Rehabilitation Plan

Project Atlas and the Atlas Stage 3 Project

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Rehabilitation Plan

1 Introduction

1.1 Purpose

Senex Energy Pty Ltd (**Senex**), through its subsidiaries Senex Assets Pty Ltd and Senex Assets 2 Pty Ltd, operates an existing, and is progressing the development of an additional, coal seam gas (CSG) project in Queensland's Surat Basin (Figure 1.1). The two projects consist of:

- Petroleum Lease (**PL**) 1037 (Project Atlas); and
- Authority to Prospect (**ATP**) 2059, PL 445, the northern half of PL 209 and parts of PL 1037 (the Atlas Stage 3 Gas Project).

Due to the different types of land use, disturbance and petroleum activities across Project Atlas and the Atlas Stage 3 Gas Project, there is need for a diversified approach to rehabilitation.

This Rehabilitation Plan (the **Plan**) identifies a range of rehabilitation methods that may be required to successfully undertake rehabilitation of land to a 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.

Additional details relating to rehabilitation methods and monitoring are detailed within the following procedures:

- Queensland Reinstatement and Rehabilitation Procedure (SENEX-QLDS-EN-PRC-002); and
- Queensland Environmental Rehabilitation Monitoring Procedure (SENEX-QLDS-EN-PRC-001).

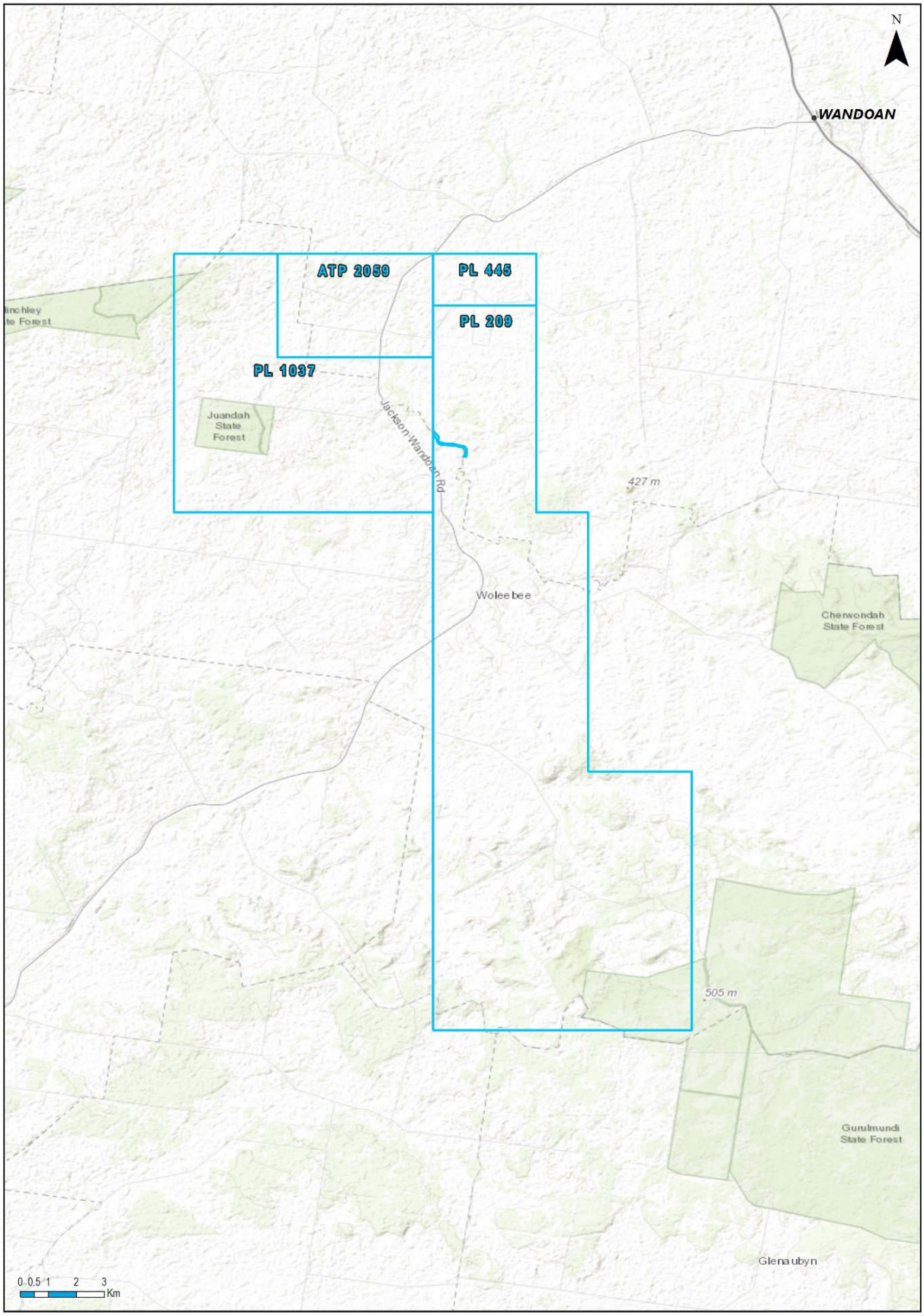

Figure 1.1 Project Atlas Tenement

1.2 Environmental Authority Conditions

Project Atlas and the Atlas Stage 3 Project are subject to the following Environmental Authorities (**EA**), which include streamline model conditions (**SMCs**):

- PL 1037 – EA0001207;
- PL 445 and 209 – P-EA-100112777; and
- ATP 2059 – EA0002524.

Senex may amalgamate these EAs in the future.

The Plan has been developed to achieve compliance with rehabilitation conditions within EA0001207 (i.e. the SMCs). 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'.

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.
(I4)	When no longer required all low consequence dams must be decommissioning to no longer accept inflow from the petroleum activities and be either: a) rehabilitated; or b) agree to in writing by the administering authority and the landholder to remain in situ following the cessation of the petroleum activity(ies) associated with the dam, with the contained water of a quality suitable for the intended ongoing use(s) by that landholder.
(I28) Decommissioning and Rehabilitation	Regulated structures must not be abandoned but be either: a) decommissioned and rehabilitated to achieve compliance with condition (I29); 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

Environmental Authority Condition Number	Requirement
	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).
(I29)	Subject to Condition I28, before surrendering this environmental authority the site must be rehabilitated to achieve a safe, stable, non-polluting landform consistent with final land use.
(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;

Environmental Authority Condition Number	Requirement
	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 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.

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:

- Final rehabilitation report for resource activities – Department of Environment and Science: Version 4.01, 4 September 2020
- 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.

1.4 Abbreviations

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)
RE	Regional Ecosystem

RoW	Right of Way
SOM	Soil organic matter

2 Background

2.1 Tenure Overview

2.1.1 Landscape and soils

The predominant land use within the project area is agriculture (cattle grazing), with some areas of State Forest. There are areas within the project areas which are mapped as Strategic Cropping Area (**SCA**) under the *Regional Planning Interests Act 2014* (Qld) (**RPI Act**). The lease area is predominantly cleared of remnant vegetation, 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 Project 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 mapped within the project area.

2.1.2 Terrestrial Ecology

The project area 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 *Nature Conservation Act 1992* (Qld) (**NC Act**).

Regional ecosystems (**RE**) listed under the *Vegetation Management Act 1999* (Qld) (**VM Act**) which have been validated as occurring within the project area are listed within Table 2.2 and shown in Figure 2.1. As further field development planning is undertaken, additional areas will be ground-truthed to validate the biodiversity values including RE, regrowth vegetation and species habitat.

Table 2.2 Validated Regional Ecosystems (Biodiversity Status)

RE Code	RE Short Description	Biodiversity Status
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	Of Concern
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Endangered
11.3.19	*Callitris glaucophylla, Corymbia spp.*and/or Eucalyptus melanophloia woodland on Cainozoic alluvial plains	No concern at present
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Of Concern
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
11.3.39	*Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils	No concern at present
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
11.5.5	*Eucalyptus melanophloia*, Callitris glaucophylla woodland on Cainozoic sand plains and/or remnant surfaces. Deep red sands.	No concern at present
11.9.2	*Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks	No concern at present
11.9.4	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks	Endangered
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	Of concern
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	No concern at present
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
11.10.1	*Corymbia citriodora* woodland on coarse-grained sedimentary rocks	No concern at present
11.10.7	Eucalyptus crebra woodland on coarse-grained sedimentary	No concern at present
11.10.11	Eucalyptus populnea, E. melanophloia +/- Callitris glaucophylla woodland on course-grained sedimentary rocks	No concern at present

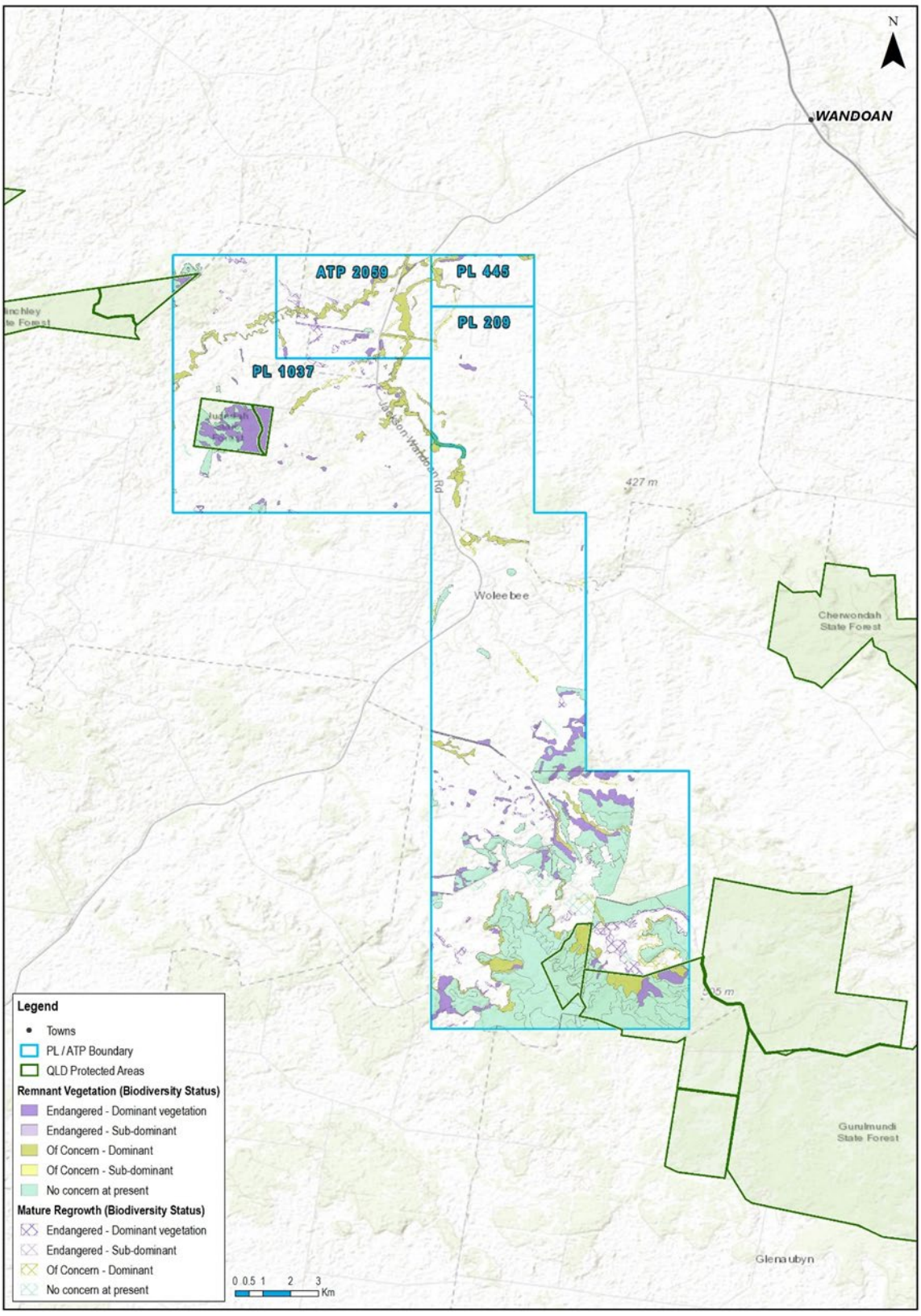

Figure 2.1 Regional Ecosystems (ground-truthed) within the project area

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.

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 approximately 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.

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

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 2), 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 (DES, 2016).

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 2 must be complied with, irrespective of whether a landholder wishes to utilise those areas already disturbed by CSG activities.

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 2):

- 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. 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. In some instances, site-specific variation to these methods may be necessary depending on the site requirements as detailed further in this Plan.

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 Topsoil and Subsoil Stripping

Topsoil contains the nutrients, microbes and seed bank required for regenerating vegetation during rehabilitation activities. Depending on the scale of disturbance, topsoil should be stripped prior to excavating subsoil. 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.

4.3.2 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.

4.3.3 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 2).
- 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.

4.3.4 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.

4.3.5 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. 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.

4.3.6 Soil Amelioration

The need for soil amelioration will depend on soil type and associated chemical 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.

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.

4.3.7 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, which can impact the success of

revegetation.

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

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.

4.6 Final Rehabilitation Revegetation

4.6.1 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.

4.6.2 Pasture Grassland

Pasture establishment during final rehabilitation may involve direct seeding as below. Species selection will be made in consultation with landholders. Alternatively, natural regeneration may be used if existing site conditions are conducive to effective regeneration (i.e., existing seed bank, good quality top soil).

4.6.3 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.
- Significance to traditional owners.
- Potential to provide food and shelter resources to local fauna.
- Soil conditions, micro-climate and aspect of the new landform.

4.6.4 Natural Recruitment

Natural recruitment of seed relies upon the dispersal of seed from undisturbed areas via natural mechanisms such as wind and animals. This process may be used in some instances such as where disturbed areas are adjacent to established vegetation and narrow in width (i.e. pipeline ROW, Seismic lines etc). The timeframes required for meeting final rehabilitation criteria will also be considered when selecting this option as initial establishment of vegetation can take longer than other direct seeding methods.

4.7 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.

4.8 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.

4.9 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.

4.10 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.

4.11 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.

4.12 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.

If watering is undertaken, the water used should be of a quality suitable for the intended purpose.

5 Disturbance Type

Reinstatement and rehabilitation methods for infrastructure types are detailed within relevant reinstatement and rehabilitation procedures. The following table outlines the key rehabilitation requirements for the primary types of infrastructure present within the project area.

Table 3 Typical rehabilitation methods

Infrastructure Type	Rehabilitation Technique
Well pads (production wells, exploration/appraisal, and monitoring bores)	▪ Reinstatement following the completion of drilling to reduce well pad area to approximately 0.36 ha. ▪ Stabilise batters, if a cut & fill lease, including profiling to reduce batter slope. Most surface drainage lines occur with areas of greater slope so extra measures are required for erosion control and soil stabilisation. ▪ Respread topsoil (should be a minimum depth of 150mm, if material available). Do not compact topsoil. ▪ Surface roughness is encouraged when respreading topsoil in order to trap water and seeds. ▪ Lightly tyne (scarify) topsoil, but no do mix with subsoil. ▪ Revegetate with native or pasture grasses. (Pasture grasses create cover to allow native species to colonise the area and impedes weed growth.) ▪ For plug & abandon wells, final rehabilitation including profiling cut and fill batters, and enabling the site to return to pre-existing conditions. ▪ Restrict vehicles from driving on rehabilitated areas. ▪ Manage weeds ▪ Temporary ESC's should be removed from site only once sufficient rehabilitation has been established to ensure site stability.
Gathering lines (gas and water)	▪ Backfill trenches with subsoil. Do not mix with topsoil. ▪ Re-profile natural contours and drainage lines to their original profile. ▪ Rip subsoil and compacted areas. ▪ Install whoa-boys along slopes, as per Senex ESCP. ▪ Restoration of watercourses by installing, as required, jute matting on the banks, contour berms on the high bank, rock lining the creek base to minimise scour, and limiting the use of fertilisers. ▪ Seeding will be utilised where rapid restoration is required (e.g. watercourse crossings and potential high erosion areas).

Infrastructure Type	Rehabilitation Technique
	▪ Respread topsoil (should be a minimum depth of 150mm). Do not compact topsoil. ▪ Surface roughness is encouraged when respreading topsoil in order to trap water and seeds. ▪ Lightly tyne topsoil, but no do mix with subsoil. ▪ Respread mulch or felled vegetation across the RoW for stability and fauna habitat ▪ Allow for natural regeneration. Seed areas, if natural regeneration (>70% groundcover) has not occurred within 6 months. ▪ Restrict vehicle access from driving on rehabilitated areas. ▪ Temporary ESC's should be removed from site only once sufficient rehabilitation has been established to ensure site stability. ▪ Manage weeds to remove existing and prevent spread of any new plants.
Dams Embankments	▪ Permanently stabilize dam batters. Stabilization approach to be used by contractors must be approved by Senex ahead of works commencing. This will include but not be limited to: o Respread topsoil to a minimum depth of 150 mm, where available. o Install permanent erosion and sediment controls to shed runoff from the altered surface. o Temporary ESC's should be removed from site only once sufficient rehabilitation has been established to ensure site stability.
Access Tracks	▪ Where retained, grade wheel ruts to prevent erosion on access track. ▪ Maintain ESC's as per Senex ESCP (whoa-boys, table drains, etc.) ▪ Temporary access tracks not required for operations or retained by the landholder are to be rehabilitated by ripping to remove compaction, re-spreading stockpiled topsoil. ▪ Allow for natural regeneration. Seed areas, if natural regeneration (>70% groundcover) has not occurred within 6 months. ▪ Manage weeds
Non-operational areas (excess construction site area not required for ongoing operations)	▪ Undertake reinstatement of areas not required to remain open during operations. ▪ Re-profile natural contours and drainage lines to their original profile. ▪ Rip subsoil and compacted areas. ▪ Respread topsoil (should be a minimum depth of 150mm). Do not compact topsoil. ▪ Surface roughness is encouraged when respreading topsoil in order to trap water and seeds. ▪ Lightly tyne (scarify) topsoil, but no do mix with subsoil. ▪ Revegetation with native grasses and ground cover species (remnant vegetation) or pasture grasses (cropping or grazing). ▪ Manage weeds ▪ Temporary ESC's should be removed from site once sufficient rehabilitation has been established to ensure site stability.

5.1 Nuisance Management

The potential for environmental nuisance relating to noise and dust generation exists during rehabilitation activities. Key mitigation measures are included within the relevant Environmental Management Plan and will be considered when planning for rehabilitation.

6 Rehabilitation Completion

6.1 Acceptance Criteria

Acceptance criteria are developed from reference site / pre-disturbance survey data and comprise an important component of the rehabilitation monitoring program. Results from monitoring nominated indicators 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

Rehabilitation monitoring is undertaken in accordance with the relevant rehabilitation monitoring procedures. These procedures will be developed to address site specific requirements and set out the monitoring methods for the following key project stages:

- Practical Completion
- Transitional
- Final Rehabilitation

A summary of the monitoring requirements and details are provided below.

Project Stage	Purpose	Criteria	Frequency
Completion of construction	Identify any corrective actions during the defects liability period (or similar).	NA – observation focussed.	Upon completion of a project
Transitional	Monitor the effectiveness of reinstatement activities.	Risk rating applied based on the presence of: • Erosion / subsidence • Restricted weeds • Groundcover	Annual
Final Rehabilitation	Demine that the disturbed area meets regulatory requirements for progressive rehabilitation or relinquishment.	• No erosion present • Landform is stable • Contours consistent with surrounding landform • Greater than or equal to total percent groundcover of adjacent vegetation or pre-disturbance assessment	Annual

Project Stage	Purpose	Criteria	Frequency
		• Greater than or equal 70% native groundcover species richness compared to adjacent vegetation/ pre-disturbance assessment • Declared weed species less than or equal to the percent species richness of adjacent area/ pre disturbance assessment. Additionally, for ESA areas: • Greater than or equal to 50% organic litter cover • Greater than or equal to 50% of total density coarse woody material • All predominant species in the ecologically dominant layer, that define the pre-disturbance RE are present.	

Where referenced within the above table, annual monitoring will be undertaken during the growing season to provide an ongoing representation of rehabilitation progress and success.

8 Data Management and Reporting

Information on site rehabilitation activities carried out on the project area will be recorded upon completion of transition or final rehabilitation works.

Monitoring data recorded by Senex staff or external consultants will be stored within GIS spatial data. Monitoring data will be analysed to evaluate rehabilitation progress over time and may also be used for financial assurance calculations and informing the content of Plans of Operations.

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 Team 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 Environment Team are responsible for undertaking on-site checks to ensure the procedures in this Plan are followed. Senex Site Supervisors are responsible for implementing any corrective actions identified through assurance activities.

10 References

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Registered Office
Level 30, 180 Ann Street,
Brisbane Qld 4000
Postal Address
GPO Box 2233,
Brisbane Qld 4001
Phone: +61 7 3335 9000
Facsimile: +61 7 3335 9999
Web: senexenergy.com.au

Senex Energy Pty Ltd
ABN 50 008 942 827