MANAGEMENT PLAN

Spring Gully North-West & North- East Project Environmental Constraints Planning and Field Development Protocol

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Australia Pacific LNG Project

Spring Gully North-West and North-East Project Environmental Constraints Planning and Field Development Protocol

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- **Should** indicates a recommended course of action
- **May** or **can** indicate a possible course of action.

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Deviations from Document

Any deviation from this document must be approved by the Australia Pacific LNG Project – Origin, Integrated Gas, Strategic Approvals Manager.

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1. Introduction

1.1. Project description

Origin Energy Upstream Operator Pty Ltd (Origin), on behalf of Australia Pacific LNG Pty Limited (Australia Pacific LNG), proposes to develop coal seam gas (CSG) resources located in petroleum leases (PL) 414, 415, 416 and part of 418, known as Spring Gully North-West Development Area (NWDA) and PL 417, known as the North-East Development Area (NEDA) (collectively referred to as 'the Project'). The Project is located approximately 30km to the east of Injune and 70km north-east of Roma in Surat Basin (**Appendix A**).

The Project was referred (referral EPBC 2017/7881) to the delegate of the Minister for the Department of the Environment and Energy (DoEE) and was determined to likely have a significant impact on the following controlling provisions that are protected under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Sections 18 and 18A: Listed threatened species and communities;
- Sections 24D and 24E: A water resource, in relation to CSG development and large coal mining development.

The assessment pathway of the Project will be via preliminary documentation. This Spring Gully Environmental Constraints Planning and Field Development Protocol (the Protocol) provides the framework for the assessment of environmental values and how infrastructure planning will be, or has been, sited to avoid environmental values, specifically matters of national environmental significance (MNES), where possible.

The Project area is approximately 39,424ha, with the development footprint encompassing approximately 505 ha of the total Project area. As the Project progresses through design, construction and operation, the development footprint may change.

As stated in the referral (EPBC 2017/7881), the Project will involve the progressive development of CSG infrastructure within the NWDA (PLs 414, 415, 416 and 418 (part)) and NEDA (PL417) and will include the following activities:

- The drilling, installation, operation and maintenance of CSG production wells. The Project is expected to consist of up to 114 production wells.
- Installation, operation and maintenance of gas and water gathering flowlines;
- Installation, operation and maintenance of associated supporting infrastructure (e.g. access roads, power and communication systems, temporary accommodation camps, laydowns, stockpiles etc.);
- Decommissioning and rehabilitation of infrastructure and disturbed areas; and
- Management of CSG water produced by the Project.

The Project will not require development of gas processing facilities (GPFs) or water management and treatment infrastructure as gas and CSG water will be directed to existing infrastructure located on PLs 195 and 204 and operated pursuant to approvals for the existing Spring Gully CSG Project (outside the scope of this Protocol). The use of existing infrastructure, GPFs and water treatment facilities (WTFs), will minimise land disturbance and associated environmental impacts in the Project area.

1.1.1. Scope and objectives

The scope of this Protocol is specific to the Project area as defined in Section 1.1 and Appendix A.

The Protocol has been developed to ensure a robust strategy is implemented for the identification of environmental values (as defined under the EPBC Act) and measures to avoid and minimise potential adverse impacts to these values.

The Protocol provides the method for assessing environmental constraints during the infrastructure planning and field development process. The objective of this Protocol is to provide a framework for the following:

- The decision making process for siting gas infrastructure within the Project area in compliance with Commonwealth environmental approvals;
- The internal process for disturbance approval, from ecological assessment to post construction reporting, including calculating and tracking actual disturbance to MNES;
- Data collection and maintenance processes;
- Compliance and corrective actions; and
- Protocol review requirements.

This Protocol is relevant to all phases of the Project where significant disturbance to land is proposed or is likely to occur on a terrestrial basis.

Origin have developed the Protocol to form part of the approval documentation for EPBC 2017/7881, with the intention of having the implementation of the Protocol form part of conditions of approval for the Project.

1.1.2. Protocol review

The Protocol is proposed to be reviewed every five years, post approval of this current revision. The review will assess the effectiveness of this Protocol in avoiding, minimising and mitigating adverse impacts to the environment, in particular MNES and will take into account relevant studies, policies, standards, guidelines and advice relating to CSG activities.

There are a number of circumstances under which the Protocol may require review and amendment including, but not limited to:

- Changes to the geographical extent of the Project;
- Revisions to databases and datasets;
- Changes to the listing status of MNES relevant to the Project;
- Amendments to relevant EPBC Act approval conditions;
- Amendments to legislation relevant to the Project;
- At the request of the Commonwealth Government;
- Following period review of the Protocol.

Amendments to the Protocol will be made in accordance with approval conditions for EPBC 2017/7881.

2. Infrastructure Planning

Infrastructure proposed for the Project can be categorised as one of the following three types:

- Wells;
- Gas and water gathering flowlines; and
- Supporting infrastructure.

Siting of infrastructure in regards to environmental constraints is dependent on the infrastructure type. In general, Origin will adopt a hierarchy of management principles when planning for petroleum activities that will result in land disturbance within the Project area. These management principles are:

- Avoidance – avoiding direct and indirect adverse impacts on environmental values wherever reasonably and practicably possible;
- Minimise – minimising direct and indirect adverse impacts where impacts cannot reasonably and practicably be avoided;
- Mitigate and Manage – implementing suitable mitigation and management measures to minimise direct, indirect and cumulative adverse on impacts on environmental values;
- Remediation and Rehabilitation – remediating and rehabilitating impacted areas to promote and maintain long-term recovery of affected environments; and
- Offset – providing offsets for activities that will result in an unavoidable significant residual impact to MNES.

During construction of the Project, it is estimated that approximately 505 ha of land (approximately 1.3% of the Project area) will be disturbed for wells, flowlines and associated infrastructure. The majority of this disturbance will take place on previously cleared land generally used for cattle grazing with approximately 224 ha of remnant/regrowth vegetation to be impacted on the balance area. Additional disturbance areas may be required for associated infrastructure (e.g. laydowns, drill camps, office etc.) where detailed design is yet to be completed. These will be sited to avoid TEC and listed species habitat where practicable and be sited in accordance with the above principles and the results of the constraints mapping as outlined in **Section 4.**

Prior to significant land disturbance, the Origin internal approval process will be completed to ensure environmental, landholder and engineering constraints are thoroughly considered. Further detailed is provided in **Section 5**.

3. Ecology Surveys

Ecology surveys have been undertaken prior to construction to identify environmental values within the Project area. The surveys comprised of an initial desktop assessment, followed by detailed field verification.

The environmental values recorded through the ecology surveys have been used to provide input in to the GIS layers used to generate the constraints mapping (refer **Section 4**). The Project will utilise the information from the ecology survey and constraints mapping when siting infrastructure and calculating and tracking disturbance.

3.1. Desktop assessments

A desktop assessment was undertaken to review all existing data and to identify the presence or potential presence of EPBC Act listed threatened species and TECs within the project area. The desktop assessment involved a review of previous ecological studies, environmental databases, maps and literature. Results were used to compile a preliminary likelihood assessment, which identified the target threatened species and any potential habitat areas within the project area. Survey methods and effort were based on this information and were prepared in accordance with appropriate Commonwealth guidelines.

3.2. Database searches

Comprehensive database searches were conducted to determine known, likely or potential environmental values. The following database searches were reviewed to assess the potential of MNES within the Project area:

- Commonwealth Protected Matters Search Tool (PMST) report;
- Queensland Wildlife Online report;
- Queensland Regional Ecosystem (RE) mapping;
- Queensland geological digital data;
- Queensland Essential Habitat mapping;
- Atlas of Living Australia records;
- Queensland Museum (open database);
- Queensland Wetland mapping;
- Queensland Watercourse Identification mapping;
- Commonwealth Species Profile and Threats (SPRAT) Database;
- eBird;
- Mines Online;
- QImagery;
- Queensland Land Use Mapping Program;
- Origin GTRE mapping;
- Origin fauna records;
- Aerial imagery; and
- Origin Corporate GIS databases of species records, watercourses and integrated regional ecosystems (IRE).

3.3. Review of previous studies

A total of 30 ecology and pre-clearance surveys have been conducted within the project area (although some of these studies were associated with broader projects). These existing ecological studies were reviewed to obtain the following information:

- Spatial results and extents of occurrence of TECs, threatened and migratory species and associated species habitat (where available);
- Known or likely occurrence of MSES, including REs and endangered, vulnerable and near threatened (EVNT) species records;
- Current threats; and
- Current and historical land use.

The EPBC Act threated species and TECs recorded in the project area during the previous studies are provided in **Table 3-1**.

Table 3-1: Previous studies results

Scientific Name	Common Name	EPBC Act Status
Threatened Fauna		
Dasyurus hallucatus	northern quoll	Vulnerable
Geophaps scripta	squatter pigeon	Vulnerable
Petauroides volans	greater glider	Vulnerable
Elseya albagula	white-throated snapping turtle	Critically Endangered
Phascolarctos cinereus (combined populations of Queensland, NSW and the ACT)	Koala	Vulnerable
Threatened flora		
Eriocaulon carsonii	Salt Pipewort	Endangered
Threatened Ecological Communities		
Brigalow (*Acacia harpophylla dominated and co-dominated*) TEC	Brigalow TEC	Endangered
Semi-evergreen vine thickets of the Brigalow Belt TEC	SEVT TEC	Endangered
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	Groundwater GAB TEC	Endangered

3.4. Literature review

Database searches and previous studies helped to inform a preliminary assessment regarding the likely presence of threatened species listed under the EPBC Act within the project area. Based on this list, additional information was sought for each of the identified species. The literature review included the following databases and reports:

- Relevant existing ecological studies;
- Species Profile and Threats Database (SPRAT), to determine the distribution, habitat requirements, population statistics and ecology of species (DoE, 2018);

- Survey guidelines for Australia's threatened reptiles (DSWEPaC, 2011c);
- Survey guidelines for Australia's threatened mammals (DSWEPaC, 2011b);
- Survey guidelines for Australia's threatened bats (DEWHA, 2010);
- Survey guidelines for Australia's threatened birds (DEWHA, 2010b);
- Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSWEPaC, 2011a);
- EPBC Act referral guidelines for the vulnerable koala (DoE, 2014);
- EPBC Act referral guidelines for the endangered northern quoll (DoE, 2016);
- Commonwealth Conservation Advice and/or Commonwealth Listing advice, where available, for each species; and
- Priority Threat Management for Imperilled Species of the Queensland Brigalow Belt (Ponce Reyes, *et al*. 2016).

3.5. Likelihood of occurrence assessments

Database searches and data obtained during previous studies and literature review were used to inform the likelihood of occurrence for TECs and threatened and migratory species listed under the EPBC Act and NC Act. Likelihood of occurrence assessments are used to determine survey effort required for environmental values and use a combination of known species distribution, populations, records and potential occurrence of suitable habitat which is to be field verified.

Criteria for likelihood of occurrence assessments include:

- Known: the species, population or ecological community has been observed on the site (e.g. the DA or DP).
- Likely: suitable high quality habitat for a species, population or ecological community occurs on the site, as described in the Spring Gully Threatened Species and Ecological Communities Management Plan or the advice of the suitably qualified person conducting the assessment or where nearby species records are present.
- Potential: suitable habitat (general habitat) for a species, population or ecological community occurs on the site, but there is insufficient information to categorise the species as likely, or unlikely to occur.
- Unlikely: a low to very low probability that a species, population or ecological community uses/occurs on the site due to the lack of suitable habitat and absence of records or the site is outside the species known range.
- No: the species will not occur on site e.g. marine species in a terrestrial study site.

Note: high quality habitat and general habitat is defined, per species, within the Spring Gully Threatened Species and Ecological Communities Management Plan.

3.6. Flora field survey

Flora surveys were undertaken to identify threatened species and communities listed under the EPBC Act. Flora surveys targeted threatened species identified within the desktop assessments. Searches were conducted to identify high quality habitat for the species and individuals or population findings of the species. The location of any threatened species was captured spatially.

Seasonal timing of surveys were considered in the planning and implementation of surveys.

Any flora specimens deemed as potential threatened species and not conclusively identified by the suitably qualified person were forwarded to the Queensland Herbarium for verification. Further details of the assessments are available in *Spring Gully North-East and North-West Development Area Ecological Survey and Significant Impact Assessment* (ELA, 2018).

3.6.1. Targeted habitat assessments

Habitat assessments were limited to the threatened flora species in which DoEE has determined the Project likely to impact (EPBC 2017/7881), i.e. *Bertya opponens*. Targeted flora habitat assessments were undertaken for this species, to identify the extent, condition and value of habitat within the project area.

Habitat attributes as used to conduct species specific habitat assessments for the targeted species were derived from information contained within Species Profile and Threats Database (SPRAT), approved species Conservation Advice, Department guidelines or by the guidance of suitably qualified personnel conducting the surveys.

Data captured to determine suitable species habitat included:

- Observed Regional Ecosystem (RE);
- Geology;
- Soil type; and
- Presence of rocky substrate.

3.6.2. Threatened flora surveys

Threatened flora targeted surveys were determined on the basis of EPBC Act listed flora species DoEE had considered the Project to likely impact (EPBC 2017/7881), i.e. *Bertya opponens*. An additional EPBC Act species, the endangered species *Eriocaulon carsonii* is also known to occur in association with Scott Creek spring complex (spring 192 and spring 192.1) (ALA, 2018).

No Government species-specific survey guidelines are available for *B. opponens*. As such, threatened species searches were conducted simultaneously with all other field surveys in areas identified from the targeted habitat assessments, with 234 hrs dedicated to searching for the species. All ecologists involved in the field surveys were briefed on the threatened flora species potentially occurring within the project area.

3.6.3. Vegetation assessments

RE assessments involved ground-truthing the vegetation mapping across the project area, as well as validating the presence of TECs. Three methodologies were used to collect data on the vegetation characteristics (floristic and structural form), ecological condition and extent of the vegetation communities, including RE and TEC classification; these included, vegetation structure assessments, quaternary surveys and TEC assessments.

3.6.3.1. Vegetation structure assessments

Vegetation structure assessments were undertaken within a 100 m x 50 m nested sampling plot to determine the following attributes:

- vegetation structure (e.g. woodland, low closed forest, etc.).
- geology;
- observed RE;
- dominant emergent species, height and cover;
- dominant canopy species, height and cover;
- dominant midstorey species, height and cover;
- dominant shrub species, height and cover;
- dominant ground cover species, height and cover;
- tree canopy height; and
- tree canopy cover.

3.6.3.2. Quaternary assessments

Quaternary assessments were used to validate the extent, classification and condition of ground-truthed vegetation communities across the project area. At each survey point, RE classification and vegetation condition (remnant, regrowth, and non-remnant) was recorded. These assessments were conducted in line with the '*Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland'* (Neldner *et al.,* 2017) and included the following:

- RE classification was based on the vegetation, soil and landform characteristics at each point, as well as the region's geological mapping and the Regional Ecosystem Description Database (REDD).
- woody vegetation condition status was classified using the definitions of remnant vegetation, as defined under the *Vegetation Management Act 1999* (VM Act).

3.6.4. Threatened ecological community assessments

TEC assessments were conducted to affirm the presence of those TECs identified during the desktop assessment, which included:

- Brigalow (*Acacia harpophylla dominated and co-dominated*) Threatened Ecological Community (Brigalow TEC);
- Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions ecological community (Coolibah – Black Box Woodlands TEC); and
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC).

Field assessments were conducted by a suitably qualified person to determine the presence of the TECs listed above. Data on the following was recorded:

- The TEC;
- The patch size (in hectares);
- Equivalent RE (if relevant);
- Determination of whether the patch meets the listing criteria of the TEC; and

Evidence state as age, native ground cover, dominant species, weed cover in determining how the patch meets the TEC

3.7. Fauna field survey

A combination of field verification methodologies was conducted within the study area to assess and determine the presence of MNES occurring within the project area. The field survey was conducted over 39 days (excluding the additional days bat detectors / remote cameras were deployed), with approximately 1,568 person hours undertaken to implement the methods described below within the Project area (ELA, 2018).

3.7.1. Targeted habitat assessments

Targeted habitat assessments were undertaken to identify the extent, condition and value of habitat within the project area, and as such, the likely occupancy/useability of these habitats by target threatened fauna species, in terms of breeding, shelter, roosting, denning, foraging and dispersal. These assessments helped to locate suitable areas for targeted field surveys (i.e. live trapping, active searches or spotlighting). Habitat assessments were undertaken for the following target fauna species, considered by DoEE to be likely impacted by the Project:

- Threatened mammals:
    - koala (*Phascolarctos cinereus);*
    - greater glider (*Petauroides volans*);
    - northern quoll (*Dasyurus hallucatus*);
    - large-eared pied bat (*Chalinolobus dwyeri); and*

  - Corben's long-eared bat (*Nyctophilus corbeni*).
- Threatened bird:
  - squatter pigeon (southern) (*Geophaps scripta scripta*);
- Threatened reptiles:
  - collared delma (*Delma torquata*);
  - Dunmall's snake (*Furina dunmalli*);
  - yakka skink (*Egernia rugosa*); and
  - white-throated snapping turtle (*Elseya albagula*).

Data was collected for each species during habitat assessments, which were specific to each species in confirming or determining likely or potential presence of a species based on occurrence of habitat features or signs of the species.

In determining when and where habitat assessments should be conducted for each species, knowledge of habitat preference through key habitat attributes and knowledge of habitat utilisation was used, where known.

Further details of the assessments are available in *Spring Gully North-East and North-West Development Area Ecological Survey and Significant Impact Assessment* (ELA, 2018).

3.7.2. Targeted threatened fauna surveys

Targeted threatened fauna species surveys were undertaken in areas identified as potential habitat for each target species, as determined during targeted habitat assessments. Survey methods and survey effort adhered to relevant Commonwealth survey guidelines, where they were available.

The following sections provide an overview of the methodologies conducted, with *Spring Gully North-East and North-West Development Area Ecological Survey and Significant Impact Assessment* (ELA, 2018) containing a detailed description of what was conducted for each of the target species in comparison to the relevant Commonwealth survey guideline, where available. All surveys were conducted in accordance with the conditions of the following permits:

- Animal Ethics Permit (CA 2015/08/895);
- Scientific Purposes Permit (WISP14991114);
- Scientific Purposes Permit – Hallett State Forest (WISP18732018); and
- Permit to Collect Biological and Geological Material – Hallett State Forest (WIF418731918).

3.7.2.1. Herpetology searches

Targeted diurnal searches were undertaken for collared delma, yakka skink and Dunmall's snake across the project area in areas of suitable habitat, as identified during the targeted habitat assessments. Searches were typically undertaken mid-morning to late afternoon. A total of 144 targeted searches were conducted, over 39 days, comprising a total of 174 search hours. These searches were typically undertaken by suitably qualified persons with reptile expertise to increase the likelihood of encountering the target species.

Targeted searches involved slowly walking through suitable reptile habitat and searching for reptiles sheltering inside or underneath microhabitat features such as rocks, bark, logs, leaf litter and other fallen woody debris. Physical disturbance to habitat features and reptiles was kept to a minimum.

3.7.2.2. Waterhole watches

Aerial imagery was examined to determine waterhole sites where permanent waterholes were likely to be present within Scott and Slatehill Creek. At these locations, waterhole watching was undertaken in general accordance with recommendations for visual survey of turtles as described in Eyre *et. al.* (2014). Observers searched for turtles using 10x42 binoculars. Species identification and count data were captured electronically using the fauna point feature class in ArcCollector.

Waterhole watches were conducted for a minimum of 60 minutes at each site. As the species surfaces to breathe relatively frequently, visual survey was considered an effective technique for detecting the presence of the species (Boobook, 2017d).

Waterhole watches were conducted by a suitably qualified person with previous experience with the species.

3.7.2.3. Roost searches

Areas likely to contain suitable roosting habitat were searched for either active roost sites or to assess habitat suitability for target bat species (large-eared pied bat and Corben's long-eared bat). Targeted areas included sandstone escarpments likely to contain caves and rock overhangs or vegetation areas containing bulloak or belah trees where fissures and decorticating bark may be present. Areas were searched for active roost sites, and where not found these areas were assessed for their habitat suitability.

3.7.2.4. Den and scat searches

Areas likely to contain den sites suitable for northern quoll were searched for signs of activity. Areas targeted include sandstone ridges and mid-slope areas that may contain rocky outcrops and large boulders. Signs of active roost sites were searched for (i.e. presence of scats and/or tracks), and where not found these areas were assessed for their suitability for northern quoll denning sites.

3.7.2.5. Bird survey

Diurnal bird surveys were undertaken for the squatter pigeon across the project area in suitable habitat, as identified during the targeted habitat assessments. Surveys were conducted within the first four hours and/or last two hours of sunlight. A total of 139 hours of dedicated bird surveys were conducted across the survey period.

Bird surveys involved three different techniques:

- **Bird transects**: walking slowly and strategically through bird habitat for at least 20 minutes and recording direct and indirect (heard) observations of birds;
- **Waterhole watch**: sitting quietly by water bodies for at least 20 minutes to observe birds near creeks or dams and recording direct and indirect observations;
- **Driving transects**: driving along formed tracks where groundcover may be sparse for at least 60 minutes per day. This technique was used to target squatter pigeon which are frequently observed along roadsides where groundcover is sparse.

3.7.2.6. Spotlighting

Spotlighting surveys involved slowly walking and/or driving through areas of vegetation from dusk to 22:00-23:00 using spotlights and binoculars to spot and identify species.

Spotlighting surveys were undertaken for the greater glider, koala and Dunmall's snake across the project area in suitable habitat, as identified during the targeted habitat assessments. A total of 177 hours of spotlighting (arboreal and terrestrial) were conducted across at least 44 sites over 20 spotlighting survey nights.

3.7.2.7. Call playback

Call playback surveys were undertaken for the koala, as per David Stewart (2002), across the project area in suitable habitat as identified during the targeted habitat assessments. Call playback was conducted during spotlighting for koala. The call was played intermittently for up to five minutes and a call back listened for up to 10 minutes at one location.

3.7.2.8. Koala spot assessments

The spot assessment technique (SAT) is a tool that can identify localised habitat use by koalas. It uses a point-based, tree sampling methodology: the presence/absence of koala faecal pellets (or scats) are counted in a given area around the base of trees to extrapolate a measure of koala activity. The

assessment utilises trees of any species that are known to have been utilised by koalas (e.g. a known koala food tree species) (Australian koala Foundation, 1995).

At a SAT assessment site, a centre tree is required. This tree was selected based on one or two of the following criteria, in order of decreasing priority (Australian Koala Foundation, 1995):

- A tree of any species containing faecal pellets at the base; and/or
- A tree in which a koala has been observed; and/or
- Any other tree known or considered potentially important to koalas, or for other assessment processes.

A minimum of 30 site trees were inspected for the presence of koala to establish a meaningful confidence interval. A total of 29 trees around the centre tree was sampled for evidence of koala presence (i.e. scratches or scats). Scats were analysed by experienced analyst Georgeanna Storey (ScatsAbout).

A total of 17 SATs were conducted across the project area to determine localised habitat use of koalas.

3.7.2.9. Remote cameras

Remote cameras were installed at 41 locations within suitable northern quoll habitat within the project area. Each camera was set facing towards a plastic bait station (hair tube) baited with a mixture of universal bait (honey (5%), peanut butter (10%), and rolled oats (70%) and sardines (15%), or facing potential denning or watering sites. Cameras were left in each area between 7 to 48 days. Total remote camera survey effort equates to 450 camera trap nights. All images were analysed by a suitably qualified person and animals detected in the images were identified to species level.

3.7.2.10. Echolocation detectors

Unattended bat recorders

Unattended bat recorders (SM3, SM2 or Anabats) were placed in the vicinity of caves and rocky outcrops, and also in foraging sites such as vegetation corridors, flyways, sandstone gorges, over watercourses and adjacent to artificial waterbodies (dams) in representative potential, likely and known habitat.

Ten bat detector devices were deployed at 34 sites throughout the project area, with a total of 78 detector nights.

The number of detector nights for the Corben's long-eared bat is not specified in the Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010a) as the species cannot be reliably distinguished by call. However, the detection of bat calls is a tool used for the species to determine the presence of the genus (*Nyctophilus*). Harp trapping was undertaken to target this species.

Analysis of micro-bat calls was conducted by a suitably qualified person.

Attended bat recorders

Active acoustic detection with use of hand-held detectors was conducted for a total of 14 hrs (8 nights) by bat expert, Greg Ford. Active acoustic detection commenced at dusk.

3.7.2.11. Harp traps

Harp traps were used to supplement echolocation efforts, as recommended by the Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010a).

Trapping was conducted within the vicinity of potential roosts and forest flyways, rocky outcrops, scarps and riparian zones. The location was primarily determined with the guidance of bat expert, Greg Ford. A greater focus was given to targeting potential Corben's long-eared bat habitat with the harp traps as the species cannot be reliably identified by echolocation calls.

Double-bank harp traps were used throughout the 31 sites sampled across 15 nights. A total of 55 trap nights were conducted. Each trap was left set from approximately 18:00-23:00 each night.

Trapped bats were identified to species level in the field and immediately released. Appropriate measurements were recorded, where necessary for determination to species level.

3.7.2.12. Snake funnels

Twelve snake funnel trap lines were established within suitable species habitat. The trap lines comprised of drift fence (between 15 m to 30 m), with at least three funnels each side of the fence (i.e. at least six funnels each trap line, but up to 12 funnels). Piles of dead grass, leaf litter or tree branches were placed over the traps to prevent desiccation of captured fauna. Each trap line was checked for fauna each morning (within two hours of sunrise) and during each afternoon. Funnel traps targeted reptiles, particularly snakes (e.g. Dunmall's snake) and were left open at each site for five consecutive nights giving a total of 375 trap nights.

Trapped fauna were identified to species level or photographs were taken for later identification using reference guidelines and then released at the trap site.

3.7.2.13. Pitfall traps

Nine pitfall trapping sites were established within suitable habitat of Dunmall's snake and collared delma. Trap lines comprised of drift fence (between 15 m to 30 m) with a T formation, with six 20 L plastic buckets placed at intervals. Each pitfall was given shade in the form of leaf-cover / bucket lid during the day to prevent heat stress to any fauna trapped in the day. Pitfall traps were checked at least twice a day.

Trapped fauna were identified to species level or photographs were taken for later identification using reference guidelines and then released at the trap site.

3.7.2.14. Hair tubes

A total of 184 hair tubes were placed along 18 transects within suitable habitat across the project area. Hair tubes were left in place for a period of one to four weeks. Hair tubes suitable for medium sized mammals (i.e. northern quoll) were either strapped to trees or logs or fixed to the ground along tracks or rocky outcrop areas. Each hair tube was baited with universal mixture bait with sardines. Double sided tape was placed on the opening of each hair tube to collect the hair.

3.7.2.15. Incidental fauna observations

All fauna species observed or heard across the project area were recorded, including between survey sites. Species were identified to species level, where possible.

3.8. Data analysis

ArcCollector was utilised to collect field data, using iPads or smartphones. The spatial data collected during the field survey were imported into ArcView GIS (Version 10.2). Vegetation and habitat boundaries were validated and re-defined where necessary, and a final ground-truthed vegetation map was produced.

The following Origin GIS corporate layers were updated, post collection of field verified data:

- Integrated Regional Ecosystem (IRE) using data collected during the RE survey and TEC assessments. This layer includes the RE classification as per the Biodiversity Status and whether the RE meets the condition and diagnostic criteria of a TEC under the EPBC Act.
- Habitat layer using habitat assessment data in conjunction with RE survey data. This habitat layer is for MNES species only and is attributed to specific threatened flora and/or fauna species. The layer is polygon-based so that the area of suitable habitat can be intersected with proposed disturbance layers to calculate impact in hectares.
- Fauna species layer, using data collected during the fauna survey methodology. This layer includes species listed as threatened, migratory or marine under the EPBC Act, species listed as least concern, special least concern, endangered, vulnerable or near threatened under the NC Act and species listed as Restricted Matter under the *Biosecurity Act 2014*. The layer includes attributes such as the species name, number of individuals encountered and observation method (i.e. seen, evidence, heard etc.).
- Flora species layer, using data collected during the flora survey methodology. This layer includes species listed as threatened under the EPBC Act, species listed as least concern, special least

concern, endangered, vulnerable or near threatened under the NC Act, Weeds of National Significance (WoNS) and species listed as Restricted Matter under the *Biosecurity Act 2014*.

- Constraints mapping was updated to include the ground-truthed values. This was undertaken using the constraint mapping method described in **Section 4.**

These data must be available to the Project Designer and are to be considered in the placement in infrastructure, with the hierarchical approach of avoid, minimise, mitigate, remediate and offset. **Section 5** describes the internal process of disturbance approval for the Project.

4. Constraints Planning and Mapping

4.1.1. Constraints categorization

The environmental constraints for the Project have been derived from a range of sources depending on the constraints type. Overall, the most sensitivity receptors within the Project area have been identified as either extreme no-go areas, or areas of high constraint where only linear infrastructure may be developed. There are also a number of low constraints areas that do not have remnant vegetation and/or contain existing infrastructure. There are no restrictions on the petroleum activities that can be undertaken here. Finally, the remaining areas (i.e. not extreme, high or low) are considered to have moderate constraints. Whilst all petroleum activities may be undertaken in these areas, some parts of the moderate constraint area are more sensitive than others. A hierarchy has been developed and presented (see section 4.2), with the expectation that works will be first located in areas of lowest sensitivity (moderate 3 areas) through medium with activities only occurring in the highest (moderate 1 areas) sensitivity areas when they cannot be preferentially undertaken in other areas.

The constraints GIS datasets considered for the Project has been compiled through detailed on-ground ecology survey data combined with Government datasets and Origin GIS datasets. The constraints categories as detailed in the GIS layers represent requirements for constraints planning and field development for the Project. The group of constraints that make up the different GIS layers will be revised if new constraints are identified, or if approval conditions for the Project are varied.

A full list of constraints, constraint categories and the relevant development restrictions that will apply are detailed in Table 4-1. The constraints mapping is presented in Section **4.**

Table 4-1: Project Constraint Categories

Constraint Categories	Development Permitted	Constraint
Extreme no-go area	No petroleum activities	• White-throated snapping turtle habitat • 200 m buffer around spring vents and/or spring complexes protected under the EPBC Act
High constraint area	Linear infrastructure only	• Denning habitat for the Northern Quoll • Roosting habitat for the Large-eared Pied Bat • High Ecological Significance Wetlands as detailed in the Map of Referrable Wetlands dataset (QLD) • Watercourses
Moderate constraint area^	All petroleum activities*	• Moderate 1 - constraints basis ranking high – MNES with a constraint basis ranking score between 8-11
		• Moderate 2 - constraints basis ranking moderate – MNES with a constraints basis ranking score between 4-7
		• Moderate 3 - constraints basis ranking low – MNES with a constraints basis ranking score of 3 or below
Low constraint area	All petroleum activities	• Non-remnant vegetation • Existing Origin infrastructure • Existing roads, rail, pipeline and other infrastructure that would have to be considered during field development

^ See section 4.2 below for methodology of determining Moderate 1 – 3 level constraint

* All petroleum activities will be permitted within the moderate constraint area, however disturbance will be avoided in accordance with the relevant constraints ranking where areas with a higher constraint basis ranking will be preferentially avoided over areas with a lower constraint basis ranking

4.1.2. Methodology for determining moderate constraint levels

As presented above, extreme, high and low constraint levels are set due to either the very high or very low ecological values present in certain areas. The remainder of the Project area is considered to be of medium constraint. However, the range of sensitivity of ecology values throughout the moderate constraint area has been recognised and is quantified using the method below.

4.1.3. Constraints basis ranking

Constraints mapping has been developed to categorise environmental sensitivity in the moderate constraint sections of the Project area. It incorporates a scoring system based on a set of four core ecological values:

- The relevant listing status for TECs and threatened species;
- The habitat quality of the patch;
- The number of different TECs and species to be impacted; and
- The value of the patch for TECs and species in a regional context.

To apply various levels of constraint on MNES using the core ecological values listed above, each patch of vegetation must be ranked. To achieve this, the following MNES constraint basis ranking will be applied:

1. A score will be assigned in relation to each of the four core ecological values; and
2. The four scores will be added together to determine the final MNES constraints basis rank.

The final constraints basis rank will be utilised as an additional constraint planning tool within the GIS for the Project. Where practical patches with a higher MNES constraint basis ranking will be avoided in preference to areas with a lower MNES constraint basis ranking.

Further details on the input score for the core ecological values and the final constraint ranking are detailed below.

4.1.3.1. Listing status score

As per the EPBC Act, TECs are listed as either Critically Endangered or Endangered, with threatened flora and fauna species listed as either Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable. There are no species with a listing status of Extinct or Extinct in the Wild that would occur in the Project area and as such these listing statuses have been excluded from this assessment. The constraint score for the listing status is shown in **Table 4-2** below.

Table 4-2: Constraint score for EPBC Status

EPBC Listing Status	Constraint Score
Critically Endangered	3
Endangered	2
Vulnerable	1

4.1.3.2. Patch quality score

The size of a patch is used as a surrogate for quality as larger patches are generally more resilient to ecological edge effects and are generally more likely to sustain population of native flora and fauna. The size of a patch and its related quality varies based on the key species for which it is considered habitat. To account for relevance of patch size to particular species, the constraint scores have been split into three categories based on the size and mobility of relevant fauna species. An additional category has been assigned to flora species and TECs and is based on the patch size of remnant vegetation generally

required to be classified as a TEC or that is generally capable of supporting a viable population of a flora species. The constraint scores for how patch size will determine quality is shown in **Table 4-3** below.

Table 4-3: Constraint score for patch quality

Constraint score	Patch size class for all mammals & Squatter Pigeon	Patch size class for all terrestrial reptiles	Patch size class for White Throated Snapping Turtle	Patch size class for all flora species and TECs
3	>100 ha	>5 ha	All habitat	>10 ha
2	10 ha – 100 ha	1 ha – 5 ha	-	5 ha – 10 ha
1	<10 ha	<1 ha	-	0.5 ha -5 ha

4.1.3.3. Number of different communities and species impacted score

Typically, patches are comprised of vegetation that provides suitable habitat for a number of different species, meaning more than one matter may be impacted. To account for the different number of species and communities within a patch, the constraint score has been divided into three separate constraint score categories, as shown below in **Table 4-4**.

Table 4-4: Constraint score for the number of different communities and species impacted

Number of different communities and species impacted	Constraint Score
7 or more matters	3
4 to 6 matters	2
3 or less matters	1

4.1.3.4. Value of a patch regionally score

The value of the patch in a reginal context is scored using the Queensland Government's Landscape Fragmentation and Connectivity Tool. Landscape fragmentation analysis was undertaken as part of the ecology surveys for the Project area and the proposed development footprint to determine fragmentation classes that will exist, post Project development. The landscape fragmentation analysis was undertaken in accordance with the method described in "Queensland Environmental Offsets Policy – Landscape Fragmentation Connectivity (LFC) Tool" (DEHP, 2016).

The LFC tool uses a local buffer around the project area of 5 km and a regional buffer of 20 km around the project area to determine fragmentation and connectivity and utilises State Remnant mapping.

Landscape fragmentation classes (sourced from Vogt *et al* 2007) used include:

- 0: the fragmentation class (i.e. non-forest)
- 1: patch – small or narrow fragments that are wholly influenced by the "edge effect"
- 2: edge – occurs within the "edge effect" zone along the outside edge of a non-patch tract (e.g. the forested area).
- 3: perforated – occurs within the "edge effect" zone along the edge of a small clearing in a non-patch tract.
- 4: core < 100 hectares – core (interior) occurs on the inside of the peripheral zone and is considered to be unaffected by the edge effect.
- 5: core ≥ 100 ha and < 500 ha – core (interior) occurs on the inside of the peripheral zone and is considered to be unaffected by the edge effect.
- 6: core ≥ 500 ha – core (interior) occurs on the inside of the peripheral zone and is considered to be unaffected by the edge effect.

- 7: other (including open water).

The results of the tool can be used to broadly measure fragmentation and connectivity in a landscape and to inform impacts to threatened species core habitat and connectivity. The constraint scores for the value of the patch in a regional context is shown below in **Table 4-5**.

Table 4-5: Constraint score for the value of a patch regionally

Landscape fragmentation class	Constraint Score
Core	3
Perforated, patch or edge	2
Non-remnant	1

4.1.4. Final constraints ranking

The scores for each of the four core ecological values will be summed to provide the final MNES constraints basis ranking for areas of overall moderate constraint. Areas that contain a high ranking score will be considered to be in better environmental condition and will be preferentially avoided relative to areas with a lower MNES ranking. The final constraints rankings are shown below in Section 4.1.4.

5. Internal Disturbance Approval Process

All Disturbance Approvals (DAs) go through a gated process, as shown in **Figure 5-1** and described below. The process allows for thorough assessment of stakeholder considerations (environmental, landholder, engineering).

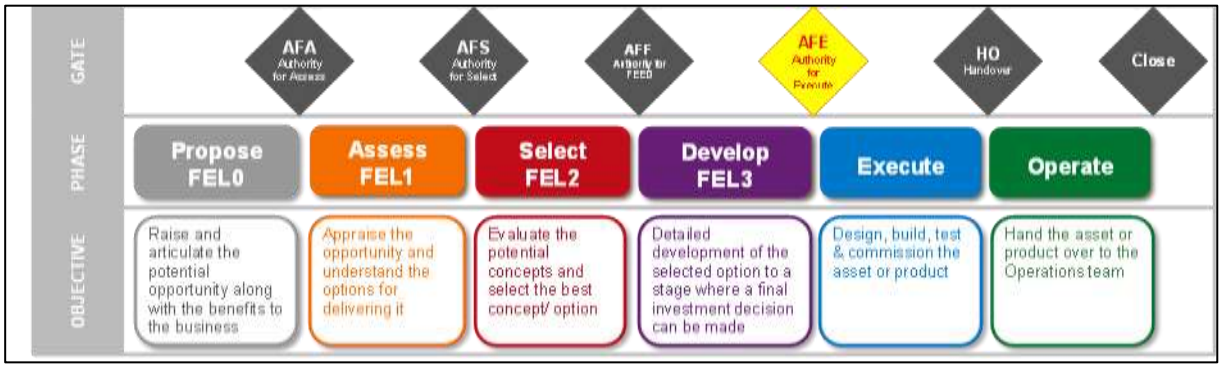

Figure 5-1: Gated Process

The final location of wells, flowlines, access tracks and ancillary infrastructure gives consideration to a range of matters including Environmentally Sensitive Areas (ESAs), TECs, significant vegetation, and habitat for listed species, topography, and cultural heritage, impact on landholders, engineering constraints and construction costs. Wherever practicable, previously disturbed areas are utilised and gathering network and access tracks are co-located. Selected locations are progressively refined in consultation with landholders and other stakeholders to minimise adverse environmental and landholder impacts whilst balancing cost and constructability. A robust internal disturbance approval process ensures the Project execution aligns with conditions of approval and management commitments, particularly avoidance of key environmental impacts where there are reasonable and practicable design alternatives.

The DA process occurs over a number of stages (FEL – front end loading):

- FEL 0: Preliminary concept developed (well spacing, number, type) based on reservoir modelling;
- FEL 1: Conceptual layout of infrastructure developed giving consideration to the results of an ecology assessment, landholder and engineering constraints;
- FEL 2: Environmental specialists, construction personnel, engineers and landholders undertake site assessment to assess the proposed infrastructure locations and the layout is finalised;
- FEL 3: Required approvals are obtained; and
- Execute: Detailed design is completed and construction commences.

The findings of the field ecology survey (**Section 3**) and constraints mapping (**Section 4**) will inform infrastructure planning and decision making. The constraints assessment and infrastructure planning decision will be documented to demonstrate conformance with this Protocol. Infrastructure will be sited in accordance with conditions of the Spring Gully EA and in accordance with the constraints mapping developed and amended from time to time.

6. Calculating and Tracking Disturbance

While the previous sections in this Protocol details the process for identifying and siting infrastructure to avoid environmental values (inclusive of REs, TECs, watercourses, wetlands, lakes, springs, threatened fauna and flora and migratory species), this Section (the calculation and tracking disturbance) is specific only to MNES, being threatened ecological communities, threatened fauna species habitat and threatened flora species habitat.

The following sections outline the process to be implemented when adverse impacts to MNES have the potential to occur.

1.1.3. Planned disturbance

Where MNES cannot be avoided through Project infrastructure planning, planned disturbance is to be calculated by an Environmental Advisor (Approvals). This will include intersecting the proposed disturbance infrastructure footprint (at Issued for Disturbance Approval (IFDA)) with the MNES using ArcGIS for each DA and/or DP (whichever is applicable).

Planned disturbance will be recorded for the following:

- EPBC listed TECs (by community in hectares);
- EPBC threatened flora species (by number of species identified and amount of suitable habitat in hectares); and
- EPBC threatened fauna species habitat (by habitat per species hectares).

The suitably qualified person will provide justification as to how infrastructure planning attempted to avoid and minimise impacts to the MNES. This will be recorded in the environmental constraints assessment, or equivalent.

This aspect is required to authorise the location of disturbance, as the intent of this Protocol is to ensure that environmental values are considered during infrastructure planning and that the requirement to place infrastructure within these areas, where there is no practical alternative, is justifiable and consistent with the intention of this Protocol.

1.1.4. Actual disturbance

Project infrastructure planning consists of conceptual design, where areas of disturbance are proposed, and detailed design, where areas of proposed disturbance are refined to the absolute area of disturbance required to undertake the activity. Planned and actual disturbance can differ in extent, with the intent of reducing areas of actual disturbance, come detailed design.

The disturbance areas are surveyed by the construction contractor and are made available to Origin GIS. If an impact occurs to MNES during the undertaking of the Project (field development, operation or decommissioning) the process described in **Table 6-1** will be undertaken.

Any impact on suitable habitat for an EPBC listed threatened flora or fauna species, regardless of whether the species has been identified on the Project site, will be recorded using the process for recording a disturbance as detailed below.

Table 6-1: Process for Recording Disturbance

Stage of Project	Description
Infrastructure planning	The Environmental Advisor (Approvals) will or with the assistance of Corporate GIS, intersect the proposed disturbance area (infrastructure layer or detailed design infrastructure layer, if available) with the following applicable ground-truthed layers to calculate the proposed disturbance: • TECs • MNES layer of threatened species This proposed disturbance will be considered during infrastructure planning and avoided, where possible. However, should disturbance continue to be proposed, reasoning for

Stage of Project	Description
	placement will be recorded by the Environmental Advisor (Approvals) and/or suitably qualified person within Squad Check notes (or superseding process). Proposed disturbances will be recorded spatially (GIS) within the Environmental Approvals workspace.
Prior to and post disturbance	Prior to conducting significant disturbance (construction phase), but when detailed design for a DA/DP is being developed, the Environmental Advisor (Asset Services) will liaise with the Contractor (Construction) to ensure the principles of this Protocol are implemented in further reducing adverse impacts to environmental values, where possible. Post disturbance a 'disturbance layer', which is part of the Project 'As Built data layer' (a GIS layer of disturbance and infrastructure) will be provided to Corporate GIS. This layer, via Corporate GIS will be made available for the business for their individual data analysis requirements.
Post disturbance	On a 6 monthly basis, Spotter Catcher Records will be reviewed to assess whether any MNES species were recorded during construction. This data will be compared to the MNES layer of threatened species. The MNES layer will be re-assessed should any MNES be recorded outside of the MNES layer of threatened species.

1.1.5. Recording and reporting disturbances to MNES

Where disturbance to MNES constraints is permitted during gas field development, operation or decommissioning, the following details will be recorded:

- The location and specific site of the disturbance, and the type of infrastructure or activity responsible for the disturbance;
- Each MNES subject to disturbance;
- The related pre-construction site assessment or field ecological survey documentation identifying the environmental constraints or MNES;
- The reasons for the decision to disturb MNES;
- The total area of actual disturbance to MNES and the relevant effect on the disturbance limits set out in the approval documents.

This requirement applies to any adverse impact on MNES whether or not a disturbance limit has been set and whether or not the impact has been decided by the proponent under the Protocol based on other physical constraints.

Total and disaggregated actual disturbance data will be reported as required in approval EPBC 2017/7881.

7. Data Collection and Storage

The data is to be captured in compliance with Origin's Corporate Field Data Collection Schemas.

Supporting data collected during field assessments is to be stored within the GIS corporate system, however, the importance on integrating this data is secondary as it is used to support the assessment (i.e. quaternary site data is used to determine REs).

Origin will maintain accurate records, survey information, photographs, field data or any material associated with the field validation requirements to demonstrate that surveys and environmental assessments were conducted in a manner consistent with the Protocol. This material will be provided to the Department upon request.

Origin will report on gas field activities as required in approval EPBC 2017/7881.

8. Compliance and Corrective Actions

A holistic approach to avoid, minimise and mitigate impacts to environmental values will be undertaken by the Project in regard to the assessment of environmental values, planning of infrastructure and disturbance (planned and actual), and recording of actual disturbance.

Origin's Atlas compliance system will track conditions of approval EPBC 2017/7881, assign responsibility and track conformance with this Protocol.

Should any aspect of this Protocol not be complied with, Origin's Risk Assurance Compliance and Process Safety Team will seek reasoning for non-conformance and implement corrective actions.

9. Definitions and Abbreviations

9.1. Definitions

Table 9-1: Definitions

Term	Definition
Suitably qualified person/ecologist	Means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.
Significantly disturbed land	*Environmental Protection Regulation 2008* definition: (1) Land is ***significantly disturbed*** if – a. It is contaminated land; or b. It has been disturbed and human intervention is needed to rehabilitate it – i. To a condition required under the relevant environmental authority; or ii. If the environmental authority does not require the land to be rehabilitated to a particular condition – to the condition it was in immediately before disturbance. *Examples of a disturbance to land -* • *The covering, compaction, exposure, removal or stockpiling of soil or other material* • *The destruction or removal of vegetation* • *The carrying out of a mining activity in a watercourse or wetland* • *The submergence of an area with a hazardous contaminant, tailings, or water* (2) Without limiting subsection (1)(b), land requires human intervention to rehabilitate it if – a. The disturbance has made the land more susceptible to erosion; or b. The land use capability or suitability of the land is diminished; or c. The quality of water in a watercourse downstream of the land has been significantly reduced. (3) If land is significantly disturbed land because it is contaminated land, it ceases to be significantly disturbed land if a suitability statement is issued for the land. (4) If land is significantly disturbed land under subsection (1)(b), it ceases to be significantly disturbed land if the administering authority is satisfied the land has been rehabilitated – a. To the condition it was in immediately before the disturbance; or b. To another condition decided by the administering authority.
Significant impact	A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance (DoE, 2013).
Petroleum activity	A petroleum activity is – a) An activity that, under the *Petroleum Act 1923*, is an authorised activity

Term	Definition
	for a 1923 Act petroleum tenure under that Act; or b) an activity that, under the P&G Act, is an authorised activity for petroleum authority under that Act; or exploring for, exploiting or conveying petroleum resources under a licence, permit, pipeline licence, primary licence, secondary licence or special prospecting authority granted under the Petroleum (Submerged Lands) Act 1982.
Project	The proposed development of coal seam gas resources located on petroleum lease (PL) 414, 415, 416 and part of 418 (known as Spring Gully North-West Development Area), and PL 417 (known as Spring Gully North-East Development Area), referred to as the Spring Gully North-West and North-East Project.
Project area	Spring Gully North-West and North-East Project area (Appendix A).

9.2. Abbreviations

Table 9-2: Abbreviations

Term	Definition
ACH Act	*Aboriginal Cultural Heritage Act 2003*
ALA	Atlas of Living Australia
CSG	Coal Seam Gas
E	Endangered
DEHP	Department of Environment and Heritage Protection
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area(s)
EVNT	Endangered, vulnerable, and near threatened
GPF	Gas Processing Facilities
HERBRECs	Queensland Herbarium Specimen Data
IRE	Integrated Regional Ecosystems
MNES	Matters of National Environmental Significance
NC Act	*Nature Conservation Act 1992*
NEDA	North-East Development Area
NT	Near threatened
NWDA	North-West Development Area
PL	Petroleum Lease
PMST	Protected Matters Search Tool
RE	Regional Ecosystem
SAT	Spot Assessment Technique
SPRAT	Species Profile and Threats Database
TEC	Threatened ecological community(ies)
V	Vulnerable
VM Act	*Vegetation Management Act 1999*
Water Act	*Water Act 2000*
WTF	Water Treatment Facility

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Appendix A – Spring Gully Project Area

Appendix B – Constraints Mapping