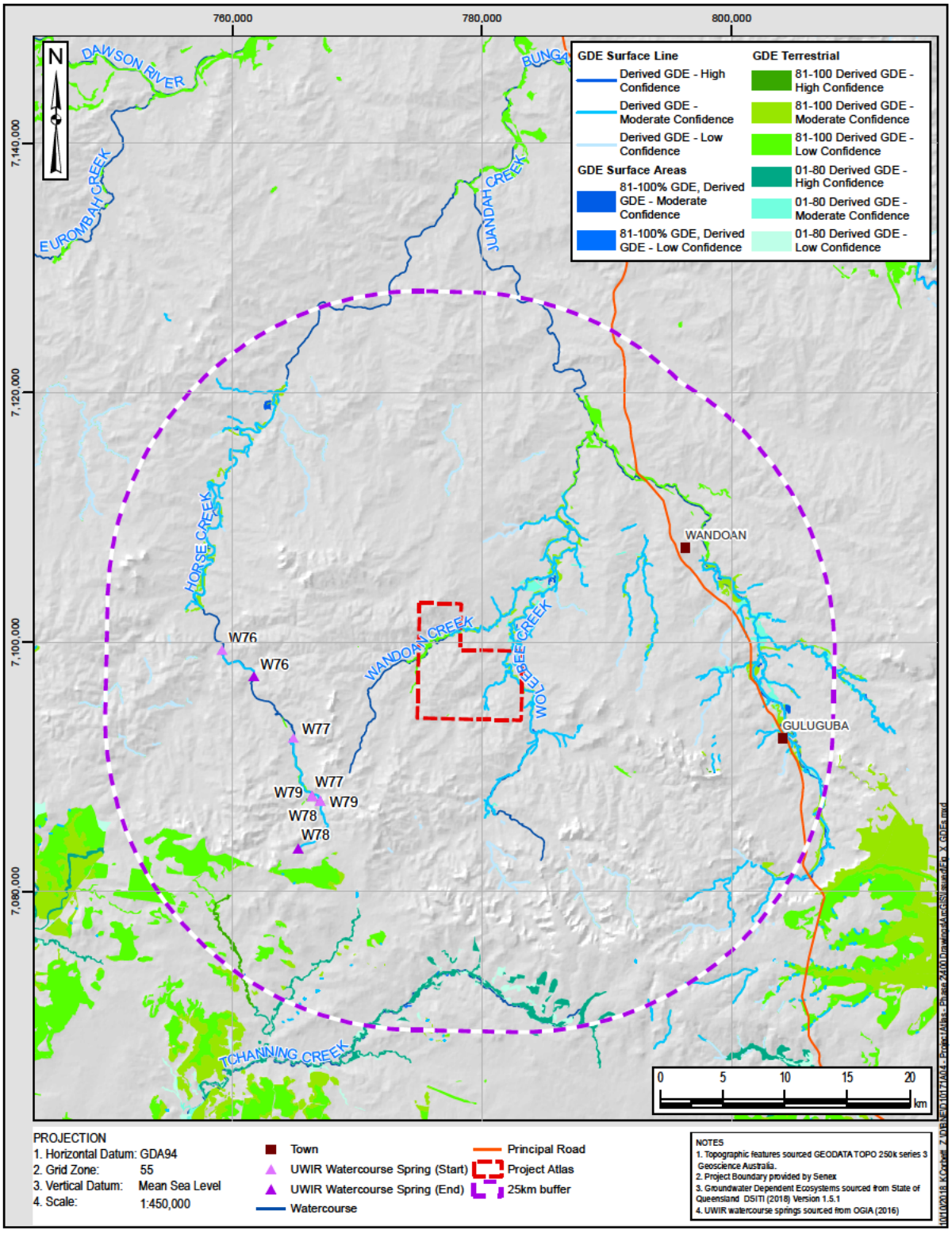

Figure 3.7: Location of UWIR Watercourse Springs and Mapped Potential GDEs (OGIA 2016; DES 2018b)

3.3. Predicted Impacts

As part of the Surat CMA UWIR (OGIA 2016), a regional numerical groundwater flow model was developed to predict groundwater pressure impacts resulting from activities from multiple petroleum and gas tenure holders. The model was first developed and utilised as part of the 2012 UWIR (QWC 2012). An updated UWIR and updated numerical groundwater model was published by OGIA in September, 2016 (OGIA 2016).

The primary purpose of the model is to predict regional water pressure or water level changes in aquifers within the Surat CMA footprint in response to extraction / production of water from the various producing coal seams. In particular, the OGIA numerical groundwater model is used to assess potential impacts to landholder groundwater bores and springs relative to the *Water Act 2000* trigger thresholds.

Senex was awarded the area for Project Atlas in late-2017, and a petroleum tenure was granted over the Project area in 2018. Therefore, CSG water production from the Project was not included as part of the UWIR (2016) cumulative impact scenario.

To assist Senex with approval applications, and to maintain consistency with the 2016 UWIR predictions, OGIA have simulated the proposed CSG production for the Project within the UWIR model based on information provided by Senex. These outputs have been provided for use and processed as part of this assessment.

The results of the modelling for the Project indicated that drawdown greater than 0.2 m (spring trigger threshold) is predicted in model layer 9 (Upper Springbok Sandstone) to model layer 19 (Upper Hutton Sandstone) in 2060, which corresponds with the end of CSG production.

Potential impacts to groundwater bores were assessed against the *Water Act 2000* bore trigger threshold of 5 m for a consolidated aquifer and 2 m for an unconsolidated aquifer using maximum drawdown outputs from the UWIR model.

3.3.1 Immediately Affected Bores

An ‘Immediately Affected Area’ is defined by *Water Act 2000* as an aquifer in the area within which water pressures are predicted to fall by more than the trigger threshold within three years. Bores within immediately affected areas are subject to make good arrangements under the *Water Act 2000*, as assigned by OGIA. There are currently no bores assigned to Senex within an immediately affected area.

3.3.2 Long-Term Affected Bores

The prediction of long-term impacts to landholder bores within the Surat CMA are the responsibility of OGIA and published within revisions of the UWIR. As with the immediately affected bores, OGIA provide tenure holders with their make good obligations under the *Water Act 2000*.

The modelling results indicate that there are 23 landholder bores within the vicinity of the Project which are predicted to experience a water level decline greater than the *Water Act 2000* trigger threshold. This decline is as a result of cumulative production from the Project and other proposed and existing CSG developments in the area.

3.3.3 GDE Impacts

The terrestrial GDE assessment indicated that the mapped GDEs along Wandoan and Woleebee Creek within the PL may be groundwater dependent, as they are mapped within the area of an alluvial system (associated with the creeks) and the ecosystem is associated with stream lines.

The OGIA numerical model does not simulate the alluvium in this location, however results did not predict any drawdown in the units underlying the alluvium. An analytical model was used and also predicted negligible drawdown in the alluvium in these areas, and therefore it is considered unlikely that there will be any potential impacts to the terrestrial GDEs as a result of the Project.

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4. MONITORING, MITIGATION AND MANAGEMENT

4.1. Groundwater Monitoring

Groundwater monitoring as part of the Project has been considered in relation to key legislation, policies, guidelines and standards. These are outlined in Table 4.1.

Table 4.1: Key legislation, policies and standards applicable to groundwater monitoring

Type	Name
Legislation	*Water Act 2000* (State of Queensland 2018b) *Environment Protection Act 1994* (State of Queensland 2018a) *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017a) *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2016)
Guidelines and Policies	Baseline Assessments: Guideline (DES 2017a) Queensland Water Quality Guidelines 2009 (DEHP 2013) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000) Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES 2018a)
Standards	Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012) Minimum standards for the construction and reconditioning of water bores that intersect the sediments of artesian basins in Queensland (DNRM 2014)
Reports	Underground Water Impact Report for the Surat Cumulative Management Area (OGIA 2016b) Groundwater Sampling and Analysis – A Field Guide (Sundaram et al. 2009)

4.1.1 Regional Groundwater Monitoring

Groundwater monitoring forms a key mechanism for early identification of the response to CSG water production, within the WCM and other formations where groundwater receptors exist.

The groundwater monitoring requirements for CSG tenure holders within the Surat CMA are provided as part of the UWIR WMS (OGIA 2016b), which establishes baseline trends, identifies any changes within or near CSG development areas or locations of interest, and provides information to inform future improvement of groundwater modelling.

Due to the relatively small scale of the Project, and location in relation to existing tenure holders, and monitoring infrastructure (required by the UWIR WMS), Senex are not currently required by OGIA to install any groundwater monitoring facilities within the Project tenure. The location of existing monitoring bores, installed as part of the UWIR WMS and other programs is shown in Figure 4.1. Senex will comply with any updates to the WMS that may be required in any future updates of the UWIR.

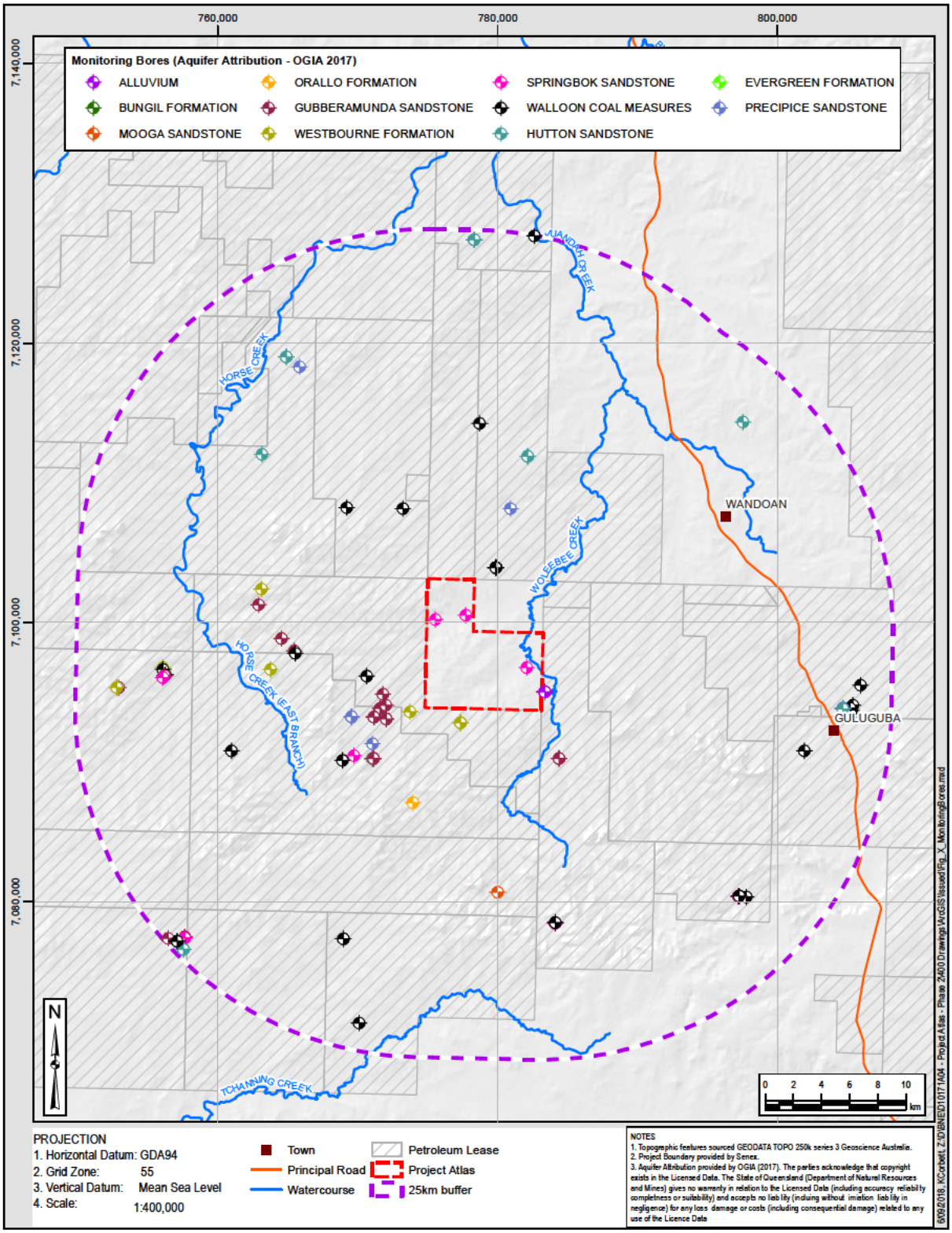

Figure 4.1: Location of Existing Monitoring Bores within the vicinity of Project Atlas

There are currently three private landholder bores which monitor the Springbok Sandstone within the Project tenure. These include:

- Two landholder bores, which are installed with telemetered monitoring equipment. Senex currently does not have access to these bores but will explore the opportunity to make arrangements with relevant landholders to access and assess this monitoring data.
- One landholder bore, which is currently monitored by the landholder as part of the CSG Net program. Historic baseline data is available for this bore, and Senex is exploring the option of accessing groundwater monitoring data at this location.

Senex is also reviewing existing third-party bores within the vicinity of the Project, in conjunction with information from the baseline assessment and Queensland Globe to identify other potential bores to be monitored. This includes the DNRME monitoring bore to the east of the Project, screened across the alluvium.

Updates to groundwater monitoring commitments in this CWMMP will be undertaken once access and agreements are in place to collect monitoring data. This is beyond the requirements of the OGIA, through the UWIR. Additionally, Senex is engaging with OGIA to include Project Atlas in the Surat CMA regional monitoring program.

4.1.2 Shallow Groundwater Monitoring

Groundwater monitoring related to water management infrastructure and beneficial use activities is outlined in the CSG Water Management Plan (SENEX-ATLS-EN-PLN-006). These activities have the potential to impact the shallow aquifer systems.

For the shallow aquifers, Senex will monitor to detect potential seepage from dams, which may include shallow groundwater monitoring bores or utilising existing bores. The bores would be drilled and installed in accordance with the Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012) and would be used to record groundwater level and quality.

4.2. Data Management and Analysis

4.2.1 Data Management

Collected groundwater monitoring data will be collated and stored in a database. The database may include but not be limited to the following information:

- Monitoring facility location details, aquifer and construction information;
- Landowner bore monitoring information from baseline assessments and the landowner bore monitoring program;
- Groundwater elevation monitoring data, as metres below ground level (mbGL) and metres above the datum (mAHD);
- Groundwater quality sampling results, including field measurements and laboratory analysis;
- Stratigraphic information (e.g. unit being monitored);
- Relevant CSG water production data (e.g. volumes / quality); and
- Climate data, including barometric pressure and rainfall.

4.2.2 Analysis of Monitoring Data

Senex have developed a procedure for review and analysis of groundwater monitoring data. This procedure will be revised once the access and agreements are in place to collect monitoring data, as detailed in Section 4.1.1. A summary of the monitoring data analysis, to understand and review potential impacts as the project progresses, is provided in the following:

- **Collect and review data**

  Monitoring data will be collected / downloaded and reviewed by a qualified hydrogeologist. Data will be reviewed through a visual assessment of the groundwater elevation hydrographs and any data quality issues will be identified.

- **Identify background or external influences / trends**

  Groundwater elevations can be influenced by several factors, which can cause fluctuations and trends in groundwater elevations, both on a short-term (daily) or long-term (years or decades) scale. These can include:

  - Changes in barometric pressure;
  - Recharge following large precipitation events (short term);
  - Longer term climatic response, such as wet / dry seasons as well as periods of drought or consecutive years of above average rainfall which overprint on season to season conditions;
  - Response to groundwater pumping; and
  - Response to aquifer repressurisation.

  These potential influences will be considered in conjunction with CSG water production volumes and CSG production well commissioning, when reviewing groundwater monitoring data to determine trends associated with CSG production.

- **Review the groundwater elevations against UWIR model predictions**

  A review of modelled drawdown versus actual drawdown at monitoring sites will be undertaken by a qualified Hydrogeologist and based on a review of the results the following triggers will be assessed; and if triggered further investigation will be undertaken.

  - Where the monitored groundwater level drawdown at the monitoring site exceeds the UWIR modelled drawdown.
  - Where the rate of drawdown at the monitoring site is greater than the rate of the modelled drawdown.
  - Where there is change in the rate of drawdown from the previous year.

  Modelled drawdown used for comparison will be updated as new predictions become available from OGIA.

- **Initiate investigation and reporting**

  If the groundwater monitoring data indicates that the there is significant deviation from the UWIR model predictions, Senex will discuss the deviation with OGIA, and investigate further if required.

  The aim of the investigation will be to determine the cause of the deviation and assess both the significance and consequence in relation to water-dependent assets. This may include the following:

- Hydrogeological characterisation of the area, including identification of information and knowledge gaps;
- Identification of the potential impacts; and
- Risk assessment.

The investigation outcome will determine the appropriate course of action, which may include:

- Continue with monitoring at the current frequency;
- Continue with monitoring at an increased frequency;
- Modification of operations;
- Stakeholder consultation; and
- Make good arrangements.

4.2.3 Make Good Arrangements

The *Water Act 2000* outlines requirements for make good obligations of a resource tenure holder for a bore located in immediately affected areas. Tenure holders must carry out a bore assessment and enter into a make good agreement with the bore owner if the bores are located within an immediately affected area. The UWIR assigns bores to tenure holders located within immediately affected areas.

Senex do not currently have any make good obligations. Senex will comply with any updates to the make good agreements required in future updates of the UWIR and undertake bore assessments as required.

Senex will also respond to any complaints made from landowners in relation to potential unanticipated impacts. This will be undertaken through a bore assessment to establish whether a water bore has an impaired capacity, or is likely to have an impaired capacity, as a result of Project Atlas. The bore assessments will be undertaken in accordance with the DES *'Bore Assessments Guideline'* (DES 2017b) as presented in Figure 4.2.

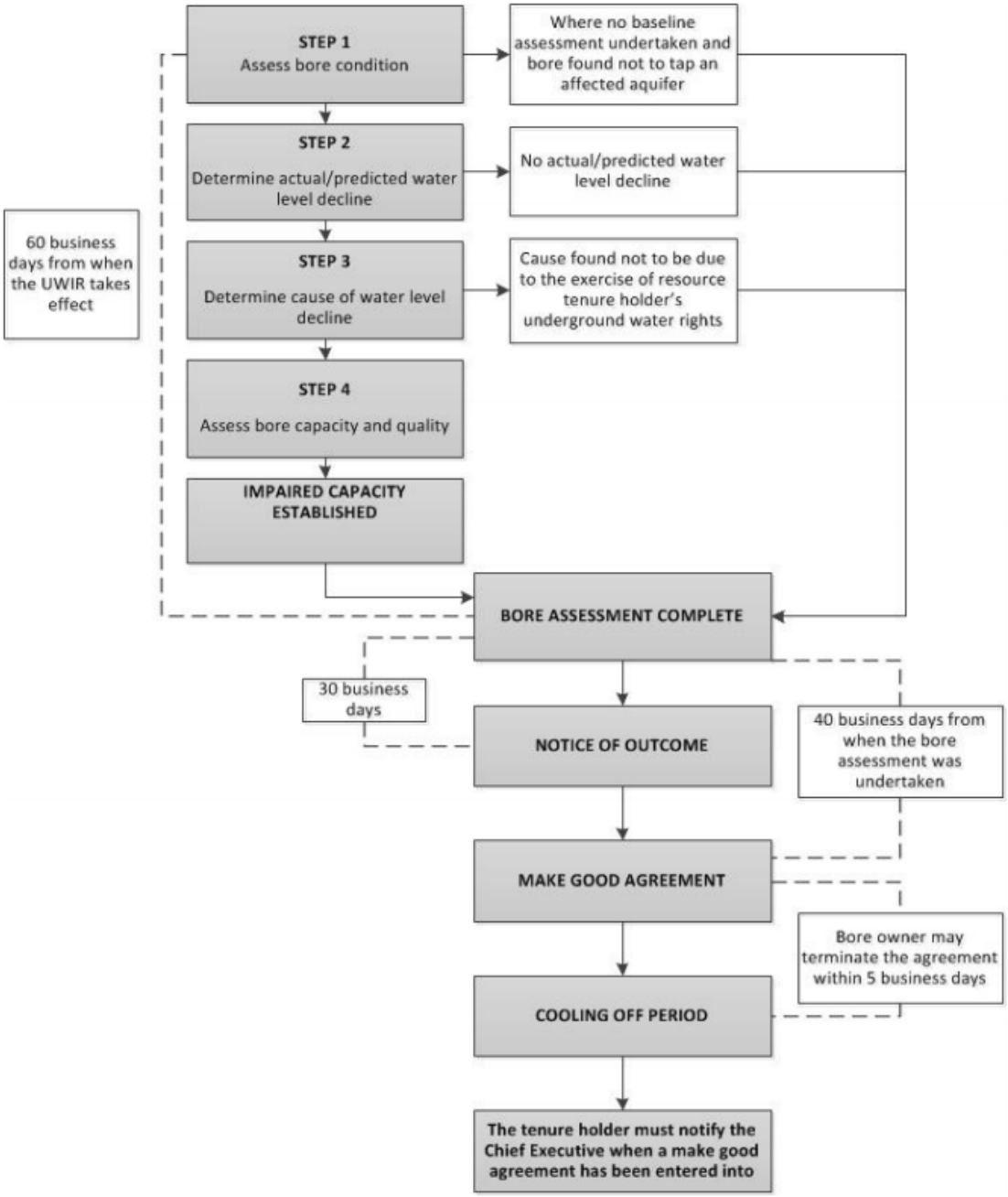

Figure 4.2: Process for Undertaking a Bore Assessment for Water Level Decline (after DES 2017b)

4.3. Petroleum Hydrocarbon Monitoring

A hydrocarbon monitoring program will be developed and implemented to identify and measure total petroleum hydrocarbons in pre-treated produced water. The monitoring program will begin from the commencement of the production well drilling program and include:

- monthly monitoring of pre-treated produced water
- details (including GPS coordinates) of the monitoring locations for collecting representative samples
- details of the methods used to identify and analyse total petroleum hydrocarbons
- determining water quality criteria (trigger levels) for total petroleum hydrocarbons for authorised uses using treated produced water, and the justification for the water quality criteria. This will include a risk assessment undertaken with regards the proposed beneficial use.
- measures for addressing exceedances to ensure that beneficial re-use of aggregated produced water is fit for purpose.

Data collected during the monitoring program will be analysed and summarised in annual compliance reporting.

4.4. Future Research and Reporting

4.4.1 Future Research

To develop further understanding of the hydrogeological conditions within the tenure, Senex will remain involved in any further assessment of the available geological and hydrogeological information, which may be updated as more information becomes available through drilling of CSG production wells and groundwater monitoring data becomes available.

Senex will provide the findings of any future relevant research to OGIA for incorporation into future revisions of the Surat CMA UWIR.

4.4.2 Reporting

This CWMMP will be reviewed and updated:

- within the first three-years of operation
- when new relevant information becomes available

Revisions of the plan will be published on the Senex website.

Senex will report to the government in accordance with:

- Relevant conditions and approvals issued by DES; and
- UWIR requirements. This will include reviewing the plan, and updating if required, within six months of the publication of each UWIR.

Additionally, Senex may undertake groundwater assessments, and other hydrogeological studies to enhance knowledge, and make them available as required.

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———. 2018b. *Water Act 2000*. https://www.legislation.qld.gov.au/view/html/inforce/current/act-2000-034.
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s22

From: s22
Sent: Friday, 11 January 2019 7:52 AM
To: s47F
Cc: s47F
Subject: RE: checking- which QGC project has already triggered the bore with >5 m drawdown? [SEC=UNCLASSIFIED]

Thank you

From: s47F
Sent: Thursday, 10 January 2019 2:18 PM
To: s22
Cc: s47F
Subject: RE: checking- which QGC project has already triggered the bore with >5 m drawdown? [SEC=UNCLASSIFIED]

Hi s22
The bore that has been triggered is on PL277. The EIS for EPBC approval (EPBC 2008/4398) referred to it as PL(A) 277.
Regards,
s47F

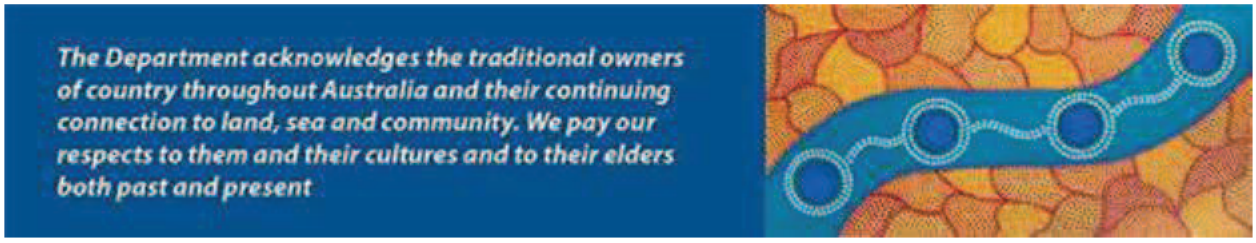
From: s22
Sent: Thursday, 10 January 2019 9:29 AM
To: s47F
Cc: s47F
Subject: checking- which QGC project has already triggered the bore with >5 m drawdown? [SEC=UNCLASSIFIED]

Hi s47F

For my report I need the EPBC number of the QGC project that has already triggered the bore in the lower Springbok sandstone. Looking at the map it seems to be the QGC development to the south- EPBC 2008/4398. Is that correct?

Cheers
s22

s22
Assessment Officer
Queensland North Assessments | Environment Standards Division
Department of the Environment and Energy
51 Allara Street Canberra ACT 2600 | GPO Box 787, CANBERRA ACT 2601
Phone: (s22 | Email: s22 | Web: www.environment.gov.au



Queensland Erosion and Sediment Control Procedure

Document Number:

SENEX-QLDS-EN-PRC-003

Revision: 0

Position	Name	(tick one column only)		Signature	Date
		Approve	Review		
Environment Manager	s47F	☒	☐	s47F	27/ 8 / 18

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REVISION HISTORY

Revision	Revision Date	Document Status	Revision Comments	Author	Approved By
0	27/08/2018	Issued for Use	Created, Superceded WSGP version	s47F	

1. PURPOSE

The purpose of the Erosion and Sediment Control (ESC) procedure is to ensure Senex meets its regulatory obligations relating to managing disturbed land that has potential to release soil directly or indirectly to land or water on or adjacent to Senex work sites.

It provides guidance to implement erosion and sediment controls during civil earthworks for activities in Queensland, where there is significantly disturbed land[1].

The objective of the procedure is to set out methods to manage soil erosion and control sediment generated close to the source, thereby minimising the potential for onsite activities adversely impacting the surrounding environment.

The procedure must be implemented for all work sites greater than 2500m^2, including well pads, tracks and networks of linear pipeline right of ways.

Where the procedure cannot be followed, that is, where the generic well pad plan or steps in section 4 cannot be applied (Appendix A); a site specific erosion and sediment plan (ESCP) is required to be prepared by a suitably qualified person, and implemented.

Contractors undertaking work activities onsite requiring significant disturbance to land[1] must comply with this procedure.

2. LEGISLATION REQUIREMENTS AND GUIDELINES

Relevant legislation, guidelines and industry standards that apply to erosion and sediment control on Senex controlled construction and operational work sites are:

- *Environmental Protection Act 1994*
- Environmental Protection Regulation 2008
- Environmental Protection (Water) Policy 1997
- *Water Act 2000.*

Key regulatory requirements that apply to a work site that must be implemented include the relevant:

- Environmental authority, which includes specific conditions to be addressed
- Environmental Management Plan, for example Western Surat Gas Project Environmental Management Plan (EMP).

Relevant guidelines and industry standards include:

- Erosion and Sediment Control - A Field Guide for Construction Site Managers, Feb 2010;
- International Erosion Control Association, Best Practice Erosion and Sediment Control, Nov 2008.

[1] Environmental Protection Regulation 2008, Schedule 12 Section 4 meaning of significantly disturbed land

3. ROLES AND RESPONSIBILITIES

Senex is responsible for the ongoing management of activities on its tenure. Senex requires its employees and contractors to undertake work in accordance with regulatory requirements, EA conditions, and Senex procedures and policies including this procedure. Roles and responsibilities of Senex personnel and contractors relevant to this procedure are summarised in Table 3.1.

Table 3.1 Roles and Responsibilities

Role	Responsibilities
Senex Environmental Manager	• Report incidents to the relevant administering authority (i.e. Department of Environment and Science(DES)) and other Government agencies / stakeholders as required. • Ensures each project has an appropriate erosion and sediment control plan (ESCP) or documentation to meet regulatory requirements. • Implements an environmental compliance system to help ensure compliance, including inspections with EA conditions, other regulatory requirements and site specific ESCPs. • Ensures environmental management documentation including this procedure are updated, in accordance with regulatory environmental obligations.
Senex Project Manager	• Ensures this procedure, and where required, a site-specific erosion and sediment control plan (ESCP), to address regulatory obligations, is developed and implemented for each stage of construction through commissioning and hand over for the operations phase. • Ensures adequate resources are allocated to implement the ESCP, including ongoing maintenance.
Senex Site Supervisors (Drilling, Completions, Civil Construction etc)	• Responsible for ensuring this procedure and/or site specific plans are implemented on site, including any site specific maintenance requirements. • Ensure that Senex staff and contractors comply with regulatory requirements including all relevant EA conditions, ESCPs and requirements of the Access to Work (ATW). • Induct the Contractor Site Supervisor regarding relevant requirements of the EA, ESCP, and supporting plans and procedures applicable to their activities on site. • Report to the Senex Environment Manager on environmental matters and provide all relevant reporting and monitoring documentation as required. • Ensure that Contractors and their employees are adequately supervised. • Empower all project staff to stop work when the potential for environmental harm is perceived.
Contractor Site Supervisor	• Ensure that appropriate training and inductions have been carried out for all project staff. • Implement the site ESCP. • Determine the need for and ensure that erosion controls are properly installed, as necessary to prevent sediment flow into watercourse and other sensitive areas.

Role	Responsibilities
	• Monitor and maintain erosion and sediment controls for the duration of the contract. • Ensure that all personnel are competent to perform their assigned duties and are appropriately supervised. • Ensure resources are available to manage the obligations and responsibilities of this ESCP. • Ensure construction activities comply with the requirements of approval, legislative obligations and this ESCP by overseeing its implementation. • Adequately identify and address any risks associated with the Contractor's activities prior to commencement and develop a construction methodology which has due regard for identified erosion and sedimentation risks. • Implement this ESCP on site, including any site-specific requirements identified in planning, the ATW or as directed by the Senex Site Supervisor. • Immediately notify the Senex Site Supervisor of any incidents and non-compliances with the EA, this procedure, or the erosion and sediment control plan plans or procedures. • Ensure that records are maintained of all monitoring activities, including weekly inspection and post-rain inspection records. • Empower all project staff to stop work when the potential for environmental harm is perceived.
Contractor Personnel	• Implement procedure or ESCP on site. • Carry out all activities in accordance with the requirements set out in this procedure and other relevant documents as specified in the contract. • Immediately notify the Contractor Site Supervisor of any incidents and non-compliances with the EA, this procedure, or ESCP.

4. ESC PLANNING AND CONTROLS

The primary management measure for erosion and sediment is the control of initial ground disturbance, and timely stabilisation following land disturbance. Where disturbance is unavoidable, erosion and sediment control measures will be implemented.

Before commencing clearing, topsoil stripping and earthworks in each area/section, the limits of the site must be cleared marked out and any 'no-go' zones identified. Erosion and sediment control requirements should be planned for each specific area and installed ahead of works where practicable. Controls should be adjusted progressively as works continue and the requirement for any additional controls should be assessed.

4.1. Key Steps to Be Followed

Table 4-1 provides the steps and guidelines for the planning, design, site preparation, construction and maintenance requirements for ESC during works. (Refer to Appendix A for standard methods.)

Table 4.1 Erosion and Sediment Control Steps

Steps	
	Site Preparation – Erosion Control
1	**Minimise disturbance.** Where practicable establish a single stabilised entry/exit point that is not going to contribute erosion and sedimentation to the environment.
2	**Clearly identify and avoid 'no-go' zones**. Remove vegetation and disturb soil only in those areas approved for construction work to occur.
3	**Install whoa boys on tracks and right of ways**. To manage water flow velocity on access tracks and gathering right of ways (RoW) whoa boys should be installed as per Appendix A (Figure 2 and Figure 3). Whoa boys are to be placed at an interval of 1.5 - 2m of vertical fall on all areas of tracks and RoWs. Whoa boys are not to be placed in areas with cross fall greater than 3%.
4	**Install clean water diversions banks above the work site.** Divert up-slope clean water around the work site and appropriately stabilise any drainage channels if the area disturbed has a slope greater than 3:1(H:V) or if the drainage area is greater than 1500m^2. (Appendix A) Clean water diversion banks can be stripped topsoil, mulched vegetation or subsoil.
Construction phase - Sediment Control	
5	**Retain sediment on site.** To manage sheet flow install sediment fence(s), coir logs or mulch berms along the low side of each work area when slopes are greater than 3% and exposed area is greater than 200m^2 at any one time (Appendix A). Use rock check dams in wide channel drains to intercept concentrated flows. Sediment fences and coir logs are not to be used in channels or to intercept concentrated flows (Appendix A).
6	**Protect watercourses from potential sediment run-off.**
7	**Maintain all control measures in good working order and check following rainfall events** (>50 mm in one day or >100 mm over 4 days. Prior to any shift breaks, where contractors will leave site for a period of time, any soils to be left disturbed and exposed must have adequate controls in place.
8	**Retain topsoil for respreading on the site at reinstatement.** For topsoil stripping, the upper 100 to 200 mm of topsoil (approx., depending on soil type), which contains the bulk of the natural seed bank and organic matter is to be stripped and stockpiled. Topsoil and subsoil must be stockpiled separately.

Steps	
9	**Stockpile topsoil in a designated area within the disturbance area**. Do not double-handle the material. Install clean-water diversion upslope of stockpiles and a sediment fence or coir log on the low side. Stockpiles should be no higher than two metres.
10	**Stabilise exposed earth banks with an appropriate cover to prevent erosion.** For example, grass, erosion control blankets, hydromulch or soil binders, where deemed high risk. Soil binder can be applied to exposed soils to assist in preventing erosion. Examples of soil binder include Vital Bon-Matt P47 VR 1 and Vital Bon-Matt Stonewall. It is recommended to reapply every 3 months. Use product as per product label. Soil binder is recommended for lesser eroded soils.
Reinstatement - Reducing erosion and maintaining sediment controls	
11	**Reinstate and stabilise site.** Reinstate topsoil and revegetate or otherwise stabilise the site progressively, rather than waiting until after completion of all works. Gathering RoW must have subsoil reinstated, topsoil respread, contours reinstated, and be seeded, as per landowner approved species mix (determined through the Senex Land Access Manager) and Queensland Re-instatement and Rehabilitation procedure (SENEX-QLDS-EN-PRC-002). Erosion and sediment controls are to be retained on site until the site has achieved 70% stabilisation, and sediment loss from site has been prevented. Following drilling and completion, well pads are to be reduced to approximately 0.36 ha for the operational area, and the remainder of the pad area is to be reinstated. Stockpiled topsoil is to be respread in the area being reinstated.
12	**Ameliorate soil.** Soil should be treated where required to reduce erosion and improve site stability, as a result of organic content, acidity, alkalinity, sodicity or salinity. To determine the need for ameliorants, soil testing should be undertaken to determine amelioration requirements. Refer to Appendix B to identify dispersive soils and Appendix C for generic amelioration of dispersive soils.
13	**Address corrective actions relating to erosion issues, and site stability once they have been identified.** • Soil testing may be required to check soil sodicity or other soil quality aspects (salinity, fertility). Where sodic soils are identified, soil amelioration will be required (Appendix B) to remedy erosion. • Repair whoa boys, diversion banks, and clean water diversion banks. • Remove silt and sediment from sediment fences, and upslope of rock checks when they get to 30% full. • Reapply soil binder.

5. WELL PAD CONSTRUCTION

Where practicable minimise disturbance of areas to be used for drilling by minimal disturbance methods such as slashing and grading, rather than full civil earthworks.

Where topography requires cut and fill earthworks to develop a pad, a drainage release point must be established at the downslope cut/fill line. All dirty water runoff from the pad should be drained to this point and passed through a rock/coir log or earthen bund that acts as sediment trap (Figures 7 and 11 in Appendix A).

6. ONGOING MAINTENANCE AND MONITORING

Until it is determined and agreed with the Senex Site Supervisor, monitoring and ongoing maintenance will be required of all disturbed work areas by the contractor. Regular inspections should be undertaken of erosion and sediment control structures to ascertain capacity, structural integrity and effectiveness.

Controls should be cleaned once they reach 30% full and replaced as required. All areas of disturbance should be checked after significant rain fall (>50 mm in one day or >100 mm over 4 days).

7. INCIDENT RESPONSE AND COMPLAINTS

All environmental incidents or events will be reported in accordance with the process in the WSGP Incident Reporting and Investigation Procedure (SENEX-CORP-HS-PRC-004). In the event of an incident the following steps should be followed:

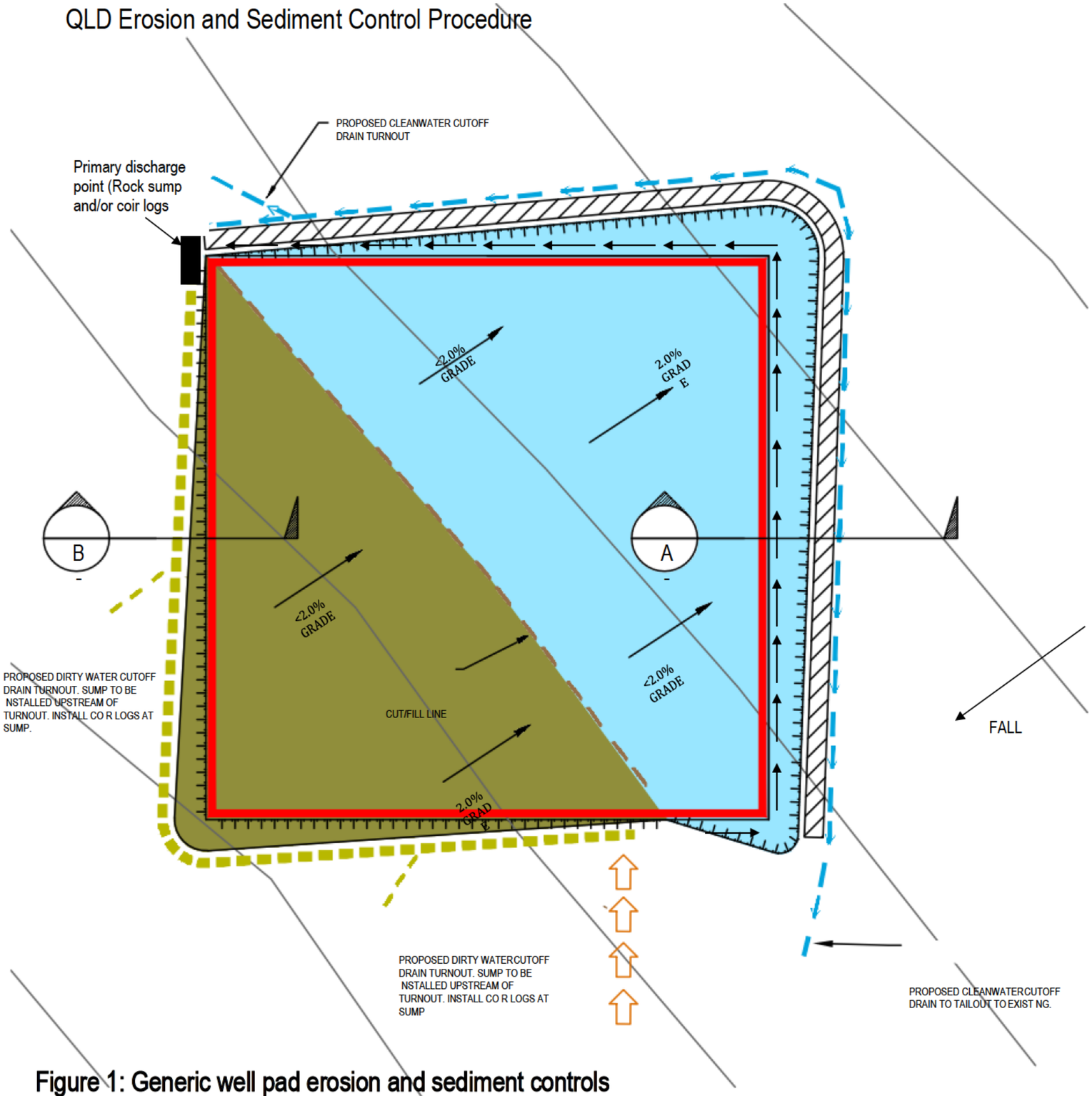
1. All Senex and contractor personnel at Senex worksites are required to notify their supervisor as soon as practical of any incident or near miss.
2. The Contractor site supervisor must then immediately notify their Senex Company Representative or Project Manager; by phone if necessary of the incident.
3. In addition to the initial verbal notification all incidents must be notified in writing using the Senex Incident Notification Form (SENEX-CORP-HS-FRM-007).
4. The notification shall be completed by the field HSE advisor, site supervisor or Senex appointed activity supervisor associated with the incident and distributed via email to the Incident Notification Group – incidentnotificationgroup@senexenergy.com.au
5. This is to take place as soon as practicable following the occurrence and within the maximum timeframes set out in Table 1 of the Environmental Incident Management Procedure (SENEX-CORP-HS-PRC-004).

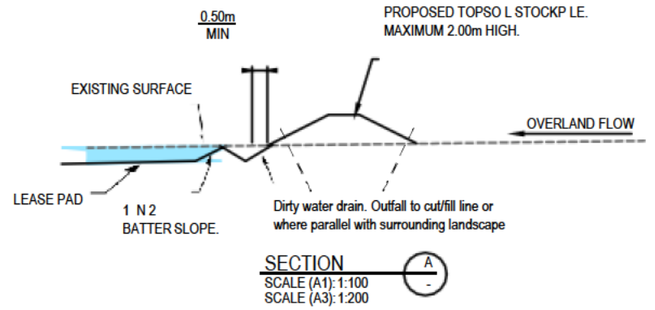
Note: The requirement to report all environmental incidents to regulatory authorities will be determined by the Senex Environmental Manager in consultation with the EGM Queensland Assets.

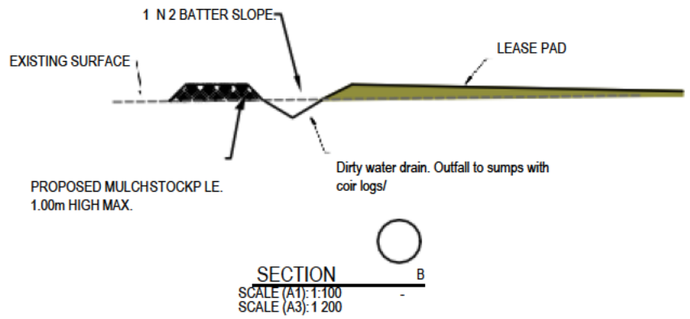
A complaints register is maintained on site and all complaints are investigated with mitigation strategies developed where necessary.

APPENDIX A – STANDARD EROSION AND SEDIMENT CONTROL DRAWINGS

QLD Erosion and Sediment Control Procedure







NOTES:

- All work to be within a 1ha area. This includes pad and batters.
- Mulch or topsoil to be used on perimeteras clean water diversion
- No burying of topsoil
- Place mulch or use soil binder on fill batter
- water may drain off lease at cut/fill line
- no water to drain towards or over fill batter

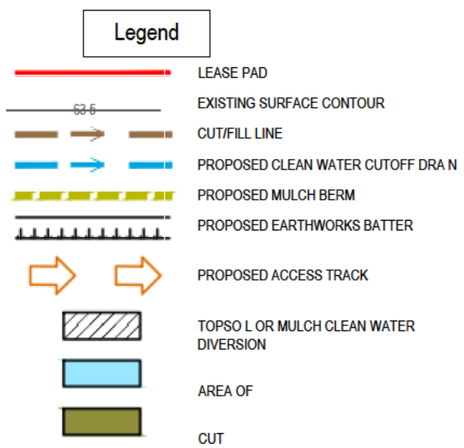


Figure 1: Generic well pad erosion and sediment controls

REVISION	DATE ISSUE DETAILS	DRAWN	DESIGN

DRAWN | STATUS
DESIGN | APPROVED | NOT FOR CONSTRUCTION

SCALE

CLIENT: Senex Energy Limited

PROJECT: GENERIC WELL PAD EROSION AND SEDIMENT CONTROL

DRAWING TITLE

PROJECT No. | DRAWING No. | REVISION

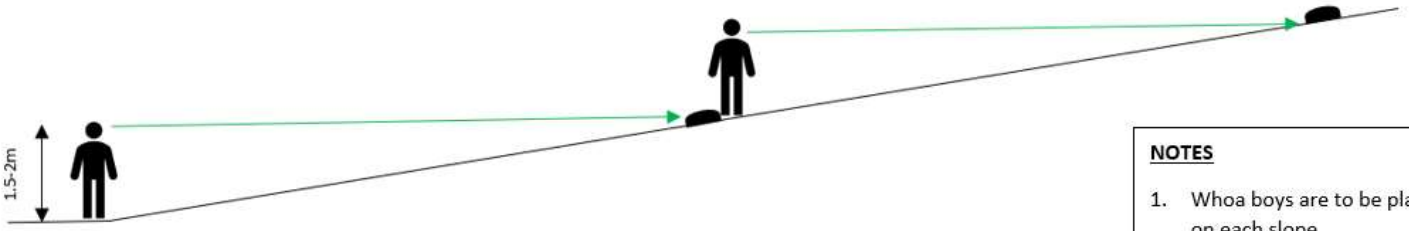


Figure 1. Measuring 1.5-2m in vertical fall on the RoW

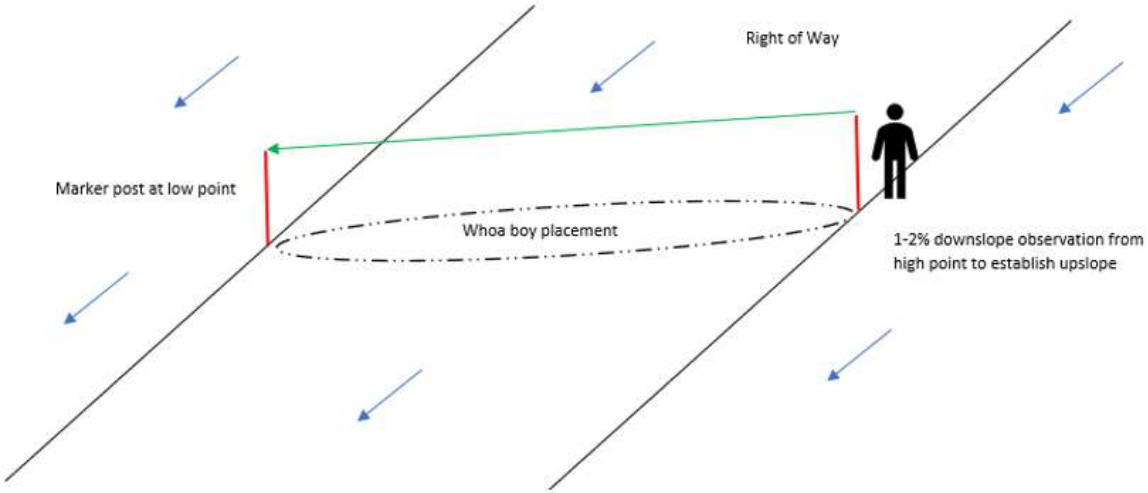


Figure 2. Measuring a 1-2% fall across the RoW

NOTES

1. Whoa boys are to be placed every 1.5-2m of vertical fall on each slope.
2. Horizontal distance between whoa boys will vary but vertical fall will be identical.
3. To correctly position whoa boys the observer must begin in the low point/valley and take a 0-degree reading with a clinometer from eye level. This identifies a point 1.5 to 2m in elevation up the slope.
4. Mark this point on either edge of the RoW.
5. Assess the local contours and determine if this point is a suitable release point for whoa boy. A suitable release point will be where the natural contours take water away from the RoW and prevent it from re-entering the RoW below the whoa-boy. Determine which side of the RoW is a suitable release point.
6. Once established mark with survey peg.
7. Using the same sized survey peg, take an observation through clinometer at height of survey peg across Row to first survey peg. Once a fall of 2% or less has been established then mark this point as the upslope endpoint of the whoa boy.
8. From this point, take another 0-degree reading up the slope to determine the location for the next whoa boy.
9. Continue this process up the slope until the 0-degree reading is close to or beyond the horizon, there is no

Figure 2. Whoa-boy placement

Figure 3: Example whoa-boy/diversion bank

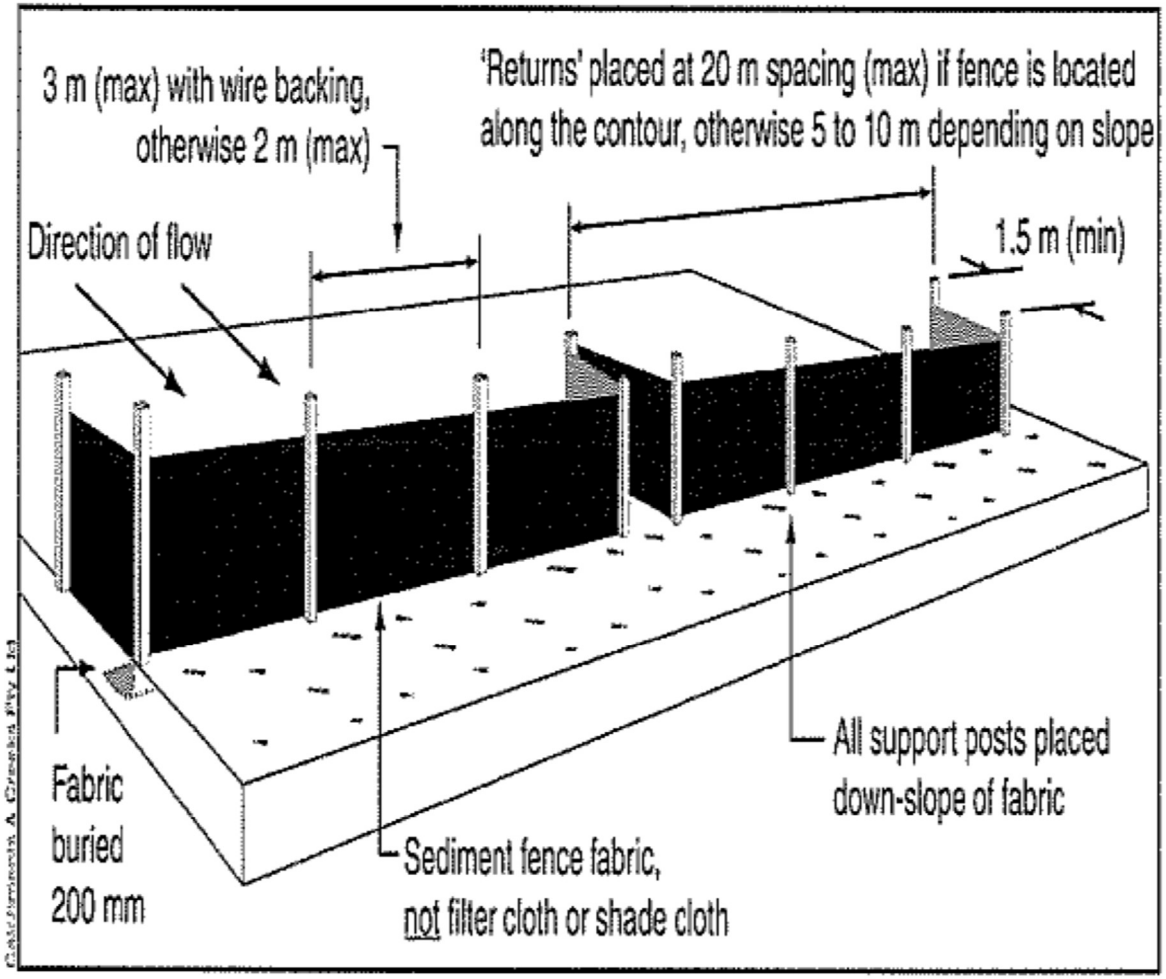


Figure 4. Typical sediment fence installation

Figure 5: Example Sediment Fence

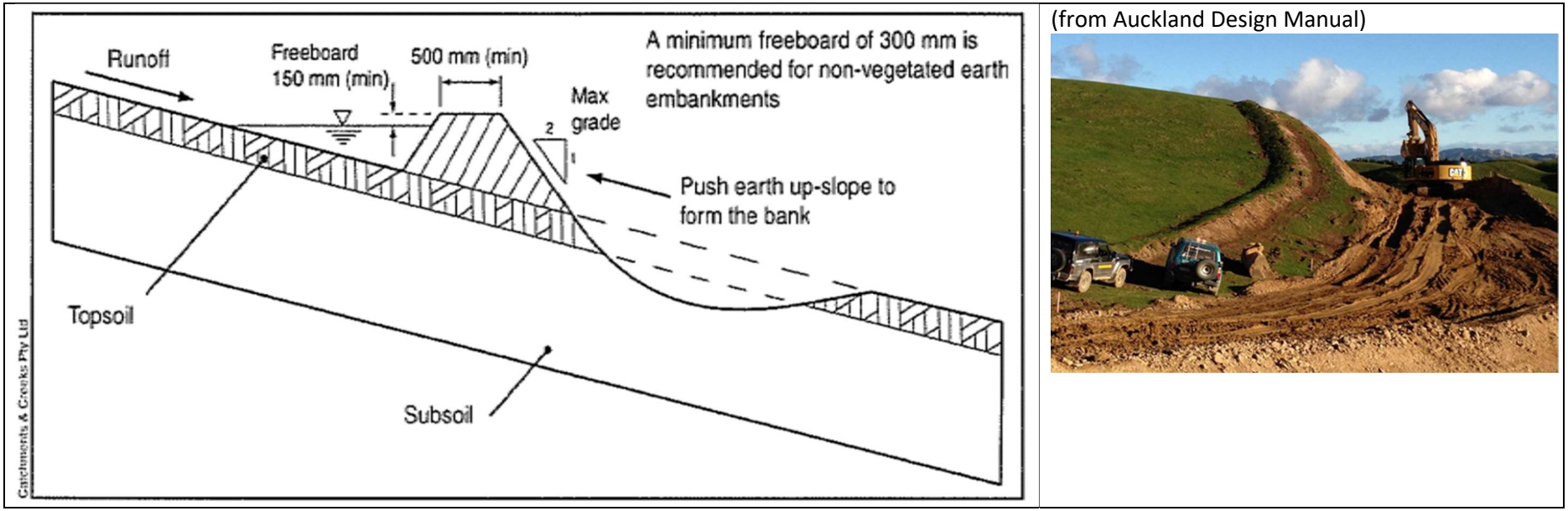


Figure 6: Typical clean water flow diversion bank

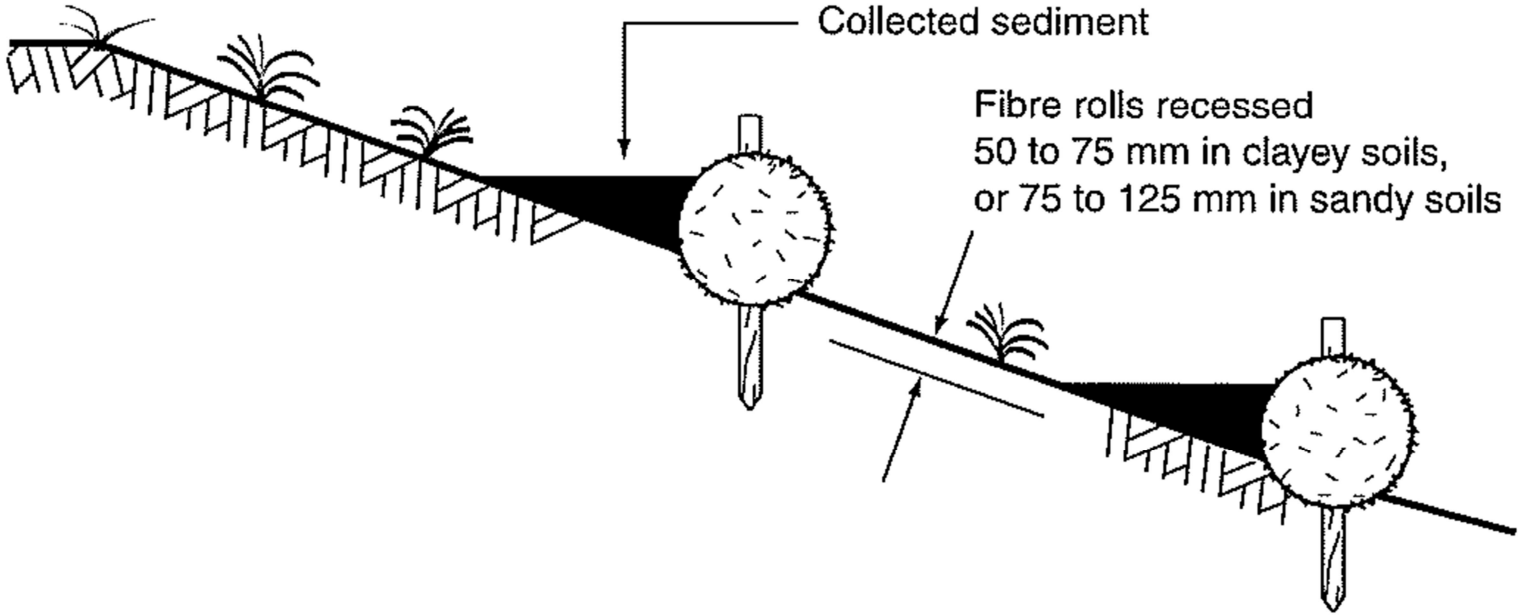


Figure 7: Typical coir log installation

Figure 8: Example coir log installation

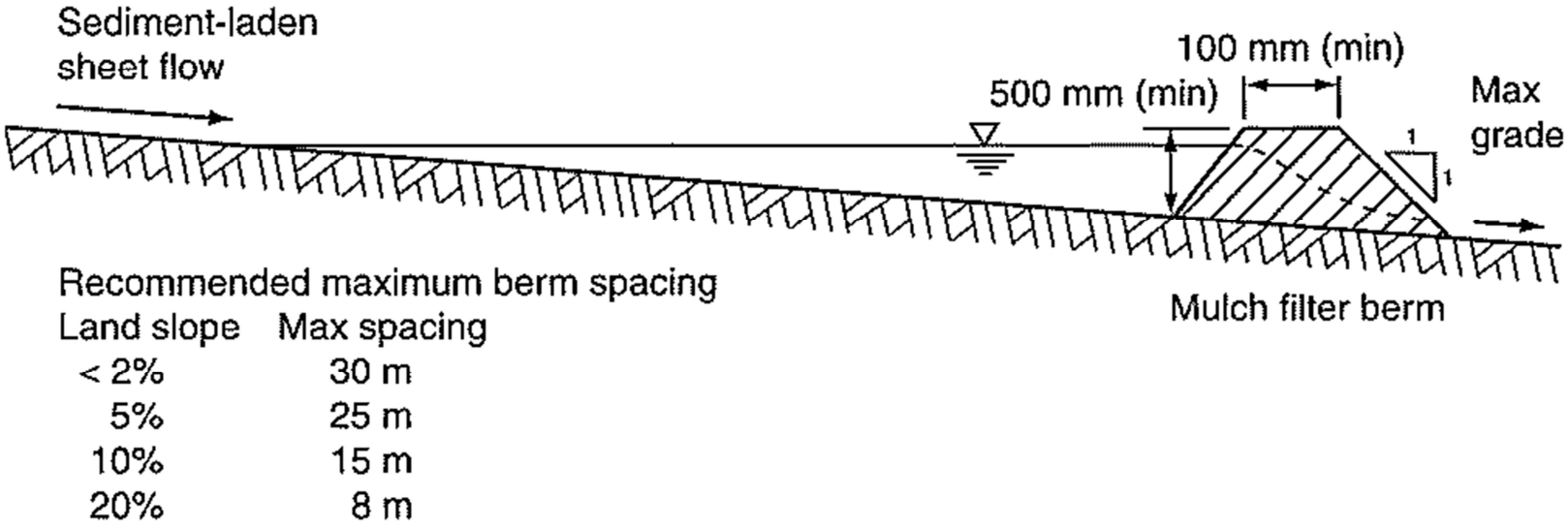


Figure 9: Typical mulch berm installation

Figure 10: Example mulch berm with upslope returns

Figure 11: Rock check dams should be used to reduce the erosive energy of flow in drains (NSW Blue Book)

APPENDIX B – IDENTIFYING DISPERSIVE SOILS

A field test can be conducted to determine relative dispersive nature of soils within the work site. Refer to instructions below on how to conduct a field test to determine whether dispersive soils exist. Further lab analysis may be required. Contact Senex Environmental Team for additional advice.

Identification of Dispersive Soils

Step 1

- *Collect soil aggregates (2 or 3 pea sized oil aggregates/1-2 cm in diameter) from each layer in the soil profile representative of the soil layers.*

Step 2

- *If moist, dry the aggregates in the sun until air-dried (could take a few hours). Note: aggregates may not disperse when they should if they have not been sufficiently dried.*

Step 3

- *Gently place the selected aggregates in a shallow glass or jar of distilled water or rainwater.*

Step 4

- *Leave the soil aggregates on a stable surface without shaking or disturbing them for 2 hours.*

Step 5

- *Compare the results to figure below to determine the level of dispersion observed.*

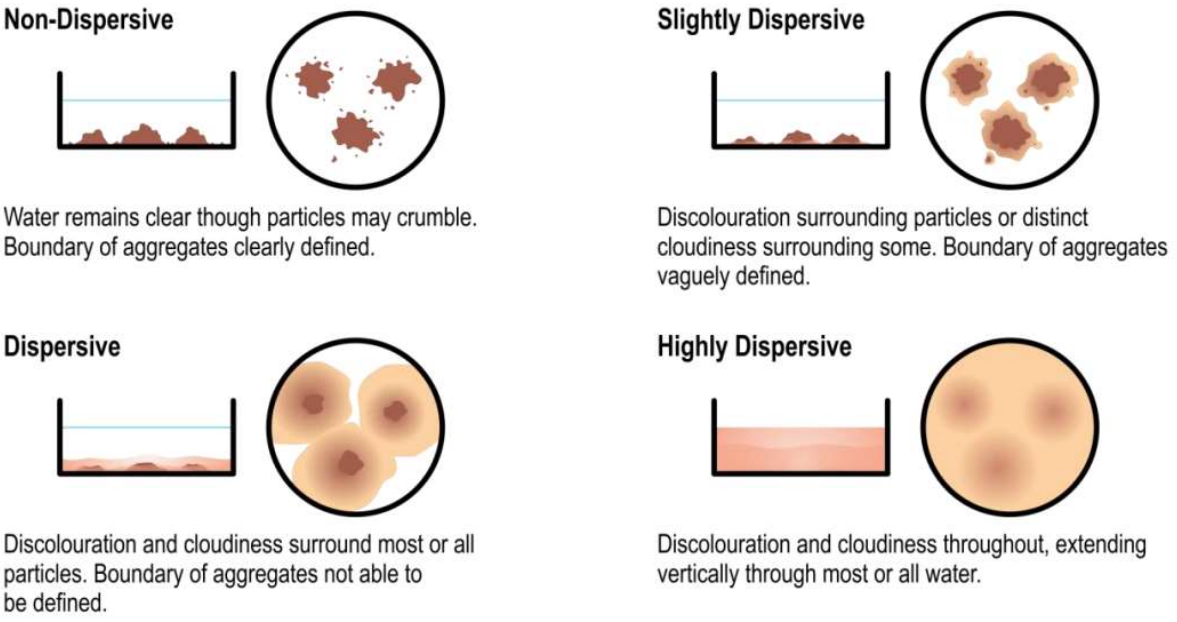


Figure 1: Aggregate dispersion results, source: Ipswich Planning Scheme

APPENDIX C – SOIL AMELIORATION FOR DISPERSIVE SOILS

Gypsum Application

Gypsum (calcium sulphate $CaSO_4 2H_2O$) shall be a natural agricultural grade material, and meet the following parameter requirements:

- A minimum 80% of gypsum
- 20% calcium (Ca)
- 15% sulphur (S)
- < 2% sodium chloride (NaCl)
- Moisture content of <15%
- Have a particle size distribution of:
  - 100% by weight to pass a 6 mm sieve
  - 80% by weight to pass a 4 mm sieve
  - 50% by weight to pass a 2 mm sieve

Table C.1 - Gypsum Application Rates

Gypsum Application Rates	
Topsoil	Up to 5 t/ha
Subsoil	3 t/ha, maximum 10 t/ha
Concentrated Flows (i.e., diversion drains or bunds)	Maximum 10 t/ha
Highly erodible soils (exchangeable sodium percentage ≥15 or Ca:Mg ratio ≤0.1) and/or acidic soils (pH ≤5)	Add lime (in addition to gypsum) to the topsoil at a rate of 15 kg/m^3

Note: Less gypsum is required for slightly dispersive soils, whereas more gypsum is required for highly dispersive soils. Refer to Appendix B on the identification of dispersive soils.

Table C.2 Gypsum Application Steps

Step	
1	Determine if gypsum is to be added to topsoil or subsoil.
2	Determine gypsum application rate.
3	Apply gypsum evenly to soil, but do not mix topsoil and subsoil together.
4	Lightly rip area to mix gypsum and soils to a minimum depth of 150mm. Do not mix topsoil and subsoil.
5	Reshape and profile the surface to the flattest suitable gradient and compact as required.

Note: On batters, the crest of the fill batter should be left so as water can sheet over, rather than pool on the edge or concentrate to a single point.

Record Management

Records must be kept of gypsum application. These records must show location of application (i.e., lease or ROW reference), date of application and application rate (t/ha).

s22

From: s47F
Sent: Tuesday, 11 December 2018 3:05 PM
To: s22
Cc: s47F
Subject: Dulacca Woodland Snail - no significant impact 2018/8329
Attachments: Dulacca Snail Memo 111218.pdf

Hi s22

As discussed over the phone, we have asked ERM to prepare the attached assessment regarding the potential for significant impacts to the Dulacca Woodland Snail, as a result of Senex activities on Project Atlas.

This memo reinforces the initial assessment presented with the ecology report that was prepared for the referral.

The main point for Senex is that we will implement our constraints protocol, undertaken further target surveys pre disturbance, and have the ability to design infrastructure to avoid any important populations.

If you have any further questions please let us know.

Cheers
s47F

ERM

4/201 Leichhardt Street,
Spring Hill
Q,4000

Telephone: +61 7 3839 8393

www.erm.com

Project Memo

6 December 2018

Reference: 0461545

Subject: Dulacca Woodland Snail

In response to a request by Senex Energy Limited (Senex) to provide further justification and explanation of the potential impact to the Dulacca Woodland Snail (*Adclarkia dulacca*; the following memo has been prepared. This response will outline the development within the Project Atlas area and the potential impacts on the land Snail.

For context, the Project Atlas tenure is an area that has been extensively cleared of native vegetation, and utilised for rural agricultural land uses that have involved extensive vegetation clearing, cattle grazing, and forestry practices and the areas of potential Dulacca woodland snail habitat are restricted to isolated fragments, with limited connectivity to other habitat remnants, external to the area.

1 Dulacca Woodland Snail in Petroleum Lease (PL) Area

The Dulacca woodland snail is categorised as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. The land snail was discovered in 1996 during a survey expedition of the Queensland's brigalow bioregions (EPBC, 2016). The Dulacca woodland snail is endemic to south-east Queensland, where it occurs as a small number of isolated and fragmented populations in the areas between Miles and Dulacca, south to Meandarra and north to Woleebee (TSSC 2016b, ALA 2018). The distribution of this species is heavily fragmented due to extensive clearing for agricultural uses of preferred habitat within brigalow-woodland/vine thicket communities. Within these habitats, suitable microclimates consisting of woody debris in combination with deep leaf litter are preferred.

The Dulacca woodland snail is included within the camaenid family of snails, which generally lay their eggs in depressions in the soil under logs and other debris. Although egg laying has not been recorded for this species, it is highly likely that it follows a similar pattern. Generation length of camaenid snails is approximately 3.5 years, assuming that breeding can start after two years, and has a life expectancy of five years. Mature snails will lay eggs on an annual basis.

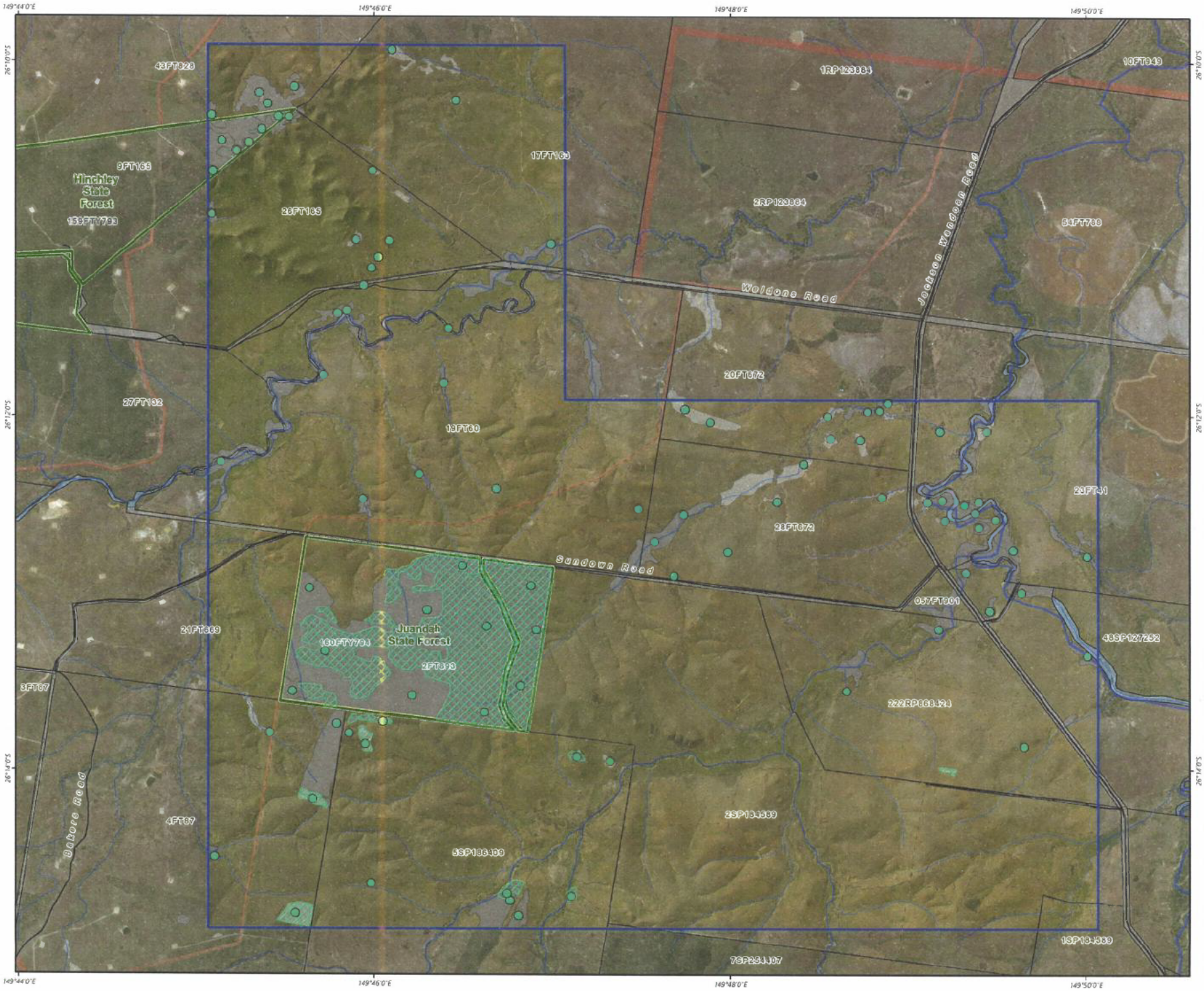
As part of the field surveys undertaken to inform the ecological impact assessment, targeted surveys were undertaken within the PL to determine the potential for species occurrence across the PL. A total of 115 30 minute active searches took place (two people for 15 minute periods). Survey methodology included searches underneath fallen woody debris and deep leaf litter in suitable vegetation communities. This is an extensive survey effort given the low proportion of the PL with suitable habitat (see **Annex A** for habitat assessment locations).

- Undertaking targeted field based surveys for the species by suitably experienced ecologists in those potential habitat areas that may be disturbed by proposed infrastructure prior to finalising the field layout or land disturbance; and
- Where there is evidence of species occurrence, there is flexibility in the design to avoid important populations (if they occur within the area). The aim of obtaining additional data on potential species occurrence is to limit the potential for fragmentation and isolation of populations, should they occur within the disturbance area or adjacent areas.

Yours sincerely,

s47F

Partner



Senex

Senex Energy Limited

Title: Project Atlas - Dulacca Snail Potential Habitat & Assessment Sites

Date: 07/12/2018

Doc: SENEX-CORP-GI-MAA-157_A

Acknowledgements:

- Habitat Assessment Sites
- Dulacca Snail Potential Habitat
- Remnant Vegetation
- Regrowth Area
- QLD Protected Areas
- Property Boundary
- Road Reserve
- Boundary Watercourse
- Easement
- Main Road
- Local Road
- Existing Road/Track

Watercourse (Stream Order)

- 1-2
- 3-4
- 5>

DATE	REV	CHANGE LOG
07/12/18	A	

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Document Path: F:\Senex GIS\GIS Mapping - All Mapping\QLD Project Atlas\Project wide mapping\Environmental\MAA-157 Atlas Dulacca Snail Potential Habitat & Assessment Sites\MAA-157 Atlas Dulacca Snail Habitat & Assessment Sites.mxd

SIGNIFICANT IMPACT ASSESSMENT

Dulacca woodland snail (Adclarkia dulacca)

The proposed development in the Production Area is unlikely to lead to a significant impact to Dulacca woodland snail (*Adclarkia Dulacca*)

The Dulacca woodland snail is endemic to south-east Queensland, where it occurs as a small number of isolated and fragmented populations in the area between Miles and Dulacca, and south to Meandarra (Stanisic 2011). The species inhabits a variety of remnant and scattered habitats, such as vine thicket and *Acacia harpophylla* (brigalow) woodland patches on rocky outcrops with clay to loam soils (Stanisic 2011), as well as Eucalyptus (ironbark) species and *Acacia shirleyi* (lancewood) woodlands on ridges (with and without rock), and *Eucalyptus woollsiana* (gum-topped box) woodland (Eddie 2016). The species may also occur in the 'Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt Bioregions' ecological community, as well as the 'Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions' ecological community.

The Dulacca woodland snail is able to exist in areas of brigalow regrowth and even in cleared paddocks but only where logs, woody debris or other suitable microhabitat sites remain (TSSC 2016b). The species may occur in association with remnant and regrowth RE types 11.3.1, 11.9.4 11.9.5, 11.9.9, 11.9.10 and 11.10.1 within the Production Area.

The Production Area provides potential habitat for the Dulacca woodland snail (262.1 ha), but no individuals were recorded as part of the field surveys. The nearest record of the species is located approximately 15 km from the Production Area. No important populations of the species have been identified as a result of field surveys. Only 5.2 ha of potential Dulacca woodland snail habitat is proposed to be disturbed as a result of the proposed development. Habitat assessments will be undertaken where habitat is proposed to be disturbed, and microhabitat features utilised for the species will be avoided, where practicable. An assessment in accordance with SIG 1.1 indicates that it is unlikely to lead to a significant impact to the species (*Table B. 1*).

Table B. 1 Significant Impact Assessment for Dulacca woodland snail

Criteria	Discussion	Criteria Triggered?
An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population	The proposed disturbance area of 5.2 ha of potential habitat for the species is not known to contain an important population of the species. Prior to undertaking activities that result in significant disturbance to land, an ecological survey to confirm presence of threatened species will be undertaken by a suitably qualified person. Infrastructure will preferentially avoid threatened species locations where possible.	No

Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat	A number of invasive weed species have been recorded within the Production Area and the construction of the access tracks through patches of potential Dulacca woodland snail habitat has the potential to introduce invasive buffel grass, rats and feral pigs. Invasive species will be managed by a Weed and Pest Management Plan, to avoid increasing the presence or distribution of pests and weeds within or outside the proposed development area.	No
Introduce disease that may cause the species to decline, or	The construction and operation of the infrastructure is unlikely to lead to introduction of a disease relevant to Dulacca woodland snail.	No
Interfere substantially with the recovery of the species.	Impacts resulting from construction and operation of the infrastructure are limited to loss of 5.2 ha of potential habitat, as no Dulacca woodland individuals were recorded in the Production Area during surveys. Therefore, the construction and operation of the proposed development is unlikely to substantially interfere with the recovery of the species. Prior to undertaking activities that result in significant disturbance to land, an ecological survey to confirm presence of threatened species will be undertaken by a suitably qualified person. Infrastructure will preferentially avoid threatened species locations where possible.	No

OFFICE OF WATER SCIENCE ADVICE
PROJECT ATLAS CSG PROJECT, BETWEEN WALLUMBILLA AND WANDOAN, QUEENSLAND

Requesting section	Queensland Assessments North	**Requesting officer**	s22
Date of request	14/11/2018		
EPBC reference	EPBC 2018-8329	**OWS reference**	OWS 2018-064
Project assessment stage	Referral		
OWS contact officer	s22		
Cleared by	s22 Director / Senior Principal Research Scientist Technical Analysis Team	**Date**	27/11/2018

The OWS provides technical advice for internal Departmental decision making and briefing purposes only. OWS advice should not be forwarded directly to external parties in the format provided. Please contact the OWS before providing the advice directly to an external source. The OWS does not speak for, and our response has not been endorsed by, the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development.

This document, prepared at the request of the Environmental Standards Division, outlines the Office of Water Science's (OWS) technical advice on the Project Atlas Coal Seam Gas (CSG) project, Queensland. The proposed project is located approximately 15 km southwest of the township of Wandoan. The project targets the Walloon Coal Measures and will include construction of up to 113 vertical wells and supporting infrastructure providing up to 40 terajoules (TJ) per day to the Queensland domestic market. The area is surrounded by a number of existing approved developments.

The requested advice is in relation to the extent of impacts on water resources likely to arise from the project. This advice is based on the information provided by the proponent as part of the referral.

Question 1: What does the OWS consider are the likely nature and extent of impacts to water resources?

1. Local and regional water resources are subject to existing impacts from human activity including agriculture and CSG actions within the Surat Cumulative Management Area (CMA).

a. The proponent has used OGIA modelling to assess both regional and cumulative impacts (as part of the Surat Cumulative Management Area) as well as to assess impacts of the project in isolation.

b. One bore (screened in the Springbok Sandstone) in the project area is predicted to experience drawdown in excess of the trigger threshold of 5 m for a consolidated aquifer the Queensland Water Act 2000. This particular bore has already experienced more than 5 m of drawdown from existing activity in the region. It is not clear if the proponent is stating that the project alone will result in this drawdown or if the drawdown is cumulative.

c. Referral Attachment 4d (Water Report) notes that while there is standing water in both Wandoan and Woleebee Creek, dewatering activities are separated from the shallow alluvium by layers of low-permeability.

2. Terrestrial vegetation, aquatic ecosystems and other ecosystems likely to be water dependent are unlikely to be significantly affected by the project. This is discussed further in response to question 2.

a. Four Great Artesian Basin (GAB) watercourse springs are located within 25 km of the project. These source groundwater from the Gubberamunda Sandstone and Mooga Sandstone / Orallo Formation (OGIA 2016a). The project does not contribute to drawdown of any of these watercourse springs.

b. Groundwater in the shallow alluvium associated with Wandoan and Woleebee Creeks is inferred from the model to be 9 mbgl. The proponent describes general creek characteristics as shallow creeks banks, highly meandering with low potential for erosion (Attachment 4d p. 45). The project is within recharge zones of the GAB (Cadna-owie Hooray Aquifer) which in many instances provides baseflow to creek systems in this region.

c. However, dewatering activities undertaken by the proponent for this project are stated to occur at depths of over 250 m in aquifers that are separated by layers with low-permeability from shallow alluvial groundwater which may support potential Groundwater-Dependent Ecosystems (GDEs).

d. Clearing activity is planned in a manner that avoids significant direct impact to flora and fauna, including Environment Protection and Biodiversity Conservation Act 1999 (EPBC) listed threatened ecological communities and species.

3. The proponent states that the water management regime for the project will not result in any release to the environment.

a. Any CSG produced water will be stored in storage dams constructed and operated in accordance with the “Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DEHP, 2016a).

b. Mine water will be treated and subject to water quality requirements used in accordance with the “General beneficial use approval” (DEHP 2016a). Residual salt/salt slurry will be removed from site and disposed of at a Regulated Waste Facility.

Question 2: Does the OWS agree with the proponent's conclusion of no significant impact on water resources?

4. The information provided largely indicates little impact is likely

5. Drawdown in target aquifers is already occurring through existing CSG activities. OGIA modelling predicts only marginal additional impact from the Atlas project.

6. All of the information provided by the proponent supports their position that there are unlikely to be substantial impacts on water resources.

    a. The proponent argues that there is little interaction between water in the target coal seams (~250 mbgl) and shallow aquifers that support, or may support, terrestrial and aquatic ecosystems and stygofauna.

    b. Hydrographs in the Water Report show no evidence of direct interaction between aquifers deeper confined aquifers and the shallower alluvial aquifer and surface water.

    c. Bores screened within the alluvium associated with Woleebee and Juandah Creek show different chemistry to the Surat Basin bedrock units, again supporting the position that there is no likely connection to the alluvial aquifer.

7. Outside of the issues associated with well construction, maintenance and closure, the limited nature of changes to surface landform and the proposed treatment of co-produced water make impacts to surface water resources unlikely.

    a. The proponent has planned the project to avoid direct clearing or alteration of potentially groundwater-dependent ecosystems.

    b. The proponent has specified that a 300 ML aggregation dam will be "located centrally" (Atlas CSG Water Management Plan).

    c. The proponent will also construct a 50 ML irrigation dam for treated water. The proponent intends to use this water under Landowner Water Supply Agreements. It appears that no agreements have been finalised and that the proponent intends to identify opportunities for beneficial use of this water.

        i. Discharges to the environment may need to be addressed if agreements are not put in place.

    d. A brine dam with up to 300 ML capacity is intended to be built on-site.

    e. Additional aggregation, irrigation and brine dams may be built if needed. These will be designed and submitted for registration prior to construction.

    f. Erosion will be managed in accordance with Queensland Erosion and Sediment Control Procedure.

    g. The proponent has acknowledged potential risks associated with water quality and proposed "beneficial use" of treated co-produced water and has a suitable monitoring plan in place. (2018-8329 Referral-Attach-Att 4f). It should be noted that the proponent has not stated what the actual response or mitigation measure will be in response to monitoring results and this should be provided.

8. The proponent has committed to decommission wells at the end of commercial productive life in accordance with the Code of Practice for Constructing and Abandoning Coal Seam Gas Wells. However, the Water Assessment Information Portal notes that there is some uncertainty about the long term risks associated with well integrity.

    a. The proponent may consider how longer term well integrity is monitored and maintained. (*Bore integrity, Background review* 2014).

Water Assessment Information Portal (WAIP): for more information on water-related environmental impacts, please see the WAIP (accessible on the intranet via Home ⇨ Themes ⇨ Water ⇨ Water Assessment Information Portal).

References

Bore integrity, Background review, Commonwealth of Australia 2014

Other documentation reviewed

2018-8329 Referral-Attach-Att 2_SENEX-ATLS-EN-APA-005_EPBC_Figures

2018-8329 Referral-Attach-Att 3a Atlas Biodiversity Ecology Report PART 1_MAIN REPORT

2018-8329 Referral-Attach-Att 3b Atlas Biodiversity Ecology Report PART 2_MAIN REPORT

2018-8329 Referral-Attach-Att 3c Atlas Biodiversity Ecology Report APPENDICES

2018-8329 Referral-Attach-Att 4a Water Report_Vol1

2018-8329 Referral-Attach-Att 4b Water Report_Vol2

2018-8329 Referral-Attach-Att 4c Water Report_Vol3

2018-8329 Referral-Attach-Att 4d Water Report_Vol4

2018-8329 Referral-Attach-Att 4e Water Report_Vol5

2018-8329 Referral-Attach-Att 4f Water Report_Vol6

2018-8329 Referral-Attach-Att 4g Water Report_Vol7

2018-8329 Referral-Attach-Att 4h Water Report_Vol8

2018-8329 Referral-Attach-Att 5_ Atlas EA00001207

2018-8329 Referral-Attach-Att 6_streamlined-model-conditions-petroleum

2018-8329 Referral-Attach-MAA-132 Project Atlas Block Description

2018-8329 Referral-Attach-SENEX-ATLAS-EN-PLN-001_3 Project Atlas EMP

2018-8329 Referral-Attach-SENEX-ATLS-EN-PLN-004_0 Project Atlas WMMP

2018-8329 Referral-Attach-SENEX-ATLS-EN-PLN-006_0 Atlas CSG Water Management Plan

2018-8329 Referral-Attach-SENEX-ATLS-EN-PLN-007_0 - Atlas Significant Species Management Plan

OFFICE OF WATER SCIENCE ADVICE
ATLAS PROJECT

Requesting section	Queensland Assessment North	**Requesting officer**	s22
Date of request	19/12/2018		
EPBC reference	EPBC 2018-8329	**OWS reference**	OWS-2018-073 OWS-2018-064
Project assessment stage	Referral		
OWS contact officer	s22		
Cleared by	s22 Director / Senior Principal Research Scientist Technical Analysis Team	**Date** 20/12/2018	Date 20/12/2018

The OWS provides technical advice for internal Departmental decision making and briefing purposes only. OWS advice should not be forwarded directly to external parties in the format provided. Please contact the OWS before providing the advice directly to an external source. The OWS does not speak for, and our response has not been endorsed by, the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development.

This advice should be read in conjunction with OWS advice OWS-2018-064 which was provided on 27 November 2018 in response to a previous request from Queensland Assessments North.

This document, prepared at the request of the Environmental Standards Division, outlines the Office of Water Science's (OWS) technical advice on the Project Atlas Coal Seam Gas (CSG) project, Queensland.

The proposed project is located approximately 15 km southwest of the township of Wandoan. The project targets the Walloon Coal Measures and will include construction of up to 113 vertical wells and supporting infrastructure providing up to 40 terajoules (TJ) per day to the Queensland domestic market. The area is surrounded by a number of existing approved CSG developments.

The requested advice is in relation to the extent of impacts on water resources likely to arise from the project. This advice is based on the information provided by the proponent as part of the referral.

Question 1: Does OWS consider that the local scale modelling is sufficient to identify the potential impacts from this project on water resources?

1. The analytical local scale modelling is sufficient to identify potential impacts to water resources.

    a. OGIA produced a regional groundwater flow model (Appendix 4 Pg. 120) to identify the likely cumulative impact of all projects in the Surat sub-basin with and without the Atlas project. OWS notes the limit of resolution for this model is 1.5 km by 1.5 km and that there is no reason to consider this inadequate (Appendix 4 Table 9.1 Pg. 115).

    b. In addition, the OGIA model was used to set boundary conditions for the analytical model for the Atlas project (Appendix 4 Pg. 120).

Question 2: What is the risk of a significant impact on MNES from the proponent's use of drilling chemicals (with reference to the proponent's Chemical Risk Assessment in Volume 6 of their water report, Appendix IV)?

2. The proponent intends to use 16 different types of drilling fluids across 3 well treatments. Some or all of these drilling chemicals would also be regularly used for drilling operations for pastoral water wells in the Great Artesian Basin. The chemical name, CAS registry number, likely quantities and/or concentrations and the chemical's general purpose and function are provided. All the chemicals proposed for use are approved for import, manufacture or use in Australia (Appendix 4 Pg. 20).

3. The proponent has carried out a risk assessment and identified 7 chemicals that required further assessment: Nuosept 78; Aldacide G; Idcide – 20; caustic soda; THPS 50% (Kinetic 560); Glutaraldehyde 25% (Kinetic 550D); and DBNPA 20% (Appendix 4 Pg. 28) .

    a. With the exception of caustic soda all these chemicals are biocides.

    b. Mobility, bioaccumulation and their degradation were assessed. This was done via an exposure assessment using potential exposure pathways and the use of a 1D contaminant transport model.

    c. The main pathways for contaminants are: overland flow; soaking into the ground; groundwater flow; leaching through the soil (Appendix 4 Pg. 44).

4. The results of this assessment indicate that the major risks to the environment are due to above ground chemical spills; the loss of chemicals to aquifers below ground and the disposal of drilling fluids (Appendix 4 Pg. 60).

5. OWS is of the view that as long as the chemicals are transported, stored and disposed of correctly i.e. standard operational procedure for the handling of chemicals, the risk from above ground chemicals spills and disposal of drilling fluids is very low.

6. The results of the 1-dimensional contaminant transport modelling, indicate that concentrations that may reach a groundwater receptor 200 m away from an exploration/production well are below that required to negatively impact on aquatic life (Appendix 4 Figure 6.1 and Pg. 60).

    a. The modelling did not include sorption or degradation of the contaminants and will therefore overestimate contaminant transport.

b. Assuming that standard and well established drilling practices are maintained i.e. standard operational procedure are followed, then the risk of groundwater contamination is very low.

Water Assessment Information Portal (WAIP): for more information on water-related environmental impacts, please see the WAIP (accessible on the intranet via Home ⇨ Themes ⇨ Water ⇨ Water Assessment Information Portal).

References

2018-8329 Referral-Attach-Att 4f Water Report_Vol6

s22

From: s22
Sent: Thursday, 29 November 2018 3:25 PM
To: s22
Cc: s22
Subject: Senex - Atlas Project [SEC=UNCLASSIFIED]

Hi s22

As you requested, please find PASS comments on Senex's Atlas water management measures/plans below.

The management plans/measures appear to consider the range of potential impacts to groundwater, surface water and GDEs associated with this type of activity. Actual requirements from a post-approval space would obviously depend on the conditions placed on approval, noting the Department is currently looking at deriving environmental outcomes, and a policy framework for managing the industry in general. Given the current degree of CSG activity within the Surat CMA, the Department is currently working on developing a joint industry framework that manage impacts in a cumulative and consistent manner across the Surat CMA.

To inform the development of this framework, the Department is working on: determining trends in and condition of water resources and springs; determining whether it is possible to separate out CSG and non-CSG impacts; and establishing acceptable outcomes for impacts to water resources and springs. The aim is for this framework to be agreed by May 2019 and will be developed in consultation with DNRME, DES, OGIA and industry. This timeframe should coincide with the next UWIR (also May 2019) and is intended to allow companies to transition their individual management plans to match the framework by the end of 2019. Small scale projects such as Atlas will have a contribution to cumulative impacts. If they are not triggered for water resources under the EPBC Act, they will not be captured by the future regulatory framework. This would reduce the ability of the Department to comprehensively manage the contribution of individual CSG developments to the cumulative impacts on water resources in the Surat basin.

Happy to discuss,

s22

Australian Government
Department of Agriculture
and Water Resources

Mr s22
Director
Queensland North Assessments Section
Assessments & Governance Branch
Department of the Environment and Energy
GPO Box 787
CANBERRA ACT 2601

Dear s22

I refer to the letter of 13 November 2018 from Mr s22 (Director, Referrals Gateway, Department of the Environment and Energy) to the Hon. David Littleproud MP, Minister for Agriculture and Water Resources, inviting comment on referral EPBC 2018/8329 (Project Atlas CSG Project, between Wallumbilla and Wandoan, Qld), under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Minister for Agriculture and Water Resources has asked me to reply on his behalf.

The department has no comments from a portfolio perspective on whether the proposed action may have significant impact(s) on any matters of national environmental significance protected under the EPBC Act.

We note on 5 September 2017, the Queensland Government awarded Senex Assets Pty Ltd a Surat Basin coal seam gas acreage (58 kilometres^2) near Miles, Queensland. The high quality acreage is estimated to be capable of sustaining production rates of more than 30 Tera joules per day at plateau.

According to the referral, the proposed action by Senex Assets Pty Ltd is to develop and operate a coal seam gas field within Petroleum Lease (PL) 1037, located about 44 kilometres north of the Warrego Highway, between Wandoan and Wallumbilla, Queensland. The proposed action involves developing production wells and supporting infrastructure (e.g. gas and water gathering systems for the producing wells; produced water management facilities; brine storage; and irrigation management systems) to provide gas exclusively for the domestic market. The development footprint is about 380 hectares. The proposed action is expected to commence in July 2019 and end in July 2059.

Based on the referral, the project area covers a range of land tenures including freehold land, state forest (Juandah State Forest), land leases and road reserves. The project area also overlaps a Native Title determination area (Iman People). The proponent holds Environmental Authority (EA0001207) over PL1037. Land use surrounding the petroleum lease is predominantly used for agriculture. The proponent will submit an application to the Department of Environment and Science (Queensland) to amend the Environmental Authority for the proposed action.

The department encourages the proponent to maintain open communication and consultation lines throughout the lifespan of the proposed action to mitigate sensitivities amongst stakeholders (e.g. Traditional Owners, environment groups). Water assessments including the establishment of robust baseline data on surface and groundwater monitoring in the project area should be carried out in accordance with management plans and made publicly accessible.

Stakeholders also need to be provided with adequate and relevant information about the proposed action. The proponent should also be audited periodically to ensure that conditions stipulated in any approval is complied with adequately.

Thank you for the opportunity to comment on referral EPBC 2018/8329.

Yours sincerely

Emma Cully
Assistant Secretary
Climate & Resilience Policy Branch
5 December 2018

FOI 191007
Document 19

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Mining and Investment
Onshore Minerals Branch
Resources Division
Department of Industry, Innovation and Science

27 November 2018

Attn: s22

Re: Invitation to comment on the referral for the Project Atlas CSG Project between Wallumbilla and Wandoan, QLD – EPBC 2018/8329

I refer to your request dated 13 November 2018, for comments on a proposal, known as Project Atlas Coal Seam Gas (the Project) by Senex Assets PTY LTD (the Proponent). Geoscience Australia (GA) has reviewed the referral documentation only, as it relates to impacts on groundwater resources relevant to Matters of National Environmental Significance (MNES) outlined in sections 24D and 24E of the Environmental Protection and Biodiversity Conservation Act, 1999 (EPBC Act).

Summary

The Proponent has self-assessed that the Project does not have the potential to have a significant impact on a water resource in relation to a coal seam gas development under Section 24D and 24E of the EPBC Act. This is due to their assessment of the results of regional modelling. Based on the information provided, Geoscience Australia considers that the Project has the potential to significantly impact groundwater resources. As such, Geoscience Australia recommends that the Project be assessed as a controlled action, with the water trigger as a controlling provision.

Background

The Project is located approximately 44 km north of the Warrego Highway between Wandoan and Wallumbilla. The Project is to develop the coal seam gas (CSG) resources located in Petroleum Lease (PL) 1037 which is currently the site of a separate appraisal program. The Project involves construction and operation of up to 113 wells and associated well site facilities, a gas and water gathering system, access tracks, produced water management facilities including additional aggregation dam, water treatment facility, brine storage and an irrigation management system.

The Project has an expected life of at least 40 years, with peak water extraction of approximately 1.7 megalitres per day (ML/day) expected to occur in 2025. The Proponent estimates that a total of approximately 6,700 ML of groundwater will be extracted during the life of the Project. CSG extraction will target the Walloon Coal Measures; the Proponent states no hydraulic fracture stimulation is expected to be required for the Project's production wells. The Walloon Coal Measures form part of the geological strata of the Great Artesian Basin (GAB). The aquifers of the GAB provide an important groundwater resource for stock and domestic purposes and town water supply in the vicinity of the

Project. The Proponent states that there are 318 registered bores within a 25 km radius of the Project and that Queensland Government Office of Groundwater Impact Assessment (OGIA) estimate these bores extract 1,345 ML/year of water.

The Project area forms part of the Surat Cumulative Management Area for which a regional-scale Underground Water Impact Report (UWIR) has been produced by OGIA. The UWIR assesses the cumulative impacts to the Surat and southern Bowen Basin from the expansion of CSG production by multiple adjacent projects. The updated 2016 UWIR includes the groundwater extraction from the proposed Project within its modelling and cumulative assessment of impacts. The 2016 UWIR cumulative scenario, when initially released, did not include actions from the Project. To determine potential impacts from the Project, the Proponent provided proposed CSG production information to OGIA who updated the UWIR model and provided outputs to the Proponent for both a cumulative scenario and a Project only scenario. GA notes the OGIA UWIR model's primary purpose is to provide information on a regional scale about cumulative impacts within the larger Surat CMA. The UWIR states:

It should be noted that the model is designed for regional water pressure impact assessment and is not designed to be used to directly predict water pressure or water level variations at a local scale. Although output from the model would be a relevant consideration when assessing impacts at a specific location, local factors should also be taken into consideration.[1]

The Proponent notes there are mapped potential groundwater dependent ecosystems (GDEs) as well as four GAB watercourse springs in the vicinity of the Project. The Proponent states that according to the UWIR the springs are source from the Gubberamunda Sandstone and the Mooga Sandstone / Orallo Formation. The mapped GDEs source water from the shallow alluvium.

Coal Seam Gas Resources

The Proponent was awarded PL 1037 by the Queensland Government in September 2017 to develop the 'Project Atlas' CSG resource. This production licence is the first Queensland Government licence explicitly requiring that all produced gas is to be sold into the domestic market. A small multi-well appraisal drilling program is underway currently, with more intensive development pending regulatory approval. The first gas sales are expected by late 2019 (Senex, 2018[2]). PL 1037 is currently Senex's only operated CSG production license in the Surat Basin, or Australia (GPInfo, November 2018).

There are no remaining petroleum reserves in PL 1037 as at 31/12/2017. The total remaining CSG reserves in the six surrounding permits is 1951 Bcf, all of which are hosted within the Walloon Coal Measures (petroleum gas and reserves data, 2017[3]).

PL 1037 is approximately 30 km west of the Scotia/Peat gas field (546 Bcf remaining reserves) and approximately 80 km southeast of the Spring Gully gas field (1495 Bcf remaining reserves; petroleum gas and reserves data, 2017[4]).

[1] Page 74,of Underground Water Impact Report for the Surat Cumulative Management Area, Department of Natural Resources and Mines, September 2016 (https://www.dnrme.qld.gov.au/__data/assets/pdf_file/0007/345616/uwir-surat-basin-2016.pdf)

[2] https://www.senexenergy.com.au/operations/surat-basin-gas/project-atlas/

[3] https://data.qld.gov.au/dataset/petroleum-gas-production-and-reserve-statistics/resource/351e9bd4-d9a1-4d60-a2ed-0e56cae79c4a

[4] https://data.qld.gov.au/dataset/petroleum-gas-production-and-reserve-statistics/resource/351e9bd4-d9a1-4d60-a2ed-0e56cae79c4a

Geoscience Australia does not compile petroleum resources data at permit level; if further information on gas reserves is required, the Queensland Department of Natural Resources, Mines and Energy should be consulted.

There are no petroleum wells drilled within PL 1037. There are many hundreds of CSG exploration and development wells (e.g. Polaris, Kathleen, Woleebee etc.) to the west, southwest and north PL 1037. Drilling is much more limited to the east and south of the permit.

PL 1037 is surrounded by six CSG production licenses and CSG exploration license (ATP 692). Four of the production licenses are owned by QGC (parent company Royal Dutch Shell); PL 209 and ATP 692 are owned by Australia Pacific LNG. Of these, only PL 401 (QGC) is also listed as a conventional gas permit.

Carbon sequestration permit EPQ 7 (Carbon Transport and Storage Corp, parent company Glencore) overlaps with in the northern part of its 2080 km^2 total extent. EPQ 8 (also Carbon Transport and Storage Corp) covers a large area (including the Spring Gully field) to the east of PL 1037.

The PL 1037 area is well served by existing pipeline infrastructure with the northern corner of PL 1037 is less than 1 km from the Polarais to Woleebee Creek central processing plant pipeline, and less than 2 km from the existing Wooleebee Creek Processing Plant to Wandoan Pipeline. The proposed 'Atlas Lateral Project' to be owned and operated by Jemena Ltd is to provide gas processing and compression for the Atlas project, and a 60 km buried gas pipeline connecting PL 1037 to the Darling Downs Pipeline. Construction is expected to commence February 2019 (Jemena, 2018[5]).

Comments

GA notes that maps were not visible within the Project Atlas Coal Seam Gas Water Management Plan (document number SENEX-ATLS-EN-PLN-006) provided with the referral.

Groundwater drawdown/depressurisation

As part of CSG production gas and water are extracted from the target coal measures, by lowering the water pressure within the seam. This can result in lowering pressure in surrounding aquifers and altering local and regional groundwater flow paths. The impacts to groundwater resources resulting from groundwater drawdown and depressurisation should be assessed due to the potential for drawdown to affect groundwater users and groundwater dependent environments, such as those identified by the Proponent.

As there is no local scale modelling, there is insufficient information on the significance of local scale impacts. The Proponent has based their conclusion of no significant impacts on the results of a region scale model which was not created to assess local scale, lease sized impacts. GA considers this at odds with OGIA's intended application of the UWIR.

Based on drawdowns provided by the modelling of the Project only scenario, only one third party bore experiences drawdown exceeding the 5m threshold value from the Queensland Water Act 2000. However many bores do receive drawdown below this threshold. GA notes that the water resource is the aquifer not the specific bore tapping it and as such any drawdown to an aquifer is an impact to a water resource.

[5] https://jemena.com.au/documents/pipeline/atlas/gas-446-ac-ev-001_atlaslateral_pfl_sitespecific_ea.aspx

Volume 3 of the Water Report submitted with the referral documents shows predicted drawdown to 158 bores within the following formations: Mooga Sandstone, Orallo Formation, Gubberamunda Sandstone, Westbourne Formation, Springbok Formation, Walloon Coal Measures, Eurombah/ Durabilla Formation, Hutton Sandstone, Evergreen Formation and Precipice Sandstone. The Proponent has identified bores tapping each of these formations within the Project vicinity demonstrating each unit acts as a water resource.

Potential cumulative impacts

The Proponents has used the results of the OGIA UWIR model cumulative scenario and the project only scenario to surmise that the project contributes little to cumulative impacts. While 62 bores within a 25km radius of the project receive drawdowns greater than the 5m trigger, the Project only contributes to 23 of these and that the maximum contribution is 31% for one of the bores while the Project's contribution is less than 10% for 19 of the 23. The referral documents do not appear to quantify cumulative drawdown to bores that was less than the 5m trigger value. GA considers that all 158 bore effected by drawdown due to the project only scenario are likely to experience cumulative impacts.

GA again notes that the OGIA UWIR model is designed to model regional scale cumulative impacts and queries the applicability for determining project specific impacts or cumulative impacts on a local scale. The modelling, however, is indicative of the project contributing to cumulative impacts and the cumulative impacts arising from CSG in the area are likely to be extensive.

If you have any queries on this, please contact me on s22 or s22

Kind regards,

s22

A/g Director - Groundwater Advice, Groundwater Branch,
Environmental Geoscience Division
Geoscience Australia

Queensland Government

Department of
Environment and Science

Ref 101/0003868-007

16 November 2018

Mr s22
Queensland North Assessments Section
Assessments and Governance Branch
Department of the Environment and Energy
GPO Box 787
CANBERRA ACT 2601

Dear s22

Invitation to comment on referral EPBC 2018/8329 – Project Atlas CSG Project, between Wallumbilla and Wandoan, Qld

Thank you for your letter dated 13 November 2018 requesting advice on whether the above action will be assessed in a manner described in Schedule 1 of the Agreement between the Commonwealth of Australia and the State of Queensland (the Bilateral Agreement) developed under Section 45 of the *Environment Protection and Biodiversity Conservation Act 1999*.

The Department of State Development, Manufacturing, Infrastructure and Planning has advised that the project is not currently being assessed under Part 4 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and is not likely to be assessed under the SDPWO Act in the future.

The Department of Environment and Science (DES) has not yet received an environmental authority amendment application for the project under the *Environmental Protection Act 1994*. You will be advised at the earliest opportunity once an application has been made and a decision has been made about the assessment approach.

Should you have any further enquiries, please contact me on telephone s22

Yours sincerely

s22

Director, Impact Assessment and Operational Support

Level 9
400 George Street Brisbane
GPO Box 2454 Brisbane
Queensland 4001 Australia
Telephone + 61 7 3330 5598
Facsimile + 61 7 3330 5875
Website www.des.qld.gov.au
ABN 46 640 294 485

EPBC Ref: 2018/8329

s47F
Executive General Manager
Senex Energy Limited
GPO Box 2233
BRISBANE QLD 4001

Dear s47F

Decision on referral
Project Atlas Coal Seam Gas Project, Queensland (EPBC 2018/8329)

Thank you for submitting a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This is to advise you of my decision about the proposed action to develop a coal seam gas field of up to 113 wells and associated infrastructure, in Petroleum Lease 1037, located approximately 44 km north of the Warrego Highway, between Wallumbilla and Wandoan, Queensland.

As a delegate of the Minister for the Environment, I have decided that the proposed action is not a controlled action. This means that the proposed action does not require further assessment and approval under the EPBC Act before it can proceed.

A copy of the document recording this decision is enclosed. This document will be published on the Department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act.

This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

The Department has an active audit program for proposals that have been referred under the EPBC Act. The audit program aims to ensure that proposals are implemented as planned. Please note that your project may be selected for audit by the Department at any time and all related records and documents may be subject to scrutiny. Information about the Department's compliance monitoring and auditing program is enclosed.

If you have any questions about the referral process or this decision, please contact the project manager, s22 by email to s22 or telephone s22 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch
18 January 2019

Australian Government
Department of the Environment and Energy

EPBC Ref: 2018/8329

Mr s22
Director
Impact Assessment and Operational Support
Department of Environment and Science
GPO Box 2454
BRISBANE QLD 4001

Dear Mr s22

Decision on referral
Project Atlas Coal Seam Gas Project, Queensland (EPBC 2018/8329).

I am writing to you in relation to the proposal by Senex Assets Pty Ltd to develop a coal seam gas field of up to 113 wells and associated infrastructure, in Petroleum Lease 1037, located approximately 44 km north of the Warrego Highway, between Wallumbilla and Wandoan, Queensland referred for a decision under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

As a delegate of the Minister for the Environment, I have decided that the proposed action is not a controlled action. This means it does not require further assessment and approval under the EPBC Act before it can proceed.

A copy of the document recording this decision is enclosed. This document will be published on the Department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act. This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

Questions about this decision can be directed to s22 by email to s22, or telephone s22

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch
18 January 2019

Australian Government
Department of the Environment and Energy

EPBC Ref: 2018/8329

The Hon David Littleproud MP
Minister for Agriculture and Water Resources
Parliament House
CANBERRA ACT 2600

Dear Minister

Decision on referral
Project Atlas Coal Seam Gas Project, Queensland (EPBC 2018/8329).

I am writing to you in relation to the proposal by Senex Assets Pty Ltd to develop a coal seam gas field of up to 113 wells and associated infrastructure, in Petroleum Lease 1037, located approximately 44 km north of the Warrego Highway, between Wallumbilla and Wandoan, Queensland referred for a decision under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

As a delegate of the Minister for the Environment, I have decided that the proposed action is not a controlled action. This means it does not require further assessment and approval under the EPBC Act before it can proceed. A copy of the document recording this decision is enclosed. This document will be published on the Department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act. This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

Questions about this decision can be directed to s22 by email to s22 or telephone s22.

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch
18 January 2019

Australian Government
Department of the Environment and Energy

EPBC Ref: 2018/8329

The Hon Matt Canavan
Minister for Resources and Northern Australia
Parliament House
CANBERRA ACT 2600

Dear Minister

Decision on referral
Project Atlas Coal Seam Gas Project, Queensland (EPBC 2018/8329).

I am writing to you in relation to the proposal by Senex Assets Pty Ltd to develop a coal seam gas field of up to 113 wells and associated infrastructure, in Petroleum Lease 1037, located approximately 44 km north of the Warrego Highway, between Wallumbilla and Wandoan, Queensland referred for a decision under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

As a delegate of the Minister for the Environment, I have decided that the proposed action is not a controlled action. This means it does not require further assessment and approval under the EPBC Act before it can proceed. A copy of the document recording this decision is enclosed. This document will be published on the Department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act. This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

Questions about this decision can be directed to s22 by email to s22 or telephone s22.

Yours sincerely

James Barker
Assistant Secretary
Assessments and Governance Branch
18 January 2019

Quality Assurance Checklist – Referral Brief

Reviewing Officer (may be assessment officer, clearing officer or peer reviewer)

Name: [redacted] s22 s22 Signature: s22 Date: 14/01/2019

Note: Assessment officer to fill out sections shaded YELLOW. Reviewing officer to complete all other sections.

Project: Project Atlas CSG, between Wallumbilla & Wandoan QLD.

EPBC No: 2018/8329 **Assessment officer:** s22 **Due Date:** 10 Dec 2018

General requirements	Brief	Decision Notice	Letters
	(tick or circle)		
Correct templates used	☑	☑	☑
Template version numbers: (assessment officer to insert version numbers)	4.2	3.1	4.1
EPBC reference number correct and used consistently	☑	☑	☑
Title of the action consistent	☑	☑	☑
The ACN (or ABN if no ACN) is listed and correct	☐ NA	☑	
The designated proponent (CA)/person proposing the action (NCA or NCA-PM) is correct. Needs to be a 'person' for the purposes of the EPBC Act.	☑	☑	
Description of the proposal is an accurate reflection of what is in the referral and encompasses all proposed activities	☑	☑	☑
Statutory deadline consistent with database record	☑		
Signature blocks and dates are correct	☑	☑	☑
List of attachments is correct	☑		
All dates mentioned accord with records	☐	☐	☐
All species references use SPRAT scientific names (first time that they are used)	☑ N/A	☐ (N/A)	☐ (N/A)
Material used to prepare briefing is listed	☑ N/A		
Public comments are included and issues raised in public comments are addressed (s75(1A))	☐ (N/A)		
Legal advice is included (if advice has been sought)	☐ (N/A)		
Line area advice is included (if advice has been sought)	☑ N/A		
All line areas consulted are clearly identified	☑ N/A		
Comments from Commonwealth and State/Territory Ministers are included and addressed	☑ N/A		
Additional information requests (stop clocks) are discussed and briefing package and additional information attached	☐ (N/A)		
Current ERT Report included	☑	Date of ERT Report: 7 Jan 19	
Compliance, monitoring and auditing fact sheet is attached (for NCA and NCA-PM)	☐		☐

Identifies the protected matters potentially impacted by the proposed action and provides clear reasons why significant impacts are likely/not likely	☑					
Recommendations on significance are based on *EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance* (2013) and relevant referral guidelines	☑					
Considers all adverse impacts the action has, will have or is likely to have on matters protected by each provision of Part 3 ((s.75)(2)(a))	☑					
Does not consider any beneficial impacts the action has, will have or is likely to have on matter protected by each provision of Part 3 ((s.75)(2)(b))	☑					
States that the decision maker must take account of the precautionary principle, and the precautionary principle is discussed as appropriate to recommendations of significance	☑					
Bioregional plans are included and discussed (where relevant)	☐	N/A				
Check listing status of all listed species potentially significantly impacted by the proposed action. Ensure correct listing statuses are used in the brief	☑	N/A	Date of check against SPRAT: 7/01/19			
BCD (Species Listing Information & Policy Section) weekly report is consulted to confirm imminent listing events or delistings (if required)	☑	N/A	Date of weekly report: 14 Jan 2019			
BCD (Species Listing Information & Policy Section) line area advice included on recent and pending listing decisions (if required)	☐	N/A	Date of advice received:			
NCA-PM decision	**Brief**		**Decision Notice**		**Letters**	
Wording of the proposed particular manner(s) clearly describe(s) the way in which the action must be undertaken to avoid significant impacts to protected matters, and accurately reflects the intent in the referral information			☐			
Proposed particular manner(s) checked by Post Approvals Section	☐					
CA decision	**Brief**		**Decision Notice**		**Letters**	
All controlling provisions have been identified	☐		☐		☐	
State/territory comments included and addressed where relevant to recommending an appropriate assessment approach (s87(3)(c))	☐					
Has a recommendation on an approach for assessment (s.87) (do not include where bilateral agreement applies, or decision on assessment approach is deferred)	☐	N/A	☐	N/A	☐	N/A
Cost recovery fee schedule included	☐	N/A			☐	