ENVIRONMENT MANAGEMENT PLAN

MEREENIE OIL AND GAS FIELD

Proposed Well Sites WM-25 & WM-26,

March 2018

Prepared By:

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DOCUMENT CONTROL

FRONTISPIECE: Images 1-4: Flora at proposed well sites WM-25 and WM-26. Photo 1: Short grass and forb and upside-down plant patch within recently burnt soft spinifex dune flank and sand plain community; Photo 2: Common white flowered *Aluta* (formerly *Thryptomene) maissoneuvei*; Photo 3: Access and potential pipeline route through common *Triodia pungens* and widely scattered Desert Oaks; Photo 4: Uncommon yellow myrtle, *Micromyrtus flaviflora* north edge of drill area.

DISCLAIMER

This document has been prepared by Low Ecological Services (LES) for Central Petroleum Limited (CTP) in accordance with an agreement with CTP. LES has prepared this document using the skill and care expected from professional scientists to provide factual and technical information and reasonable solutions to identified risks. It does not constitute legal advice.

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DOCUMENT REVISION

Approvals	Name	Signature	Date
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Reviewer:	Central Petroleum Limited	James van Rooyen	23/03/2018
Administrator:	Central Petroleum Limited		23/03/2018
Approver:	Department of Primary Industry and Resources	×	
Custodian:	Central Petroleum Limited	×	

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PREFACE

All information on proposed operations contained in this document has been supplied by Central Petroleum Limited.

GLOSSARY	
AAPA	Aboriginal Areas Protection Authority
ALARP	As Low As Reasonably Practicable
APPEA	Australian Petroleum Production and Exploration Association
API	American Petroleum Institute
ASC	Australian Soils Classification
ASX	Australian Securities Exchanges
bbls	Barrels
bgl	Below ground level
BOP	Blowout protector
CBL	Cement bond log
CLC	Central Land Council
CTP	Central Petroleum Limited
Cr	Critically endangered
DD	Data deficient
DPIR	Department of Primary Industry and Resources
EPBC	Environmental Protection and Biodiversity Conservation
EMP	Environmental Management Plan
EcSD	Ecologically Sustainable Development
En	Endangered
EW	Extinct in the Wild
EX	Extinct
FEMP	Field Environment Management Plan
FIT	Formation integrity test
HS&E	Health, Safety and the Environment
km	Kilometres
KW	Kilowatts
L	Litres
lbs	Pounds
LES	Low Ecological Services
m	Metres
Mi	Migration (EPBC listed)
Ma	Marine (EPBC listed)

GLOSSARY	
mm	millimetres
MRN	Mereenie Gas and Oil Field
NT	Northern Territory
Nt	Near threatened
OL	Operating Licence
P&A	Plugged and Abandoned
PMSR	Protected Matters Search Report
PMST	Protected Matters Search Tool
psi	Pounds per square inch
RPM	Rotations Per Minute
SoBS	Sites of Botanical Significance
SoCS	Sites of Conservation Significance
TPWC	Territory Parks and Wildlife Conservation
WM-22	West Mereenie-22
WM-25	West Mereenie-25
WM-26	West Mereenie-26
Vu	Vulnerable

1 EXECUTIVE SUMMARY

This Environmental Management Plan (EMP) has been developed by Low Ecological Services (LES) on behalf of Central Petroleum Limited (CTP) for the two proposed hydrocarbon exploration wells West Mereenie 25 (WM-25) and West Mereenie 26 (WM-26). Hydraulic fracturing of potential gas bearing strata will *not* be used in this well drilling operation. The drilling program will rely on natural fractures and porosity of the targeted Stairway stratum.

The wells are located within the Mereenie Oil and Gas Field (MRN) in operating license 4 (OL4). As such all operation must comply with the 2017 MRN field environmental management plan (FEMP). This EMP for well drilling outlines mitigation and preventative measure to reduce identified risks to the environment as a result of routine operations, as covered in the MRN FEMP.

The activities covered by this EMP include:

- Drilling of exploration wells;
- Clearing of vegetation and drill pad development; and
- Temporary camps.

The existing environment has been extensively surveyed and described by LES for both this EMP and the 2017 MRN FEMP and extensive previous surveys and development of the MRN beginning in 1964. The area in which the proposed WM-25 and WM-26 sites are located is dominated by rolling sand dunes, with scattered desert oak and mulga swales. The area is classified as having good draining soil and no water courses or defined drainage channels. The vegetation is widespread and characteristic of the surrounding area and land-systems. No flora or fauna species of conservation significance were identified as being significantly impacted by the proposed disturbance of the exploration well activities. This was determined through comprehensive desktop record searches, on ground surveys and extensive knowledge of the area by LES.

The exploration wells will be drilled using industry best practice and safety standards. No hydraulic fracturing of the wells will be conducted in this program. The wells will be drilled vertically to a depth of approximately 1200m and then drilled horizontally approximately 1400m to reach the target formation. The wells will then be tested for flow of hydrocarbons. If successful the well will be developed into a producing well, if not it will be plugged and abandoned using industry best practise principles, the *Northern Territory Schedule of Onshore Petroleum Exploration and Production Requirements 2016* and the Australian Petroleum Production and Exploration Association (APPEA) onshore oil and gas environmental code of practice, to ensure no contamination occurs.

An environmental risk of the project is through contamination of the potable groundwater aquifer currently used by the MRN camp due to cross-flow between hydrocarbon bearing formations and aquifers. Industry best practise standards for well drilling and monitoring will be undertaken during the entire life of the appraisal well development to ensure this does not occur.

The environmental management approach includes the use of Ecologically Sustainable Design (EcSD) and reducing risks to As Low As Reasonably Possible (ALARP). EcSD principles ensure all works are conducted in a manner that does not impact the future amenity of the environment for either CTP or surrounding stakeholders. Reducing risks to ALARP requires implementing current industry best practise principles and guidelines to mitigate the identified environmental risks. Where applicable

mitigation measures have been referred to the over-arching MRN FEMP where existing audited measures adequately reduce the risk to ALARP.

The level of rehabilitation will depend on the outcome of the drilling program. There are two outcomes:

1. If the wells are successful or the wells are cased and suspended, the drill pads will remain cleared at 120mx120m for approximately three years allowing for future works; that is completions or standard production and remedial well work that may be required. After this time the well pad sizes will be assessed and where possible reduced. If the wells remain on production the drill pads will be reduced to approximately 50mx50m to allow for standard production operations for the life of the well.
2. If the wells are not successful Central will plug and abandon (P&A) the wells in accordance with the NT regulations and will commence full rehabilitation of these sites as per the MRN FEMP.

If the well is suspended:

- All waste to be removed from site in accordance with the MRN FEMP;
- Well pad remain at 120mx120m for three years;
- Mud sump backfilled on site, following drying and results of soil testing (if required);
- After three years well will be reassessed;
- If the well goes to production
    - The cleared area will be reduced to 50mx50m,
    - Remainder of the pad shallow ripped along the contour
    - Any remaining stockpiled vegetation and top soil will be re-spread over rehabilitated cleared areas
- Any new weed infestations will be removed.

For P&A the following activities will be undertaken:

- All waste to be removed and disposed of in accordance with the MRN FEMP;
- Mud sump backfilled on site, following drying and results of soil testing (if required);
- Final landform to be reinstated to match surrounding environment;
- Any gravel used for hardstands will be removed and deep ripped on the contour;
- Stockpiled top soil and vegetation respread over the 120mx120m cleared well pad;
- Ensure no new weeds are present;
- Signs of vegetation re-growth following first significant rainfall season; and
- All access tracks removed.

The affected stakeholders for this operation are those outlined in the MRN FEMP including the Haasts Bluff Aboriginal Land Trust, Central Land Council and Department of Primary Industry and Resources.

CTP will follow the current and ongoing consultation process as outlined in the MRN FEMP. A record of which is shown in Appendix 6.

Key contact details for the project are:

Company Name	Central Petroleum Limited
ACN/ABN	ABN: 95 081 592 734
Street Address	Level 7/369 Ann Street
Postal Address	PO Box 292 Brisbane, Qld 4000
Telephone	+61 (0)7 3181 3800
Facsimile	+61 (0)7 3181 3855
Key Contact	James can Rooyen – Acting as General Operations Manager
Email	jamesvanrooyen@centralpetroleum.com.au
Website	www.centralpetroleum.com.au

2 TABLE OF CONTENTS

List of Tables

Table of Figures

List of Appendices

3 INTRODUCTION

3.1 Project Outline

Central Petroleum Limited (CTP) as 50% owner and operator of Operating License 4 (OL4) propose to undertake the drilling of appraisal wells West Mereenie 25 (WM-25) and West Mereenie 26 (WM-26). The wells are proposed for appraisal only and do not involve hydraulic stimulation under this Environmental Management Plan (EMP).

The proposed exploration well sites are situated within the western section of the Mereenie Oil and Gas Field (MRN), approximately 16km north-west of the MRN camp. The proposed wells will target the Lower Stairway Formation for the main conventional reservoirs, drilling to approximately 1200m deep and 1400m horizontally to reach the target hydrocarbon reserves.

This EMP provides an analysis of all potential environmental impacts and associated mitigation measures, monitoring requirements and environmental objectives for the proposed drilling program.

3.2 Location

WM-25 and WM-26 are proposed to be drilled within OL4 which is located in the Amadeus Basin, approximately 280km west of Alice Springs (by road) in the Northern Territory (NT).

Access to the field from Alice Springs is via a network of sealed and unsealed public and private roads, heading west from Alice Springs along Larapinta Drive/Red Centre Way to Hermannsburg, and then continuing towards Kings Canyon. The turn off to the MRN is left off the Red Centre Way; approximately 175km past Hermannsburg.

Figure 3.1 shows the location of the proposed WM-25 and WM-26 well sites at MRN in relation to Alice Springs and other nearby communities.

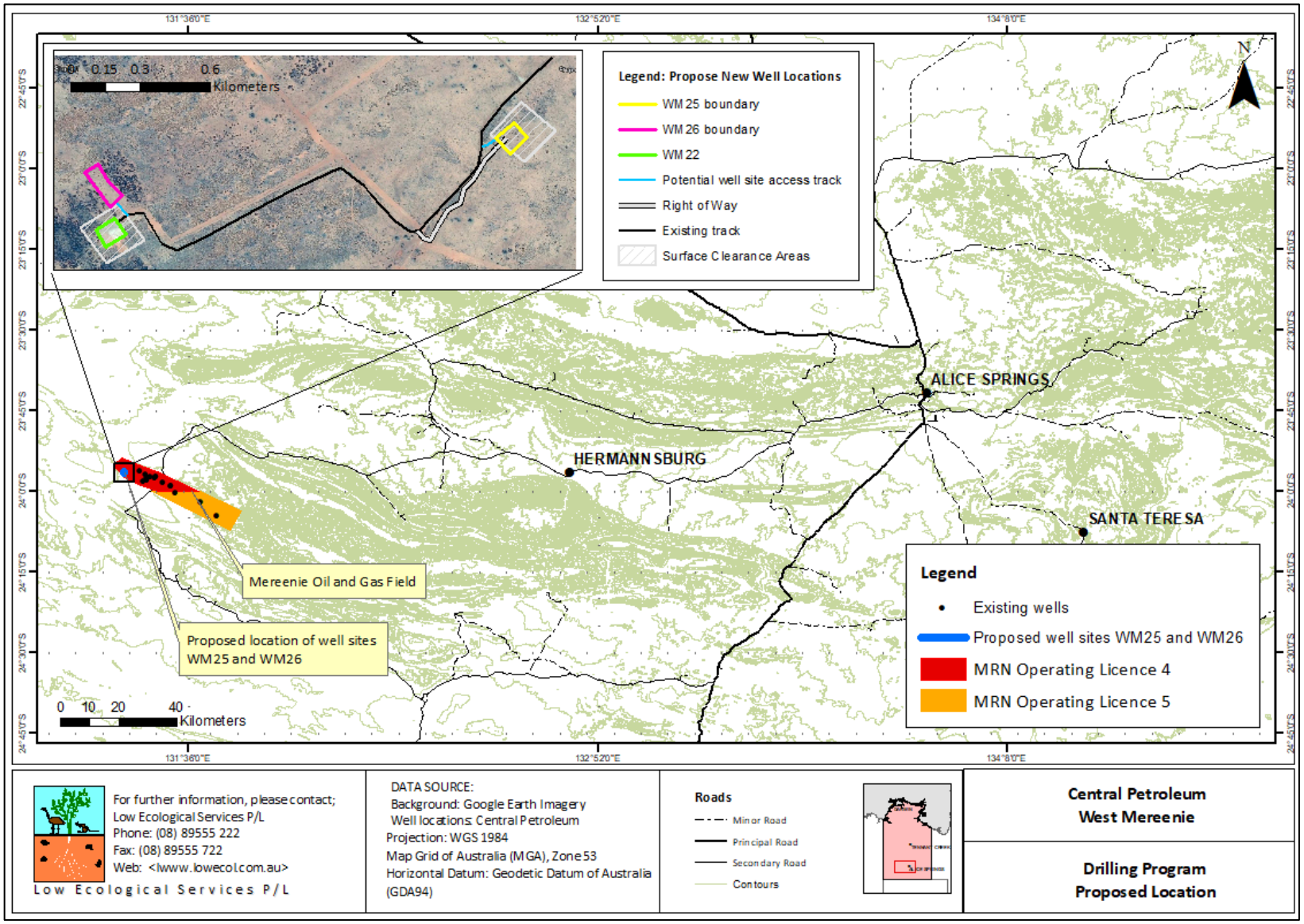

Figure 3-1. Location of the proposed drilling sites WM-25 and WM-26 in the existing MRN area.

3.3 Proponent

CTP is an Australian Securities Exchange (ASX) listed exploration and production company, registered on the 7th March 2006 under the Corporations Act 2001. CTP operates the largest holding of prospective onshore acreage in Australia totalling over 229,000km^2, predominantly in the Northern Territory, with smaller holdings in Western Australia, South Australia and Queensland.

Table 3-1. Central Petroleum company details

Company Name	Central Petroleum Limited
ACN/ABN	ABN: 95 081 592 734
Street Address	Level 7/369 Ann Street
Postal Address	PO Box 292 Brisbane, Qld 4000
Telephone	+61 (0)7 3181 3800
Facsimile	+61 (0)7 3181 3855
Key Contact	James van Rooyen – Acting as General Operations Manager
Email	jamesvanrooyen@centralpetroleum.com.au
Website	www.centralpetroleum.com.au

3.4 Purpose

The purpose of this EMP is to:

- Provide information to the NT Department of Primary Industry and Resources (DPIR) - Energy Directorate as required under Section 45 (1) (f) of the *Petroleum Act*;
- Provide additional information as outlined in the NT Petroleum (Environment) Regulations 2016;
- Provide information to the Northern Territory Environment Protection Authority (NT EPA) to make an assessment under the *Environmental Assessment Act*, if required;
- Communicate environmental aspects, risks, management measures and responsibilities to CTP personnel and contractors; and
- Provide a basis for environmental audits of the proposed appraisal well sites within MRN.

3.5 Scope

This EMP covers the environmental hazards and management measures relevant to activities relating to the proposed WM-25 and WM-26 conducted by MRN personnel and contractors hired by CTP to work on site. This EMP has been designed to work under the existing MRN Field Environmental Management Plan (FEMP) to cover environmental impacts posed by the drilling operations not already covered by the MRN FEMP. Where any activities or risks have already been covered, the MRN FEMP will be referred to. Activities covered by this EMP include:

- Clearing of land for access tracks and well pads;
- Temporary on-site staff accommodation and associated infrastructure for up to 8 staff at any one time; and
- Drilling exploration hydrocarbon wells.

3.6 Objectives

Table 3-2. Environmental Objectives for the Proposed Appraisal Drilling Program, WM-25 and WM-26

Environmental Aspect	Objectives
Biodiversity	• No significant impact to conservation significant fauna • No significant impact to conservation significant fauna habitat • No significant impact to conservation significant flora • No significant impact to matters of national environmental significance
Water	• No degradation to surface water quality or drainage • No detrimental impact to groundwater dependant ecosystems • No degradation to groundwater quality • No loss of groundwater amenity to surrounding users
Air Quality and Noise	• No impact to surrounding stakeholders from noise • No deterioration to air quality due to operation activities
Soil and Landform	• No erosion and sedimentation from the proposed drilling operations • Soil profile intact post drilling and rehabilitation operations
Cultural and Heritage	• No unauthorised disturbance to identified cultural and heritage significant sites and/or objects

4 CORPORATE ENVIRONMENT POLICY

4.1 Central's Commitment to the Environment

CTP has a high standard of environmental responsibility implemented through operational quality and integrity measures above and beyond industry standards. The Environmental Policy recently endorsed by the Board is shown in Figure 4-1 and the corporate Health, Safety and Environment (HS&E) policy is provided in Figure 4-2.

Central Petroleum

Central Petroleum Limited

CENTRAL PETROLEUM LTD
ENVIRONMENTAL PROTECTION POLICY

Central Petroleum Limited considers protection of the natural and social environment to be of the highest priority in all its activities, both domestic and international, and conducting its operations in an environmentally responsible manner.

It is Central Petroleum's policy to:

- Comply, at a minimum, with applicable laws, regulations, standards, codes and guidelines for the protection of the environment and cultural heritage, and in their absence, adopt the best practicable means to prevent or minimise adverse environmental and cultural heritage impacts;
- Cooperate with governments and industry in the formulation of rational and practical environmental and cultural heritage guidelines and legislation;
- Continuously develop the company's environmental management system and cultural heritage management plans to identify, control and monitor risks and compliance with government regulations and industry guidelines, utilising the most appropriate technology available;
- Commit all levels of management to accept responsibility for environmental and cultural heritage management in all Central Petroleum activities;
- Promote environmental and cultural heritage awareness in all Central Petroleum employees and contractors through induction and training programs;
- Maintain cooperative and positive relationships with indigenous people with custodial responsibility for the land where Central Petroleum operates to minimise the impact of those operations on the cultural heritage of the indigenous people, and cooperate with other legitimate land users so that, where appropriate, multiple land use is possible;
- Conduct all Company operations in such a way as to minimise disturbance to the environment, protect native flora and fauna, avoid the pollution of land, water and air, and avoid disturbance of known sites of archaeological, cultural heritage, historical, natural or scientific significance; and
- Maintain an active rehabilitation program that will restore operational areas to a condition which is compatible with the prior land use.

Richard Cottee
Managing Director
1st March 2017

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Figure 4-1. CTP's corporate environmental policy

Central Petroleum Limited

CENTRAL PETROLEUM LTD
HSSE POLICY

Central Petroleum Limited believes that effective management of Health, Safety, Security and Environmental (HSSE) issues is essential for success in its business, by:

- Providing leadership and commitment to HSE issues and communicating our expectations to employees, contractors and other stakeholders;
- Providing clear direction and monitoring of a zero drug and alcohol tolerance to all contractors and employees whilst involved in drilling, seismic or production activities (Operations) on site or when binding decisions relevant to Operations are required to be made;
- Zero tolerance to smoking in any workplace, except designated areas;
- Complying with national, state and local legislation;
- Providing a safe working environment for all employees, contractors and third party personnel;
- Minimising the impact of our activities on the environment;
- Selecting and managing contractors to ensure their HSE performance meets our and statutory requirements;
- Carrying out risk assessments and taking effective measures to reduce risks to as low as reasonably practicable on all our operations;
- Providing sufficient training, resources, equipment and personnel to achieve our HSE objectives;
- Maintaining appropriate HSE documentation;
- Monitoring HSE performance-investigating and reporting all incidents and accidents regularly to the Board of Directors as well as relevant authorities;
- Striving for continuous improvement;
- Ensuring effective emergency response procedures are in place;
- Supporting wherever possible the advancement of local communities in areas where we operate; and
- Conducting audits and reviews to assess compliance with this policy.
- Implementing and using management systems for integrity management of plant, pipelines and equipment.

It is the responsibility of all employees and contractors to comply with this policy and to assist Central Petroleum Limited in its implementation.

Richard Cottee
Managing Director
1st March 2017

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Figure 4-2. CTP's corporate HSSE policy

5 ENVIRONMENTAL LEGISLATION AND OTHER REQUIREMENTS

5.1 Legislation and Approvals

The legislation and associated approvals relevant to environmental management of operations at the proposed appraisal well sites are listed in Table 5-1.

Table 5-1. Legislation, Consents and Approvals.

Policy Jurisdiction	Legislation
Internal	*Central Petroleum Environmental Protection Policy 2016*
Commonwealth	*Aboriginal Land Rights (Northern Territory) Act 1967*
	Native Title Act 1993
	Aboriginal and Torres Strait Islander Heritage Protection Act 1984
	National Environmental Protection Council Act
	National Greenhouse and Energy Reporting Act
	Australian Heritage Council Act 2003
	Environmental Protection and biodiversity Conservation Act 1999
Northern Territory	*Aboriginal Land Act 2013*
	Work Health and Safety (National Uniform Legislation) Act 2016
	Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations 1988
	Plant Health Act 2015
	Petroleum (Prospecting and Mining) Regulations Act 2001
	Biological Control Act 2011
	Northern Territory Aboriginal Sacred Sites Act 2013
	Bushfires Management Act 2016
	Control of Roads Act 2015
	Dangerous Goods (Road and Rail Transport Act) 2012
	Energy Pipelines Act 2015
	Environmental Assessment Act 2013
	Environmental Offences and Penalties Act 2011
	Fire and Emergency Act 2016
	Heritage Act 2016
	Petroleum (Environmental) Regulations 2016
	Petroleum Act 2016
	NT Petroleum (Environmental) Regulations 2016
	Public and Environmental Health Act 2016

	Public and Environmental Health Regulations 2014
	Schedule of Onshore Petroleum Exploration and Production Requirements 2017 (under the Petroleum Act 2016)
	Soil Conservation and Land Utilisation Act 2016
	Territory Parks and Wildlife Act 2014
	Waste Management and Pollution Control Act 2016
	Water Act 2016
	Weeds Management Act 2013
Operating Consents	OL4 – renewed 6th November 2002, expires 17th November 2023
	Mereenie Agreement 2003 (Central Land Council)

No referral or notice of intent was required under the EA Act or EPBC Act due to the minor nature of the work program. The Department of Environment and Natural Resources was consulted in this decision.

5.2 Standards and Policy

The standards and policy relevant to environmental management of operations at the proposed appraisal well sites are listed in Table 5-2. These Standards will be applied in accordance with CTP's HS&E MS and have assisted in determination of "as low as reasonably practical" in Section 8.

Table 5-2. Central Petroleum Standards and Policy

What	Standard and/or Policy
Drilling	American Petroleum Industry (API)
Transport of wastes across State or Territory borders	NEPM 2013 standards
Contaminated sites	
Waste removal from site	NT EPA approved contractor
Erosion and sediment control	IECA and DLRM guideline and best practise principles
Land access agreements	AAPA approval and certificate
Risk Assessment	AS/NZS ISO 31000:2009 and HB 203:2006
General Operations	APPEA Code of Environmental Practice
CENTRAL	
	MSTD09-01 v1 – Hazard Identification, Risk Management and Control.
	CTP Health, Safety and Environmental Management System (HS&E MS).

6 DESCRIPTION OF ACTIVITY

6.1 Background

WM-25 and WM-26 proposed appraisal well sites have been designed to provide necessary well construction and operational aspects for the protection of the surface and sub-surface environments from contamination during drilling operations, and for the life of the wells. The wells are to be drilled and constructed using American Petroleum Industry (API) Standard equipment accompanied by certified personnel. The proposed appraisal well design and equipment used to drill the wells are designed to prevent groundwater aquifer contamination, uncontrolled discharge of water or gas at surface, chemical/fuel spills, and minimise surface disturbance by operating to industry best practise standards. It is noted that general operations associated with the Mereenie gas field are already covered by the DPIR approved MRN FEMP. Such activities would include:

- Road, track and lease construction, maintenance and access,
- Well bore management,
- Gas and oil systems,
- Pipeline and flow line operations,
- Processing facilities,
- Fuel and chemical storage, handling and transportation, and
  Waste Management.

6.2 Plan

WM-25 and WM-26 will be drilled as sub horizontal boreholes through the Stairway Sandstone Reservoir using compressed air and mist. If the wells are successful, showing economical/commercial gas flow rates, they will be completed as production wells. No hydraulic fracture stimulation will be undertaken. A summary of the proposed appraisal well activities is provided in Table 6-1 and 6-2.

If the wells are successful or the wells are cased and suspended, the drill pads will remain cleared at 120mx120m for approximately three years allowing for future works, re completions or standard production and remedial well work that may be required.

After this time the well pad sizes will be assessed and where possible reduced. If the wells remain on production the drill pads will be reduced to approximately 50mx50m to allow for standard production operations for the life of the well.

If the wells are not successful Central will plug and abandon the wells in accordance with the NT regulations and will commence full rehabilitation of these sites as per the MRN FEMP Section 11.

Table 6-1. West Mereenie-25 Proposed Appraisal Well Data Summary

Well Name and Number:	West Mereenie-25	
Designation:	Petroleum Appraisal Well	
Permit:	OL 4 (Northern Territory)	
Basin:	Amadeus Basin	
Proposed Location: (MGA94, Zone 52)	Latitude	23° 56' 19.85" S (GDA94)*
	Longitude	131° 24' 56.22" E (GDA94)*
	Easting	745,860.00 m E (MGA94, Zone 52)*
	Northing	7,350,440.00 m N (MGA94, Zone 52)*
Drill Pad area:	Approximately 120m x 120m	
Anticipated Spud Date:	Mid to late May 2018	
Anticipated Total Well Days:	31 (Operational Days)	
Drilling Contractor:	Ensign Australia Limited	
Rig Name and Type:	Ensign Rig 932, Dreco Conventional Drilling Rig	
Primary Objective:	Hydrocarbons (Gas) within Lower Stairway Sandstone	
Estimated Total Depth:	2535.0mRT MD (1148mRT TVD)	

Table 6-2. West Mereenie-26 Proposed Appraisal Well Data Summary

Well Name and Number:	West Mereenie-26	
Designation:	Petroleum Appraisal Well	
Permit:	OL 4 (Northern Territory)	
Basin:	Amadeus Basin	
Proposed Location: (MGA94, Zone 52)	Latitude	23° 56'31.262" S (GDA94)*
	Longitude	131° 23' 57. 982" E (GDA94)*
	Easting	744, 207.00 m E (MGA94, Zone 52)*
	Northing	7, 350,117.00 m N (MGA94, Zone 52)*
Drill Pad area:	Approximately 120m x 120m	
Anticipated Spud Date:	Mid-April 2018	
Anticipated Total Well Days:	36 days	
Drilling Contractor:	Ensign Australia Limited	
Rig Name and Type:	Ensign 932, Dreco, Conventional Drilling Rig	
Primary Objective:	Hydrocarbons (Gas) within Lower Stairway Sandstone	
Estimated Total Depth:	2915.0mRT MD (1243mRT TVD)	

6.2.1 Proposed Drill Site Locations

WM-25 and WM-26 proposed drill sites will be located in the north-western corner of operating licence 4 (OL4), approximately 10km north-west of the existing MRN camp and in the vicinity of existing well site WM-22 (Figure 6-1)

6.2.2 Access

The proposed drill sites will be accessed utilising existing roads in the MRN area. Short additional access tracks will be constructed to link in the proposed drill sites to the existing roads (see Figure 6-2 and 6-3). An additional right of way track is proposed to be constructed linking WM-25 to the existing road (see Figure 6-1).

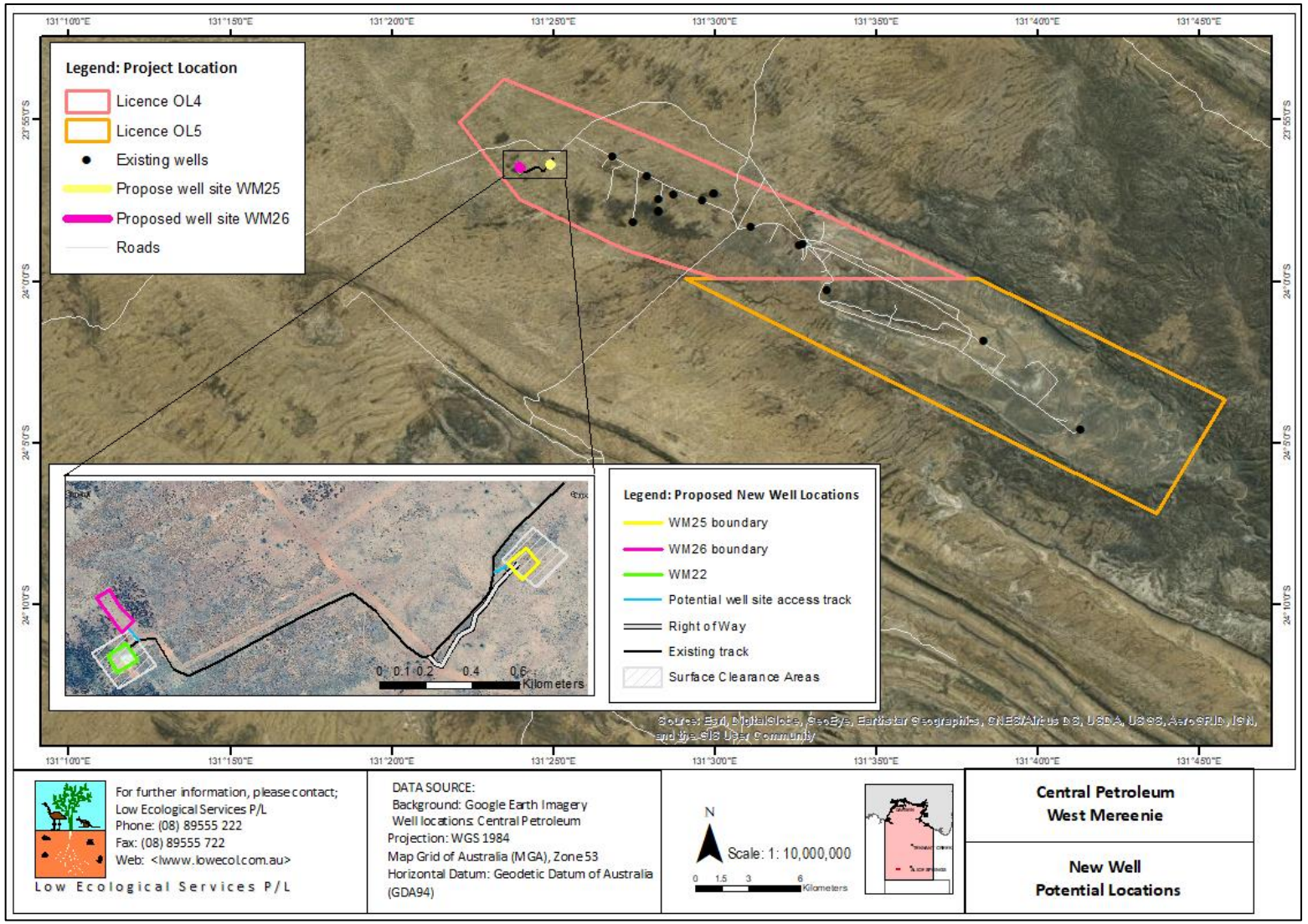

Figure 6-1. Proposed location of WM-25 and WM-26 in relation to existing wells and the MRN area

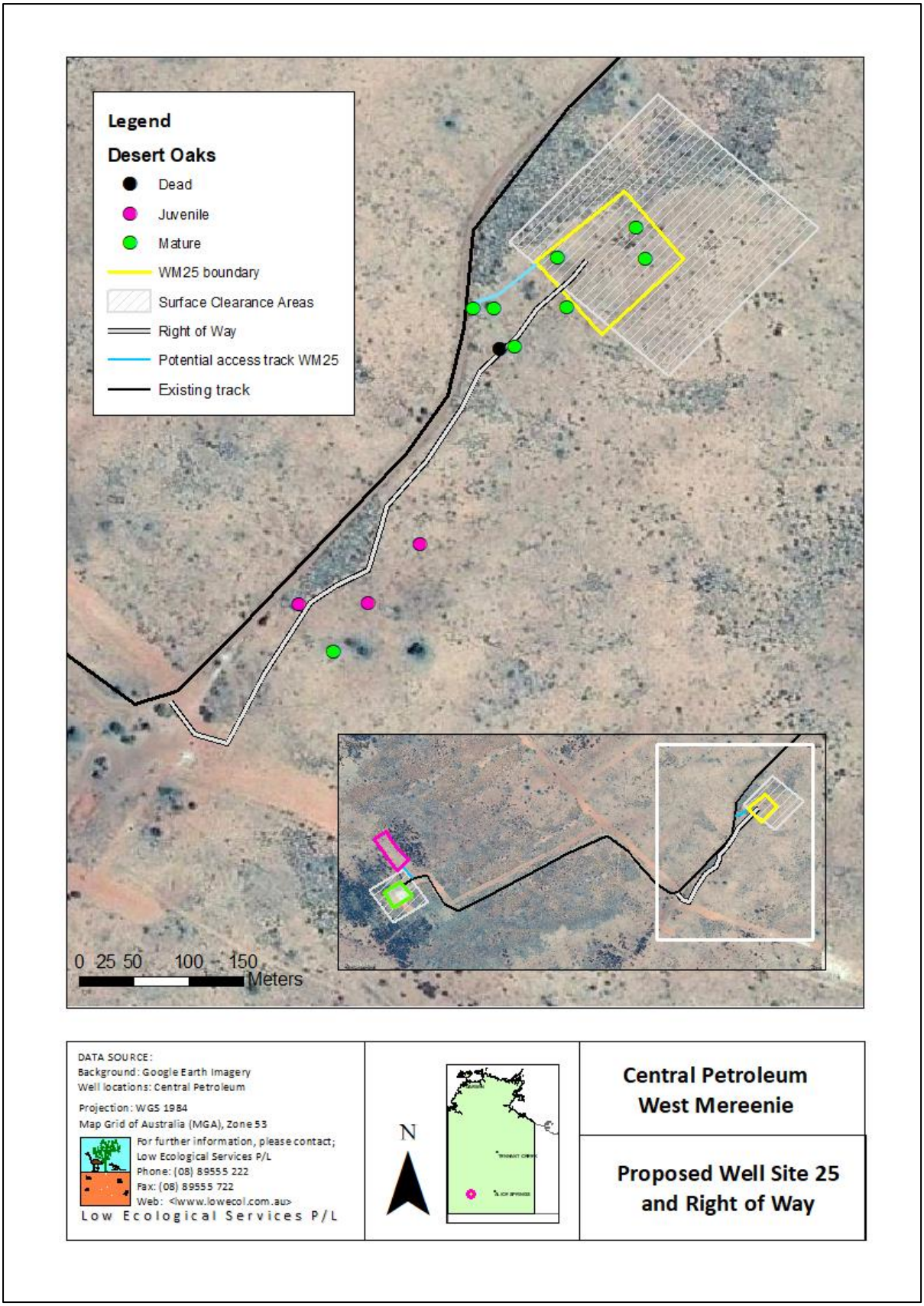

Figure 6-2. Location of proposed drilling site at WM-25, access track and right of way and location of Desert Oaks to avoid

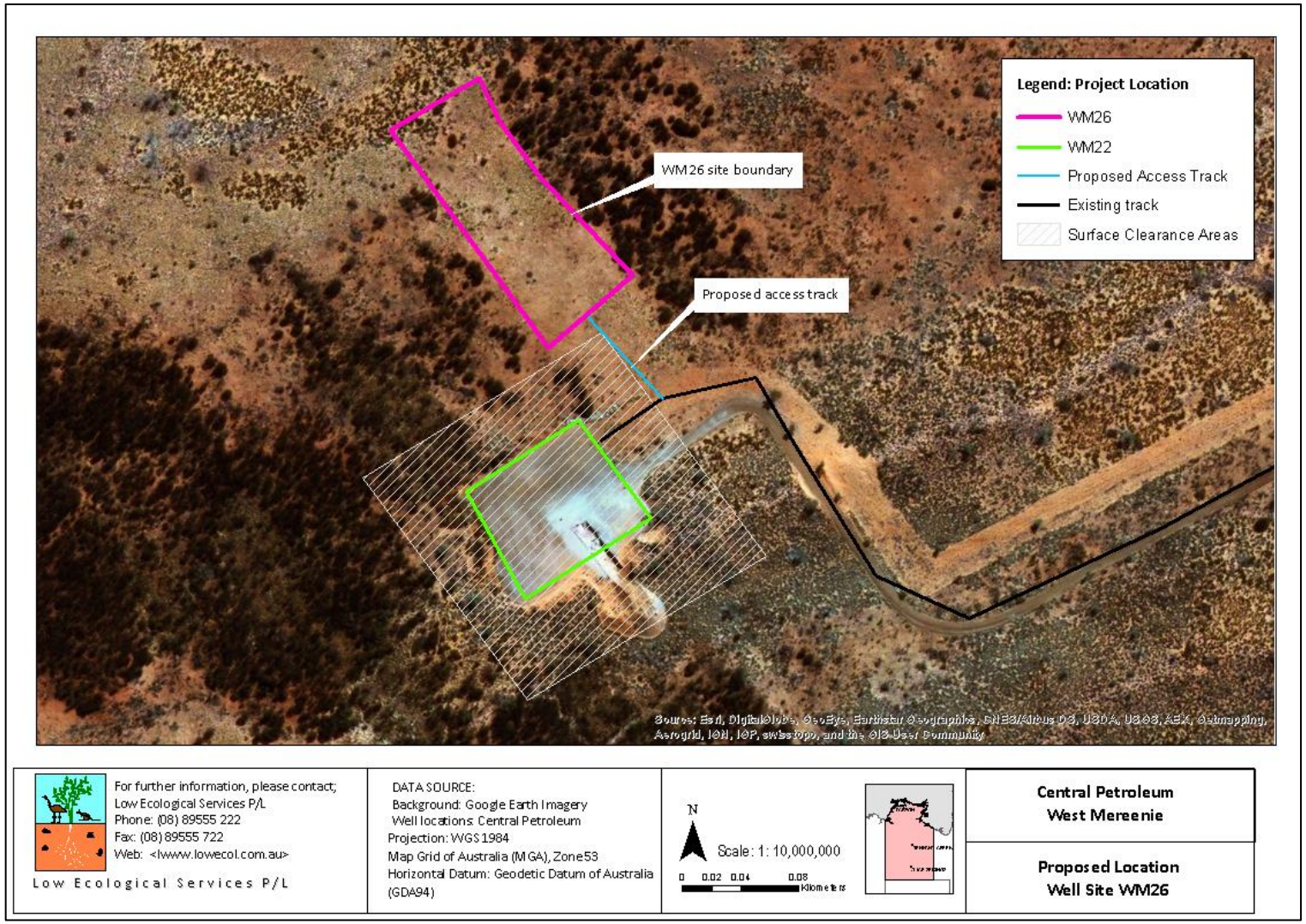

Figure 6-3. Location of proposed drilling site WM-26 and access track

6.3 Drill Rig

A Dreco Conventional Drilling Rig will be used to drill the WM-25 and WM-26 wells. The rig will include an air package, consisting of two compressors, booster, mist pump and Blooie line. Additional back-up equipment may also be located onsite. Mobilization of the rig and associated equipment to the site will require approximately 45-55 triple trailer truckloads. A summary of drill specifications is provided in Table 6-3 and Figure 6.4.

Table 6-3. Dreco Conventional Drilling Rig Specifications

GENERAL RIG SPECIFICATIONS	
MAST:	Dreco Cantilever - 40.54m 500,000lbs (10 lines) Static Hook Load Capacity 467,000lbs (8 lines) Static Hook Load Capacity
SUBSTRUCTURE:	Dreco four section box style, Working Height – 6.1m
DRAWWORKS:	Tri-Service oilfield TSM 1200 HP rating 1200 HP/input power 1000HP
TOP DRIVE:	Tesco HMI-250
MUD PUMP:	2 x National 8P-80 Triplex, 800HP Powered by G.E. 752 DC motors
MUD TANKS:	Total Volume: 1302bbls 1 x Shaker tank: 324bbls 1 x Suction tank: 556bbls 1 x Mixing tank: 422bbls
DAY TANK:	1 x 640bbls
SHALE SHAKER:	3 x SWACO Mongoose, Desilter
BOP:	11”x 5000psi Shaffer Annular 11”x 5000psi Shaffer Double Gate
CATWALK:	2 sections 7’-8” wide x 40’ Long x 3’-6” high
FUEL TANK:	1 x 64,000L, Double skinned, Skid mounted
AIR PACKAGE:	2 X Compressors, 1 Booster, Mist Pump, Blooie Line, RCD

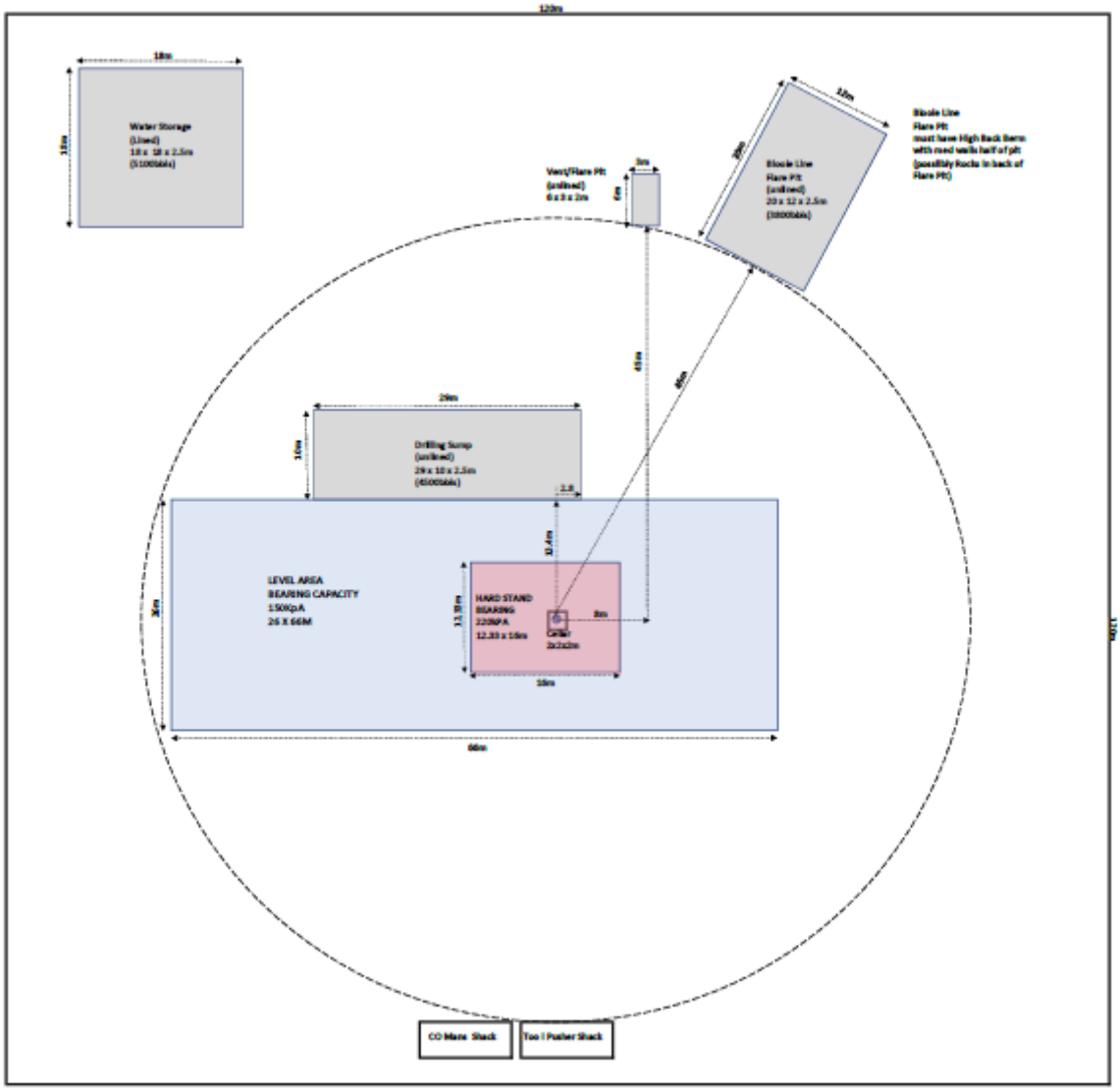

Figure 6-4. General Well Pad Layout

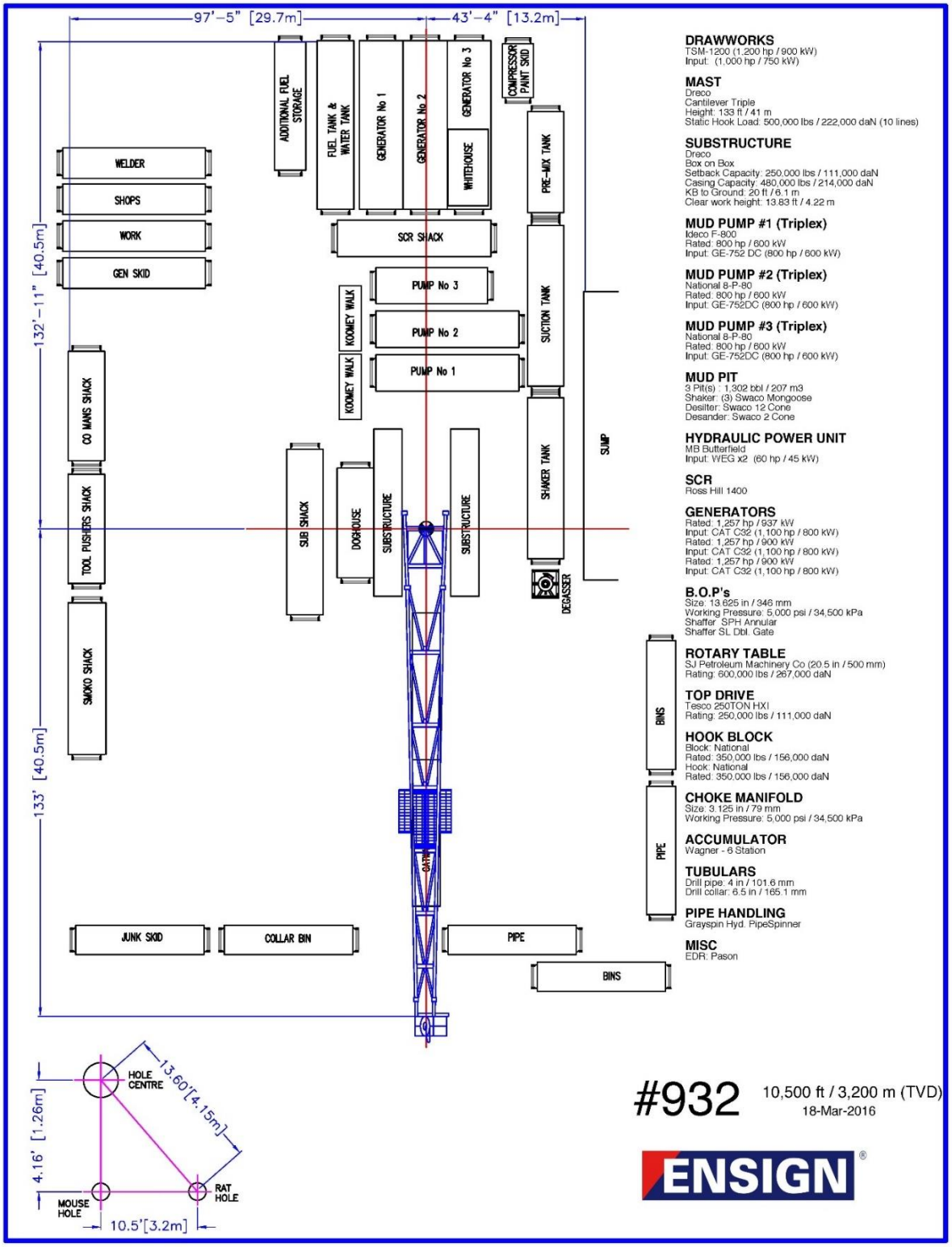

Figure 6-5. General Ensign Rig layout

6.3.1 Proposed Appraisal Well Sites

Clearing activities will be limited to the removal of vegetation over an area of approximately 120m x 120m. Cleared vegetation and topsoil will be piled separately around the edge to clearly denote the cleared area in low profile mounds under 1.5-2m in height. The top soil and vegetation stockpiles will

be used to denote the boundary of the well sites. (Refer to section 7.6.2 “Land – Soil” mitigation measures of the FEMP for further detail on soil stockpiling and preservation techniques to be used).

The well pads have been designed to accommodate the drilling rig, associated equipment, materials and consumables and provide space for all personnel. The well pads have been designed to ensure adequate drainage to ensure a safe work environment during operations. Excavation activities will be completed for the construction of drilling sumps (approximately 15 x 10 x 2.5m), flare pit (approximately 18mx10mx2.5m), a lined (HDPE) water storage pit (approximately (15 x 15 x 2.5m), and the installation of a cellar. A general Rig layout is shown in Figure 6-5; illustrating the positioning of the drill rig and associated equipment.

Gravel may be required to develop a hardstand to support the drill rig substructure foundation under maximum load conditions. Any gravel imported to site will be from the existing MRN field borrow pits, a weed free source and removed on final rehabilitation of the site.

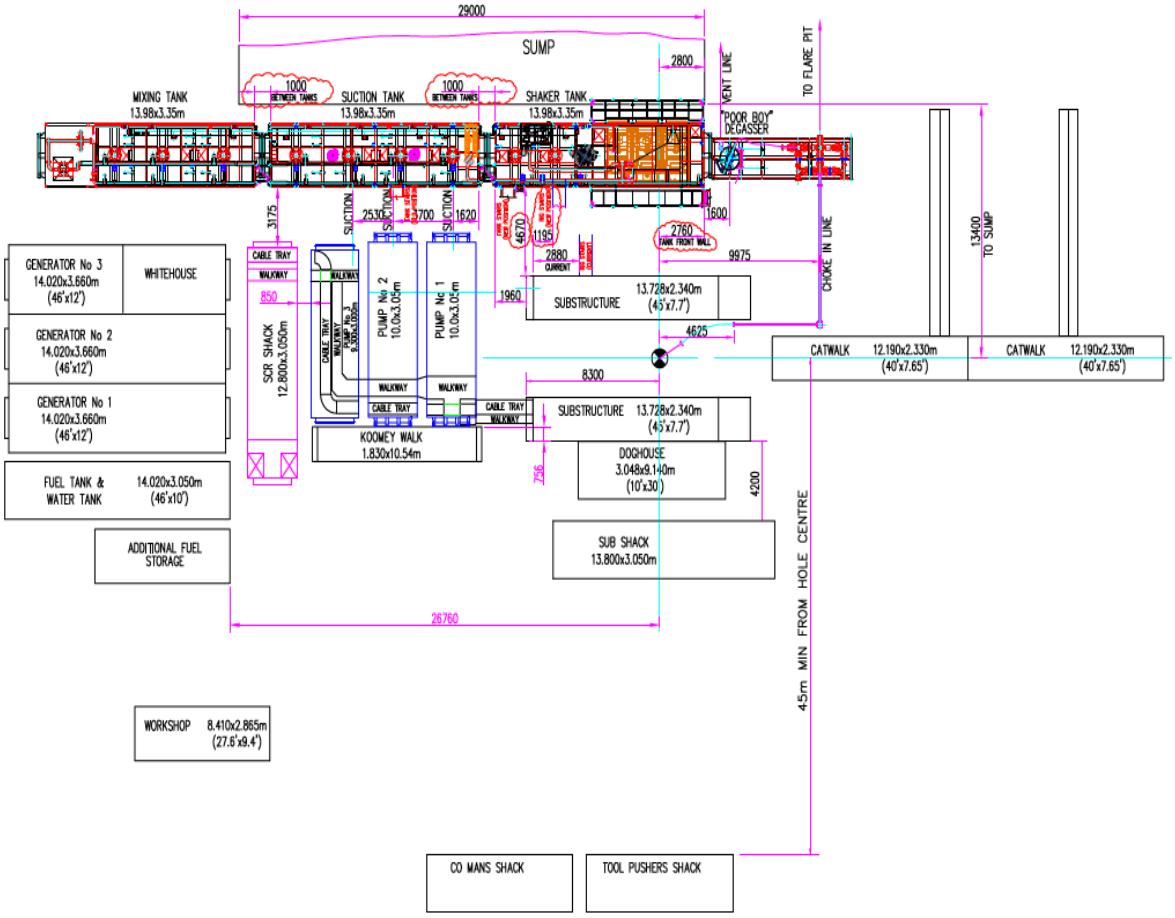

Figure 6-6. General Rig layout illustrating the positioning of the drill rig and other associated equipment

6.3.2 Camp

CTP intend to utilize the existing MRN camp located approximately 10km from the proposed drill sites as detailed in the Mereenie FEMP. There will be also a 40 person drilling camp positioned on the side of the WM-25 lease pad while WM26 is being drilled. The camp will remain on the side of the WM-25 lease pad while drilling WM-25. If required, due to space constraints, the camp will be moved to WM-26 during the drilling of WM-25. The Camp will be equipped with a fully self-contained sewage

treatment plant (Ozzi Kleen) furnished with an irrigation sprinkler system. The full discharge specifcations of the sewage system can be found in Appendix 7. Below is a general site layout illustrating the camp and associated equipment. (Refer to section 6.5.11 & 6.5.11.1 “Campsite and Offices & Temporary Campsite” of the FEMP for full details of the Mereenie permanent camp and sewage system).

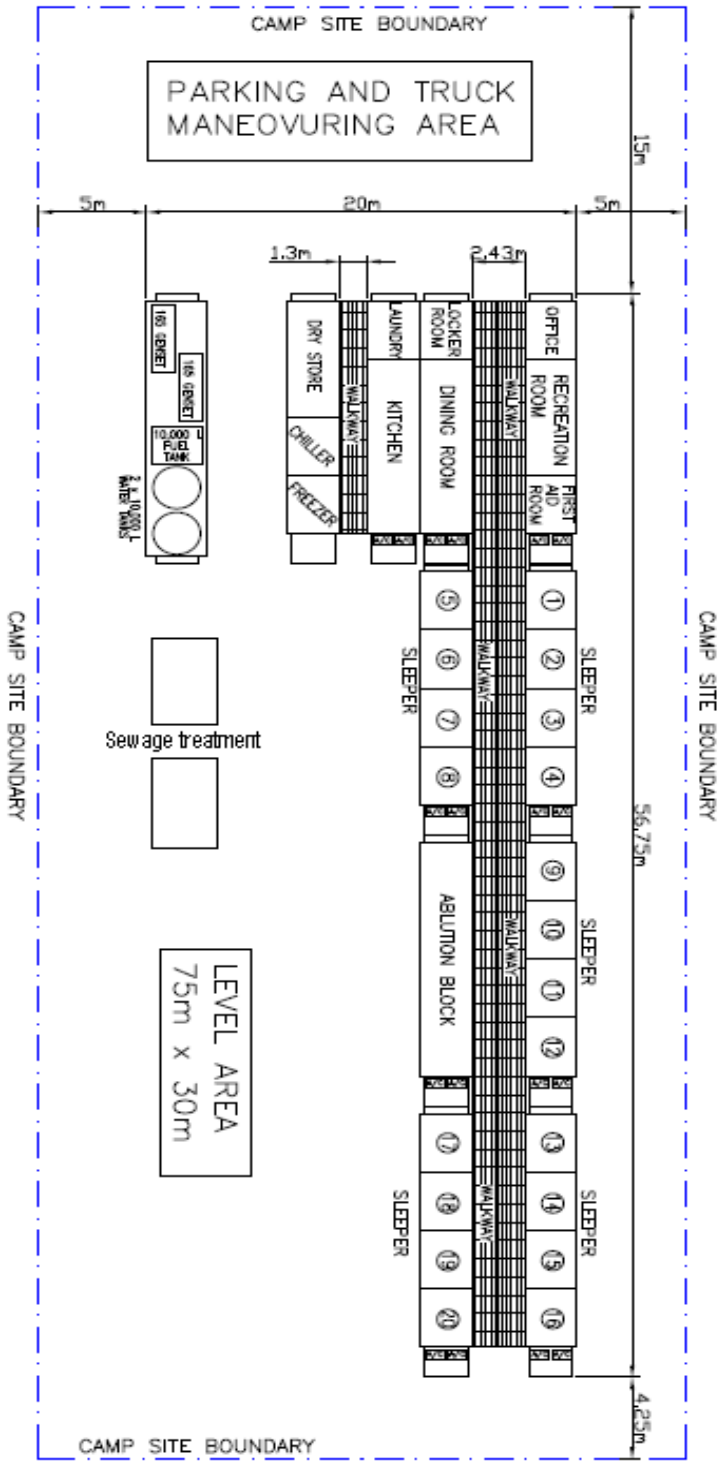

Figure 6-7. General site layout illustrating potential temporary camp and associated equipment

6.3.3 Water Use

The amount of water required to drill each proposed appraisal well will be approximately 800,000L. The wells will be predominantly drilled with air. Water will be trucked or piped (poly/lay flat) from locally sourced water bores or dams as illustrated in Table 6-4. All water use from groundwater abstraction will be recorded with inline flow meters and reported to the regulator as required. Water will be stored in temporary water storage facilities within the proposed drill sites. All standing water will be fenced to deter fauna.

Table 6-4. Proposed water sources for drilling activities at proposed WM-25 and WM-26 sites

West Mereenie Wells Water Source					
Bore Name	West Mereenie 15	East Mereenie 2	ESS or PL5	CTP	Production No 2
Bore RN	RN018955	RN004620	RN013861	RN017657	RN017898
Used	Stock Water	Raw Water for CTP	Stock & Fire system	CTP Drinking Water	Camp Water
Location: Latitude: Longitude: (GDA94)	 23º 56' 28.849" 131º 26' 48.865"	 24º 2' 3.268" 131º 38' 51.025"	 24º 2' 46.842" 131º 38' 34.368"	 24º 0' 4.536" 131º 33' 16.783"	 24º 0' 27.659" 131º 33' 11.761"
Construction	Steel Casing	Steel Casing	Steel Casing	Steel Casing	Steel Casing
Diameter	155mm	N/A	152.4mm	150mm	150mm
Total Depth	192m	152m	213m	233m	236m

Note: All bores are owned by CTP and managed in accordance with the MRN FEMP.

6.3.4 Grey Water Disposal

All grey water produced from the MRN camp will be disposed in accordance with the MRN FEMP. (Refer to section 6.3.2 "Conceptual Site models" of the FEMP).

6.3.5 Sewerage Water Disposal

All sewerage water produced at the MRN camp will be disposed in accordance with section 6.5.12.3 "Wastewater" of the MRN FEMP. This includes relevant limits for release quality and volumes and identified control mechanisms such as monitoring and wet weather contingency.

Discharge from the Drilling temporary camp located at the WM-25 and WM-26 well sites will be treated in accordance with the specifications as specified in Appendix 7. This will be sprayed 50-100m away from the camp location to the surrounding environment using a sprinkler system.

6.3.6 Waste Management

Waste will be segregated into listed and non-listed waste as determined in Schedule 2 of the Waste Management and Pollution Control (Administration) Regulations before final disposal. Non-listed waste will be transported off site and disposed of at the appropriate waste transfer stations. All listed waste will be transported off-site by an NT EPA approved and registered waste contractor for disposal at the nearest appropriate and licenced waste management facility. Where transport is required across state or territory borders the NEPM 2013 guidelines will be adhered to as well as local regulations.

If required waste will be placed in sealed containers for transport to the locations indicated in Table 6.5. All waste will be removed weekly.

Table 6-5. Waste disposal locations and facilities currently used for disposal of listed and non-listed wastes by MRN operations

Type of Waste	Disposal Location
General and food	JJ Richards, Alice Springs NT
Empty ICBs	JJ Richards, Alice Springs NT
Metal and plastic drums	JJ Richards, Alice Springs NT
Waste metal	Alice Metal Recyclers, Alice Springs NT
Batteries and Tyres	Cleanaway 6, Alice Springs NT
Listed Waste	Any waste prescribed wastes under the *Waste Management and Pollution Control Act* as specified as a listed waste by the NT EPA as found at https://ntepa.nt.gov.au/waste-pollution/approvals-licences/listed-waste, will be disposed of in accordance with the regulations and by a company licensed to handle and dispose of this waste.

Any other waste not covered in the above table to be separated and removed from site for final disposal in accordance with sections 6.5.12 to 6.5.12.3 of the MRN FEMP.

6.3.7 Storage of Drilling Fluids and Chemicals

Chemicals required for the water based drilling fluids are stored in self-bunded trailers called Tautliners, or on specifically designated and bunded storage areas onsite away from any potential hazards. Where possible, all chemicals used for drilling will be biodegradable. The rig contractor will have double lined mobile storage diesel tanks onsite, total capacity will be 67000L. Waste product generated during drilling operations will be disposed of in accordance with sections 6.5.12 to 6.5.12.2 of the MRN FEMP and site specific EMP.

At the end of the program, any unused chemicals will be removed from site and returned to vendor.

Water based drilling fluid is mixed onsite and stored within integrated mud tanks. Mud tanks volumes will total approximately 1000bbls. Tanks integrity will be verified before commencement of drilling program.

Air or mist will be used while drilling the production hole to prevent possible formation damage that could be caused from a water based drilling fluid. Possible formation damage within the reservoir may include surface tension or swelling of clays, which can restrict gas flow.

6.3.8 Chemicals used

A simple mud system will be used which consist of additives for fluid density (Potassium Chloride or Sodium Chloride), filtration control, viscosifiers, hole stability and pH control will be used. Where possible, all additives will be biodegradable.

For all chemicals used on site there will be SDS available and copies will be furnished to the DPIR at the end of the well. Chemicals used and the mud composition will be documented in the daily mud report and daily drilling reports.

Chemical usage will be optimised through an onsite mud engineer to ensure adequate hole cleaning, well control and well bore stability. Appendix 1 provides detailed information of chemical composition and toxicity of drilling muds. Drilling contractors of SOP's (standard operating procedures), full MSDS, appropriate PPE and handling procedures will be available on site at any one time. MSDS's sheets have been provided to the DPIR.

6.3.9 Mud Sump and Flare Pit

During air drilling operations all the cuttings will be directed through a Blooie line to the flare pit which will have a capacity of approximately 3,000-4,000bbls. A de-duster will be installed on the Blooie line. This device will wet the air stream as the cuttings exit the Blooie line, minimizing dust output into the air.

During mud drilling operations, the fluid is re-circulated down the hole following the removal of drill cuttings from the returns by passing over/through solids control equipment at the surface. The cuttings will be directed into the drilling sumps and the fluids directed to the mud tanks which will have a capacity of approximately 1000bbls (Figure 6-7).

The total volume of rock removed during the drilling operations of the wells (air and mud drilling) is approximately 700 to 850bbls. When drilling and associated activities have been completed on the site, the sumps and flare pit are left to dry out before backfilling. If required, soil testing will be undertaken of the cuttings to determine suitability for backfilling or if removal and offsite disposal is required.

A simple mud system may be required during the drilling of the well and a fluid system will always be on site for standby for well control. This fluid is stored in the contractors steel mud tanks during the well construction phase. During drilling operations with mud, fluid and cutting returns are taken to the shale shakers where the mud is separated and the cuttings discharged to the drilling sumps. As the drilling muds are very basic with biodegradable additives, this fluid is also discharged as per standard industry practice into the drilling sumps. Baseline soil samples will be taken prior to sump construction. Liquids in the sump shall also be sampled and tested with test results sent to DPIR from an independent third party confirming that in-situ burial is acceptable in accordance with the following criteria:

- pH of 6-10.5 (prior to mixing with soil)
- Electrical conductivity of 20,000 uS/cm (prior to mixing with soil)
- Chloride of 8000 mg/L (prior to mixing with soil)
- Metals as per the NEPM 2013 (once mixed with soil).

The sumps and cuttings are allowed to dry out before back filling. The specific process for backfilling is as follows:

- the base of the subsoil and residual solid mixture will be separated from the groundwater table by at least 190 metres of a continuous layer of impermeable subsoil material (kw=10–8m/s) or subsoil with a clay content of greater than 20% (note that the nearest aquifer is 190m as identified in section 7.1.5)

- the dried drilling mud will be mixed with subsoil in the sump and covered
- the subsoil and drilling mud will be mixed at least three parts subsoil to one part waste (v/v)
- a minimum of one metre of clean subsoil will be placed over the subsoil and muds mixture
- top soil will be replaced.

The criteria and methodology proposed are consistent with the standards set by the Queensland Department of Environment and Science for onshore oil and gas activities. The mud sumps shall be backfilled prior to the wet season or, if not fully evaporated, appropriately tested and managed so that waste materials are either safely relocated and disposed or buried on site. Refer to Figure 6-4 in Section 6.3.

In situ burial of drilling muds where appropriate quality criteria are able to be met is considered to represent an acceptable and low as reasonably practical environmental risk when considered holistically. Other options such lining ponds and removing the drilling muds for off-site disposal generate more waste plastic, generate more greenhouse gases and importantly add significantly more road kilometres which represent one of the largest safety risks to staff and the community associated with onshore oil and gas activities.

6.3.10 Number of Staff

During drilling operations there will be approximately (but not limited to) 30 personnel onsite. During specific stages there will be a higher number of personnel onsite; up to approximately 47 people. A summary of personnel onsite including drilling rig personnel and other service providers, is summarised in Table 6-6.

Table 6-6. Summary of approximate number of personnel onsite during proposed drilling activities, including drill rig personnel and other service providers

PERSONNEL ONSITE	
Drilling Rig Personnel	**Total Onsite**
Senior Toolpusher	1
Night Toolpusher	1
Driller	2
Assistant Driller	1
Derrickman	2
Motorman	2
Floorman	2
Leasehand	2
Electrician	1
Mechanic	1
RSTC (HSE)	1
TOTAL	**16**
OTHER SERVICE PROVIDERS	**Total Onsite**
Mudlogging	4
Air Package	3
Cementing	3
Directional Drillers	4
Wireline	5

PERSONNEL ONSITE	
Drilling Rig Personnel	**Total Onsite**
Wellsite Geologist	2
Wellsite Supervisor	2
Additional Personnel	8
TOTAL	**31**
GRAND TOTAL	**47**

6.3.11 Contractor Details

Table 6-7. Contractor details and contact information

Company & Contact	Service	Work	Mobile
Ensign Energy **Dave Murphy**	Rig Contractor	08 8209 3142	0408 492 318
Halliburton **Travis Alkek** **Account Lead**	Cementing	07 3811 6045	0426 226 751
RMN Drilling Fluids **Andre Skujins**	Drilling Fluids		0428 833 872
Newpark Drilling Fluids **Hennie Potgieter**	Drilling Fluids		0408 623 341
Baroid (Halliburton) **Mohamed Magdy**	Drilling Fluids		0410 221 675
Sperry Drilling (Halliburton) **Brian Huston**	Directional Drilling	07 3811 6033	0448 048 593
Schlumberger **Nicole Cooper**	Directional Drilling	08 9420 4602	0467 008 079
Schlumberger **Omar Mansour**	Wireline Logging	08 9440 2987	0498 009 644
Kenetic **Sean Williams**	Wireline Logging	07 4622 2511	0400 222 511
Geoservices **Nicole Cooper**	Mudlogging	08 9420 4602	0467 008 079
ADA **Jim Carr**	Air Package		0423 644 779

6.3.12 Timing and Duration

It is proposed that drilling activities will commence mid-April 2018 at sites WM-25 and WM-26. The anticipated duration of the drilling program is 36 days each site. Drilling operations will run 24 hours a day during this time.

6.4 Staging Area and Drilling Activities

Once the drill pad and access tracks are cleared and excavation works are completed (installing all drilling sumps, flare pit, water storage pit, and the installation of a cellar to house the wellhead and BOP), the drilling rig will be mobilised to the site.

6.4.1 Drilling Program Activities

Drilling program activities will include:

1. Installation of a conductor pipe either by pilling/auger methods or drilling with a water/polymer drilling fluid. The conductor pipe will be set and cemented within a competent formation, isolating the unconsolidated surface sediment.
2. Installation of a second conductor string across the shallow freshwater aquifer (Mereenie Sandstones) identified in section 7.1.5. The conductor casing will be set in a competent formation and cemented to surface. The Conductor-2 hole will be drilled using a water based drilling fluid. The hole section may be drilled with air and a hammer bit by Direct Circulation Air Drilling techniques if performance objectives are not met during mud/fluid hammer drilling operations to maximise the rate of penetration due to the hardness of the formation.
3. Following the installation of the second conductor, the surface hole will be drilled using a simple water based mud system or Direct Circulation Air Drilling techniques depending on performance objectives. The water based mud will consist of additives for fluid density (Potassium Chloride or Sodium Chloride), filtration control viscosifiers, hole stability and pH control.
4. A Surface casing string will be run and cemented to surface adding an additional barrier over the potential water aquifer.
5. A Formation Integrity Test (FIT) will be conducted prior to drilling below the surface casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT test ensures/confirms that the formation directly below the surface casing shoe will not breakdown during a well control event.
6. Drilling of the intermediate hole (build section) will involve directionally drilling until the Lower Stairway Sandstone is intersected horizontally. This section will be drilled with a water based drilling fluid consisting of additives for fluid density (Potassium Chloride or Sodium Chloride), filtration control viscosifiers, hole stability and pH control.
7. Following completion of the build section, a liner will be run and set from section Total Depth to at least 30m into the previous casing string. The liner will be set in place with a liner hanger and packer assembly and cemented in place.
8. A Cement Bond Log (CBL) will be run measuring the cement integrity behind the liner and surface casing.
9. Prior to drilling the production hole, a FIT will be conducted below the liner shoe.
10. The production hole will be horizontally drilled using Direct Circulation Air/Mist Drilling techniques. Flow tests may be conducted during the drilling of the production hole to test potential gas flow rates. This process involves a controlled release/flow of hydrocarbon (gas) diverted to a flare pit for combustion. Flaring will last for the entire drilling of the production hole, approximately 13 days.

11. Following the results obtained from flow tests (if applicable), a decision will be made to either run a completion or to plug and abandon the well.

6.4.2 Completion Activities

If gas flow rates to surface are satisfactory, the wells will be completed as production wells. The wells are "open hole completions" (not requiring any perforating activities). Completion activities will include:

- Installation of a production tubing string and production packer.
- Installation of wellhead assembly enabling the well to safely flow gas to surface.

6.5 Closure and Rehabilitation

6.5.1 Suspension or Production

If the wells are successful or the wells are cased and suspended, the drill pads will remain cleared at 120mx120m for approximately three years allowing for future works; that is completions or standard production and remedial well work that may be required. After this time the well pad sizes will be assessed and where possible reduced. If the wells remain on production, the drill pads will be reduced to approximately 50mx50m to allow for standard production operations for the life of the well.

6.5.2 Plug and Abandon Activities

If flow rates to the surface are unsatisfactory, the wells will be Plugged and Abandoned (P&A). Prior to commencing with the P&A operations, the wells will be logged. This involves electrically powered tools being run over the production hole (horizontal section), where continuous measurements of the formation properties will be conducted to gather further information regarding the formation characteristics. Once logging operations are completed the well will be P&A. All casing strings will be left in the hole (no casing cuts or removal of casing sections downhole are required). P&A operations will involve:

- Placing cement plugs within the open hole over porous formations and any hydrocarbon bearing zones (minimum of 100m of cement above and 50m cement below any significant gas or fresh water zones);
- Placing a cement plug of at least 50m in height above the 7" liner hanger;
- Placing a surface cement plug extending at least 15m below the surface within the innermost string of casing that extends to surface;
- Cutting casing strings that extend to surface 2m below the surface and removing the wellhead;
- Welding a steel plate on top of casing stub that details the well name, date of completion and total depth;
- Removing cellar and backfilling; and
- All top soil will be respread evenly over the well pad, with vegetation stockpiles used as a final layer as soon as practical in accordance with Section 6.3.1. Also refer to Section 7.6.2 of the FEMP.

7 DESCRIPTION OF THE ENVIRONMENT

7.1 Physical Environment

7.1.1 Climate

The climate of the proposed well sites is considered semi-arid with 70% of precipitation occurring between October and March, caused mainly by monsoonal depression systems in northern Australia (Slatyer, 1962).

The site experiences low and variable rainfall and high diurnal and seasonal temperature fluctuations. The mean annual rainfall for MRN is 300mm, with most of rainfall in summer. Temperatures vary from very hot in summer to below freezing in winter, and frosts occur regularly during the winter months. The mean annual evaporation rate at Alice Springs is 3066mm. The dominant wind directions are southeast to northeast with not much seasonal variation. Climatic conditions for Alice Springs and Hermannsburg, the two closest reliable weather stations, are shown in Figure 7-1.

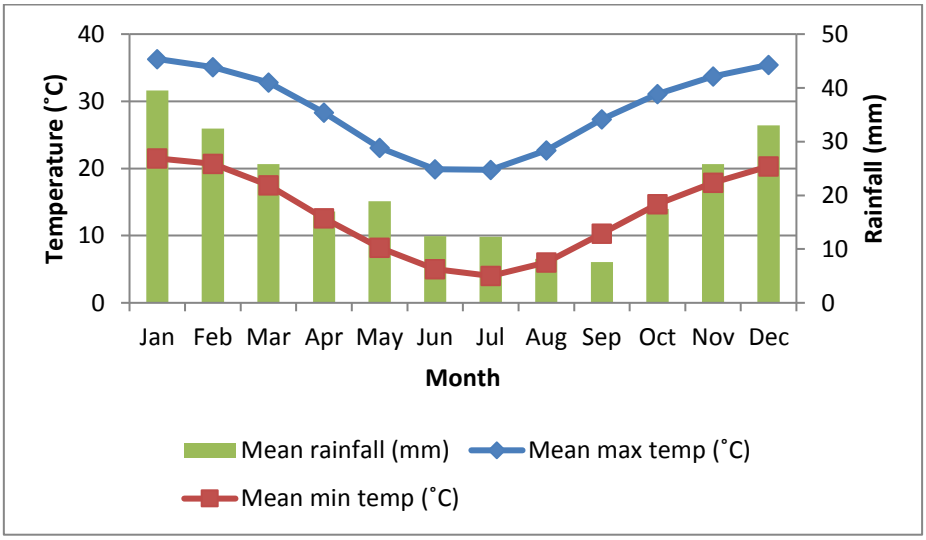

Figure 7-1. Alice Springs (1942 – 2016) weather data showing mean minimum and maximum temperature and Hermannsburg (1888 – 2016) mean monthly rainfall (Bureau of Meteorology, 2017)

Landscape and Topography

The proposed well sites are in the widespread Simpson land system (See Figure 7.2, Table 7-1), described by Perry et al. (1962) as an area of extensive dunefields with hard spinifex pastures. The Simpson land system occupies the north-west section of OL4.

Table 7-1. Description of land systems associated with proposed well sites as described by (Perry, et al., 1960)

Land System	Code	Geology	Topography	Soils
Simpson	Si	Extensive dune fields with hard spinifex pastures	Sand dunes of varying height and alignment up to a maximum of 70ft in Simpson Desert section	Red sands to red clayey sands and locally red earths.

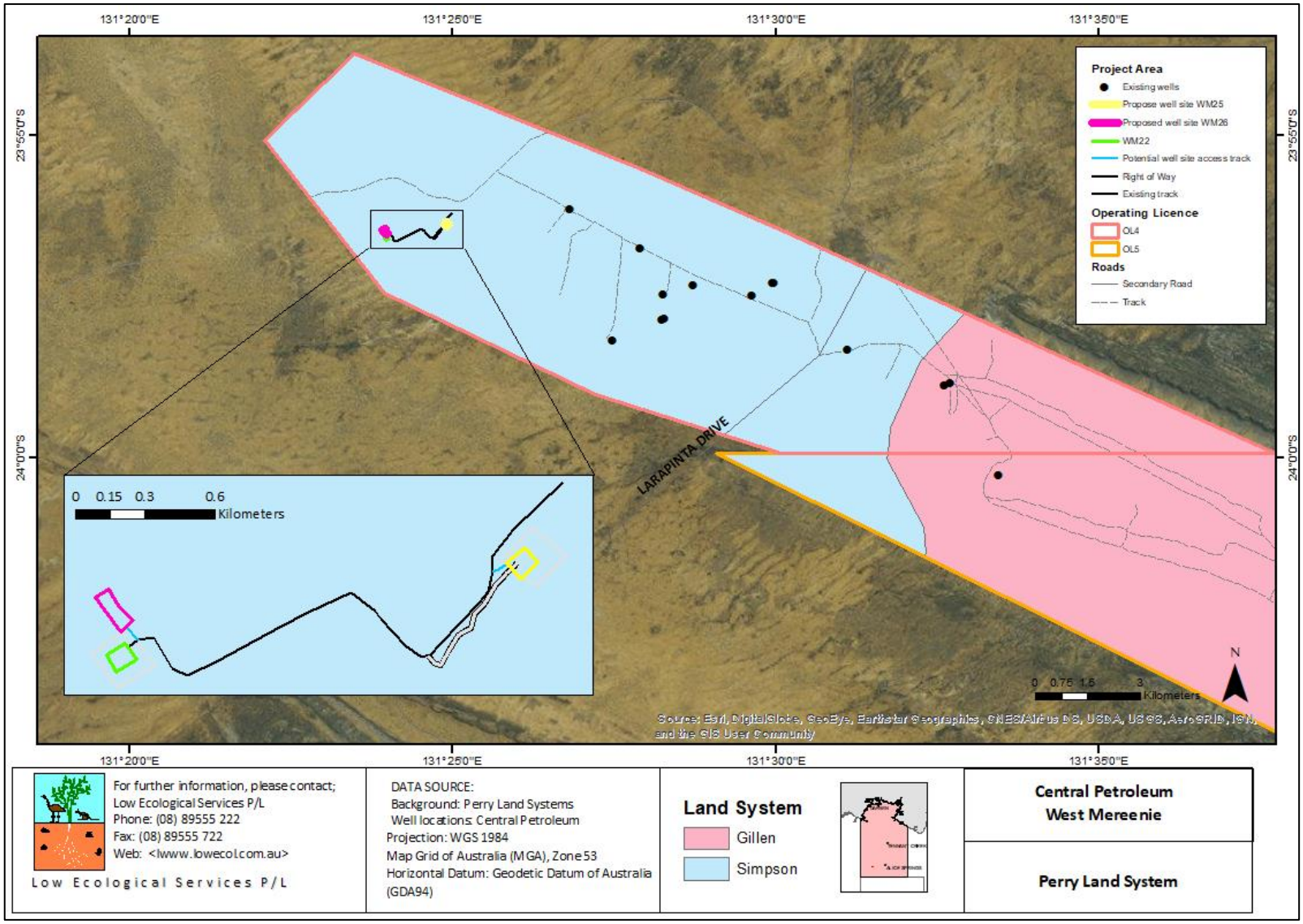

Figure 7-2. Perry Land Systems (Perry, et al., 1960) in relation to the proposed WM-25 and WM-26 sites.

7.1.2 Soils

Soil types in the project areas have been mapped using the Atlas of Australian Soils (mapped by Bureau of Rural Sciences after Commonwealth Scientific and Industrial Research Organisation, 1991; described by (Northcote, 1968)). However, because the currently accepted classification system is the Australian Soil Classification (ASC) (Isbell & National Committee on Soil and Terrain, 2016) a conversion from the Atlas of Australian Soils to Australian Soil Classification was developed by (Ashton & McKenzie, 2001). Well sites WM-25 and WM-26 are characterised by soil type AB31, reclassified as a Tenosol under the ASC Conversion (Ashton & McKenzie, 2001). Soils are described Table 7-2 and mapped in Figure 7-3.

Table 7-2. Description of soil types within the proposed WM-25 and WM-26 sites, including Australian Soils Atlas Description by Northcote (1968) and Australian Soil Classification conversion by Ashton & McKenzie (2001)

Map unit	Location	Australian Soils Atlas Description	ASC Conversion
AB31	WM-25, WM-26, access tracks and right of way.	Flat to gently undulating sand plains with some low broad sand rises and intervening swales; some small alluvial flats; some clay pans; and some stone covered ridges: chief soils are red earthy sands on the plains and swales. Associated are red siliceous sands on the sand rises. Small areas of sandy red earths occur on the plains, in the swales, and on the alluvial flats.	Tenosol: Soils with generally only weak pedologic organisation apart from the A horizons. Encompasses a diverse range of soils that do not fit the requirements of any other soil orders and generally with one or more of the following: i. A peaty horizon. ii. A lumose, melacic or melanic horizon, or conspicuously bleached A2 horizon, which overlays a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite or unconsolidated mineral materials. iii. A horizons which meet all the conditions for a peaty, humose, melacic or melanic horizon except the depth requirement, and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials. iv. A1 horizons which have a more than weak development of structure and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials. v. An A2 horizon which overlies a calcrete pan, hard unweathered rock or other hard materials; or

Map unit	Location	Australian Soils Atlas Description	ASC Conversion
			partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials. vi. Either a tenic B horizon, or a B2 horizon with 15% clay (SL) or less, or a transitional horizon (C/B) occurring in fissures in the parent rock or saprolite which contains between 10 and 50% of B horizon material (including pedogenic carbonate). vii. A ferric or bauxitic horizon >0.2 m thick. viii. A calcareous horizon >0.2 m thick.

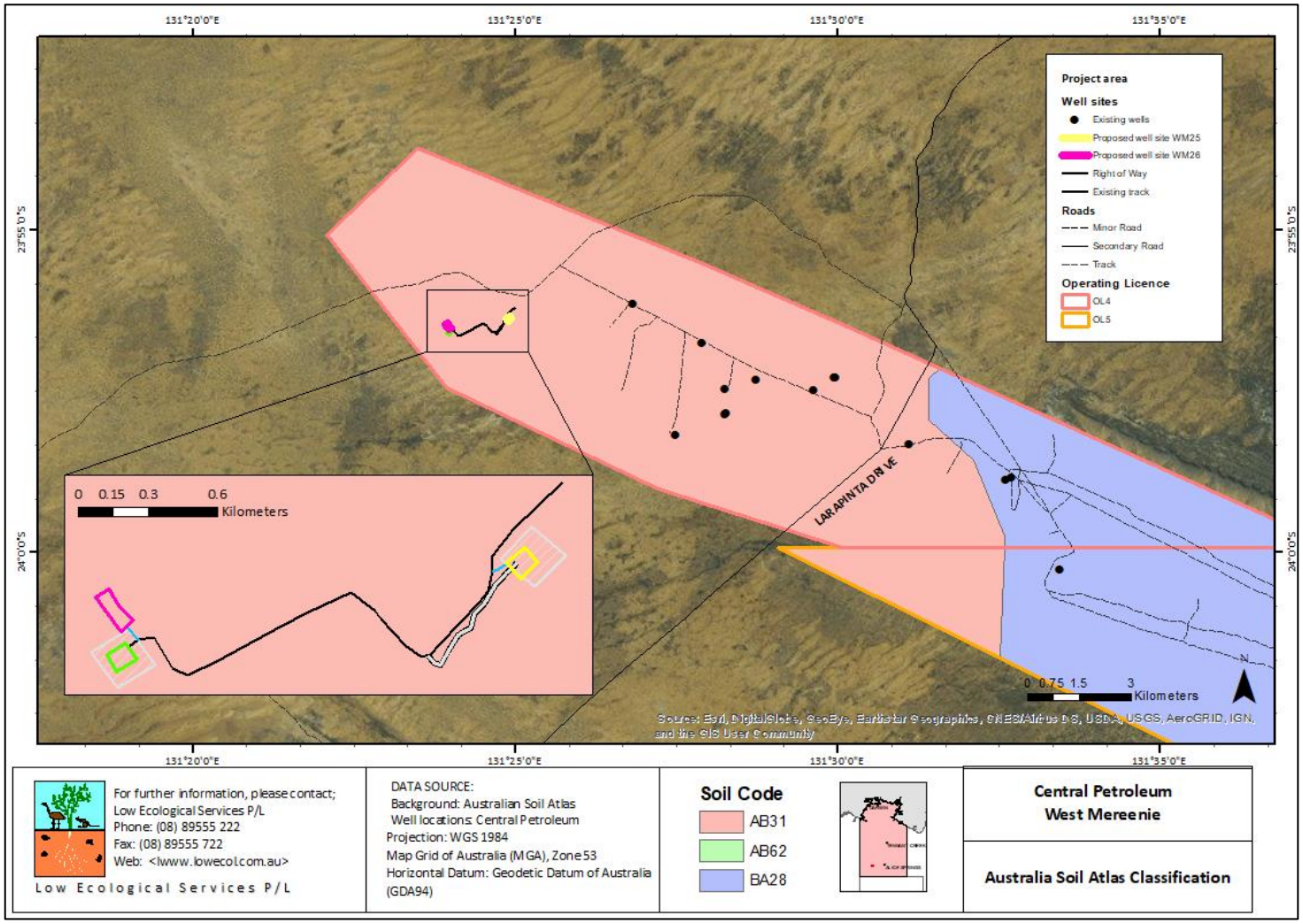

Figure 7-3. Australian Soil Atlas soil types mapped over the proposed WM-25 and WM-26 sites. Refer to Table 7-2 for description of soil types and conversion to the current Australian Soil Classification system

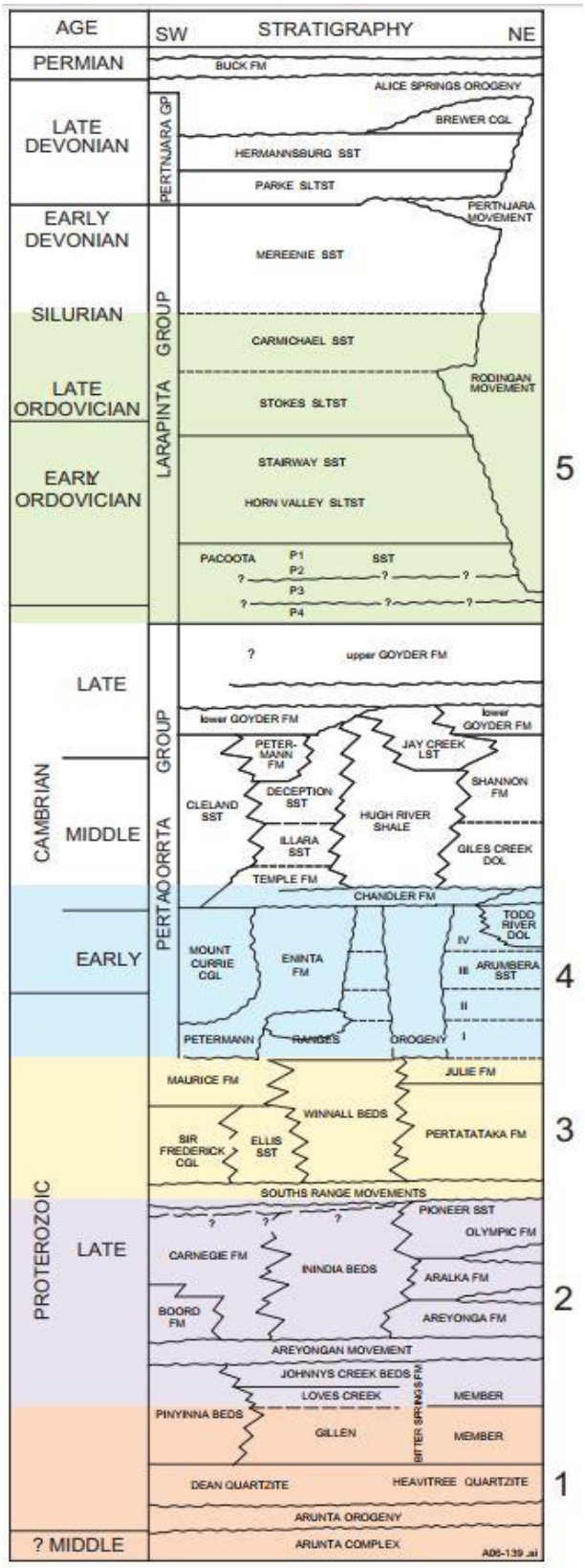

Figure 7-4. Generalised stratigraphy of the Amadeus Basin

7.1.3 Geology

MRN falls within the Amadeus Basin, an east-west trending structural depression extending across the southern part of the Northern Territory and into Western Australia. The basin covers an area of approximately 207,000km^2 and contains up to 9100m of late Proterozoic and Palaeozoic sediments (see Figure 7-4). The majority of the Amadeus Basin is comprised of intensely folded and fractured Cambrian and Late Proerozoic strata with the northern section comprised of Devonian, Silurian and Ordovician fold systems. The MRN lies within these fold systems in the north of the Amadeus Basin (Dickinson & Moser, 2001).

Geologically, the MRN comprises a large anticlinal structure within the Amadeus Basin. Rocks in the proposed WM-25 and WM-26 areas and throughout most of OL4 consist of sandstones, which form resistant strike ridges and less resistant siltstones commonly covered by superficial soils. The proposed well sites sit entirely over unit 'S' (Ahmad, 2000). The geological units associated with the proposed well sites are described in Table 7-3. For a geological map of the area (see Figure 7-5).

Oil and gas reserves at MRN are predominantly located in the Early Ordovacian Pacoota Sandstone and Stairway Sandstone formations (see Figure 7-4). The proposed wells will be drilled to the depth of the Staircase Sandstone formations through overlying layers including Mereenie Sandstone, Park siltstone and Hermannsberg Sandstone, before drilling horizontally towards target hydrocarbon reserves.

Table 7-3. Geological units present at the proposed WM-25 and WM-26 sites and surrounding region as described by Ahmad (2000)

Map unit	Rock type	Description	Geological Region
C	Sedimentary	Dolostone, limestone, sandstone, shale, conglomerate	Amadeus Basin
P10>4	Sedimentary	Sandstone, limestone, siltstone	Amadeus Basin
D	Sedimentary	Sandstone, limestone	Amadeus Basin
O	Sedimentary	Sandstone, shale, dolostone	Amadeus Basin
S	Sedimentary	Sandstone	Amadeus Basin

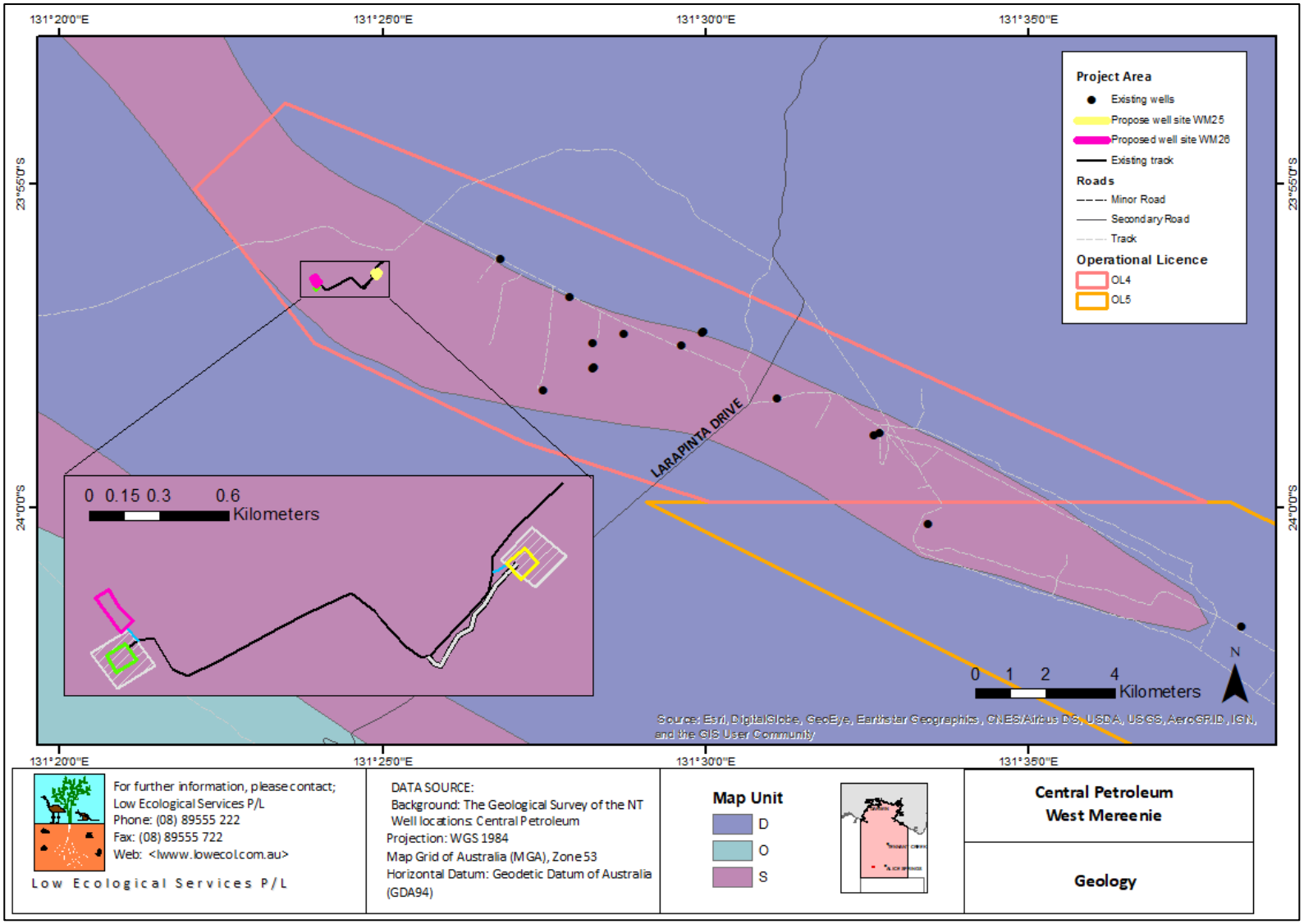

Figure 7-5. Geological units at a scale of 1:250,000 mapped over the proposed WM-25 and WM-26 sites

7.1.4 Groundwater

The MRN field lies within the Devonian, Silurian and Ordovician fold systems in the north of the Amadeus Basin and is sited on the Mereenie Anticline. CTP has a good understanding of the groundwater formations near the proposed well through the drilling of 69 wells in the region and specifically well WM 22 in close proximity to proposed wells WM25 and WM26.

The Ordovician-Devonian part of the Amadeus Basin sequence, with its relatively uniform, basin-wide, layer-cake distribution, contains thick porous aquifers, including the Mereenie Sandstone, Hermannsburg Sandstone and Pacoota Sandstone (see Figure 7-6). In these aquifers, groundwater flow is generally eastwards along synclinal axes (Lau & Jacobson (1992). Groundwater quality in these aquifers varies considerably however is generally good near the outcrop at the synclinal margins. Groundwater from the Mereenie Sandstone is currently the source of potable water for the MRN camp and water quality is considered high.

Hermannsburg Sandstone

Hermannsburg Sandstone overlies Parke Siltstone in the MRN area west of the Finke River, with a maximum thickness of 1100m. The average standing water level of the Hermannsburg Sandstone is 33m below ground level (bgl), although varies from near surface to 36m bgl. Permeability of the unit is generally considered low although transmissivity is recorded as varying significantly in some locations. Regional groundwater flow of the aquifer is from west to east along the Missionary Plain Trough alignment. The aquifer is widely used for small settlement and livestock water supplies (Dickinson & Moser, 2001).

Parke Siltstone

The Parke Siltstone is a red brown formation with interbedded minor limestone and fine silty sandstone layers. The formation overlies Mereenie Sandstone in the MRN area and outcrops along the margins of the anticline. Groundwater is encountered within the layer however the formation is not considered hydrogeologically prospective due to the limited thickness and low groundwater potential of the unit (Dickinson & Moser, 2001). It is of significance as it provides a low permeable barrier to vertical groundwater flow (leakage) between the Hermannsburg Sandstone and the underlying Mereenie Sandstone.

Mereenie Sandstone

The Mereenie Sandstone outcrops along the axis of the Mereenie Anticline along the length of the MRN field, reaching a maximum thickness of 1000m across the entire basin. It is considered the most important aquifer in the Amadeus basin, providing most of the Alice Springs water supply taken from the Roe Creek Borefield, with additional proven resources from the Rocky Hill borefield and irrigation supplied at Deep Well (Lau & Jacobson , 1989). The average depth of this groundwater aquifer is 65m bgl, however in the MRN field, groundwater levels within the Mereenie Sandstone are closer to 190m bgl (Figure 7-7).

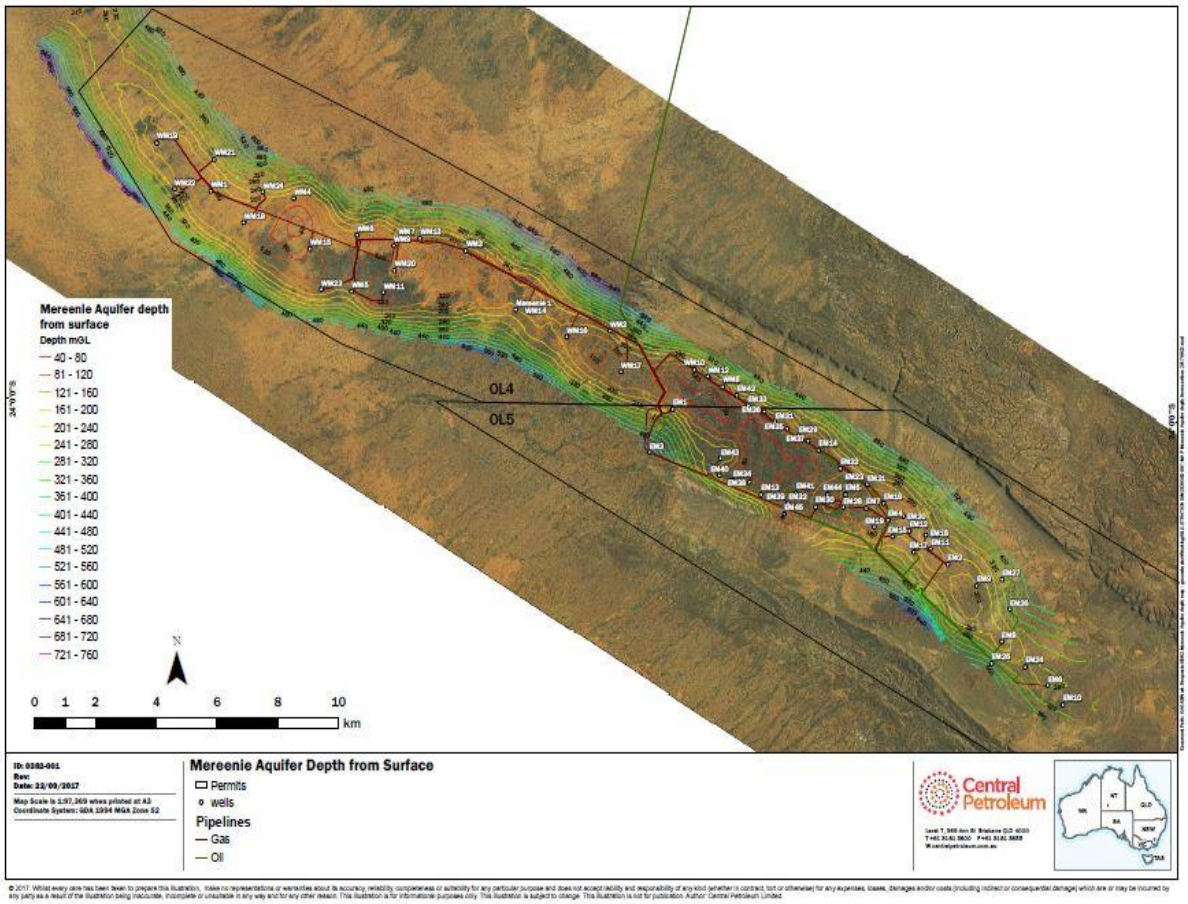

Figure 7-6. Depth of the Mereenie Aquifer from surface in the MRN area

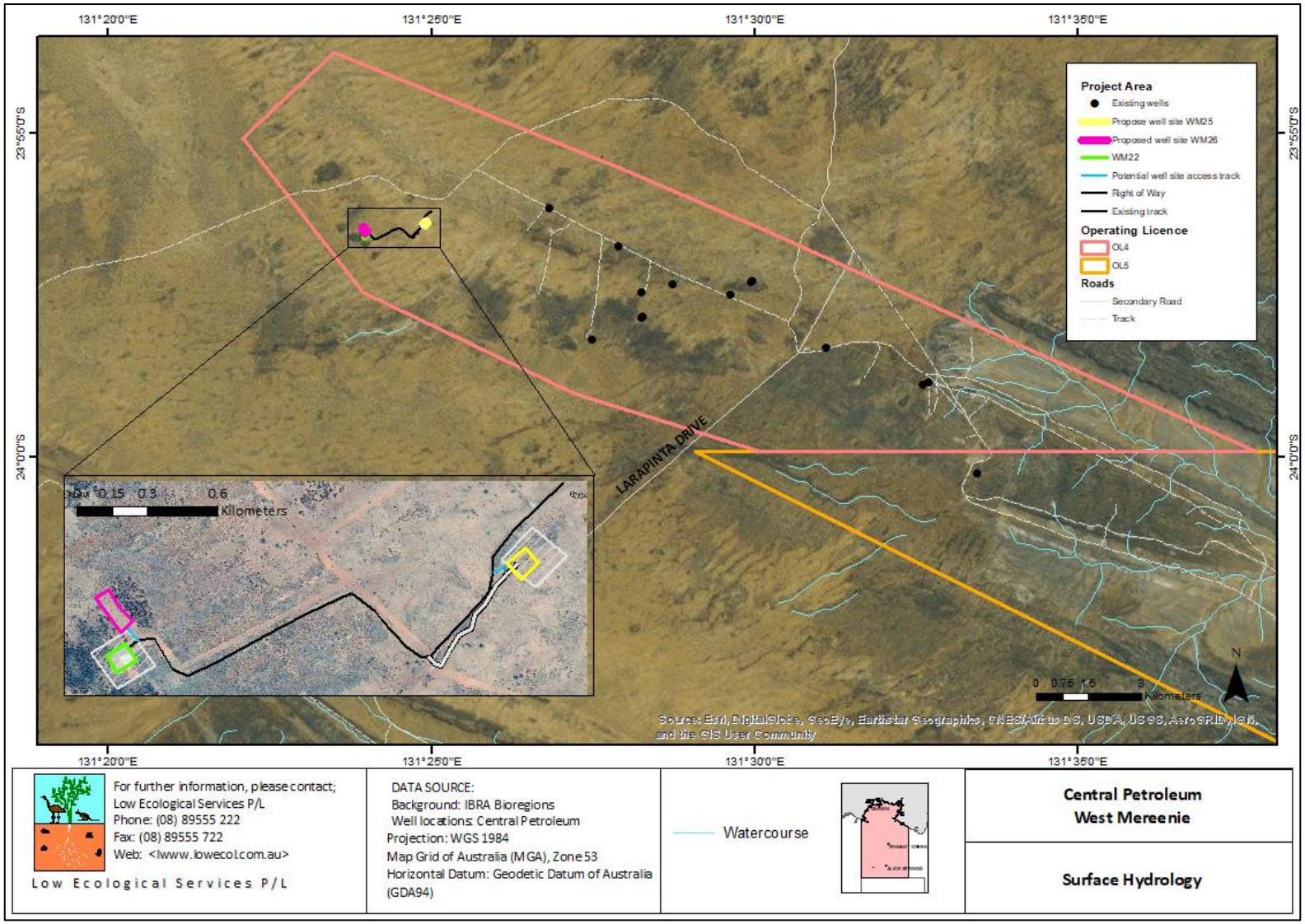

Figure 7-7. Surface hydrology mapped over the proposed WM-25 and WM-26 sites.

7.1.5 Surface Hydrology

No ephemeral streams are located in the vicinity of the proposed WM-25 or WM-26 sites. The lack of drainage patterns in the area indicates that runoff seldom, if ever, occurs. Sandy soils at the proposed area allow for surface water to infiltrate quickly, although some ponding may occur in interdunal swales where small areas of clayey soils and red earths may be present. A map of the surface hydrology of the proposed area is available in (Figure 7-7).

7.2 Biological Environment

7.2.1 Vegetation types

The proposed new well sites fall within widespread the Simpson land system. This land system supports distinctive associations characterised by desert oak trees, various *myrtaceous* and *protaceous* shrubs, and grasses including spinifex; thickets of mulga are common. The following vegetation communities have been identified as occurring (Figure 7-8):

- *Eucalyptus gongylocarpa* (Marble Gum) open woodland with open hummock grassland understorey; and
- *Triodia pungens* (soft spinifex) hummock grassland with *Allocasuarina decaisneana* (desert oak) open-woodland overstorey between dunes.

Neither of these vegetation communities represent areas of conservation significance. They are wide spread and undisturbed in the surrounding area. Operations associated with the proposed well sites will not significantly impact the integrity of these vegetation communities at a regional scale.

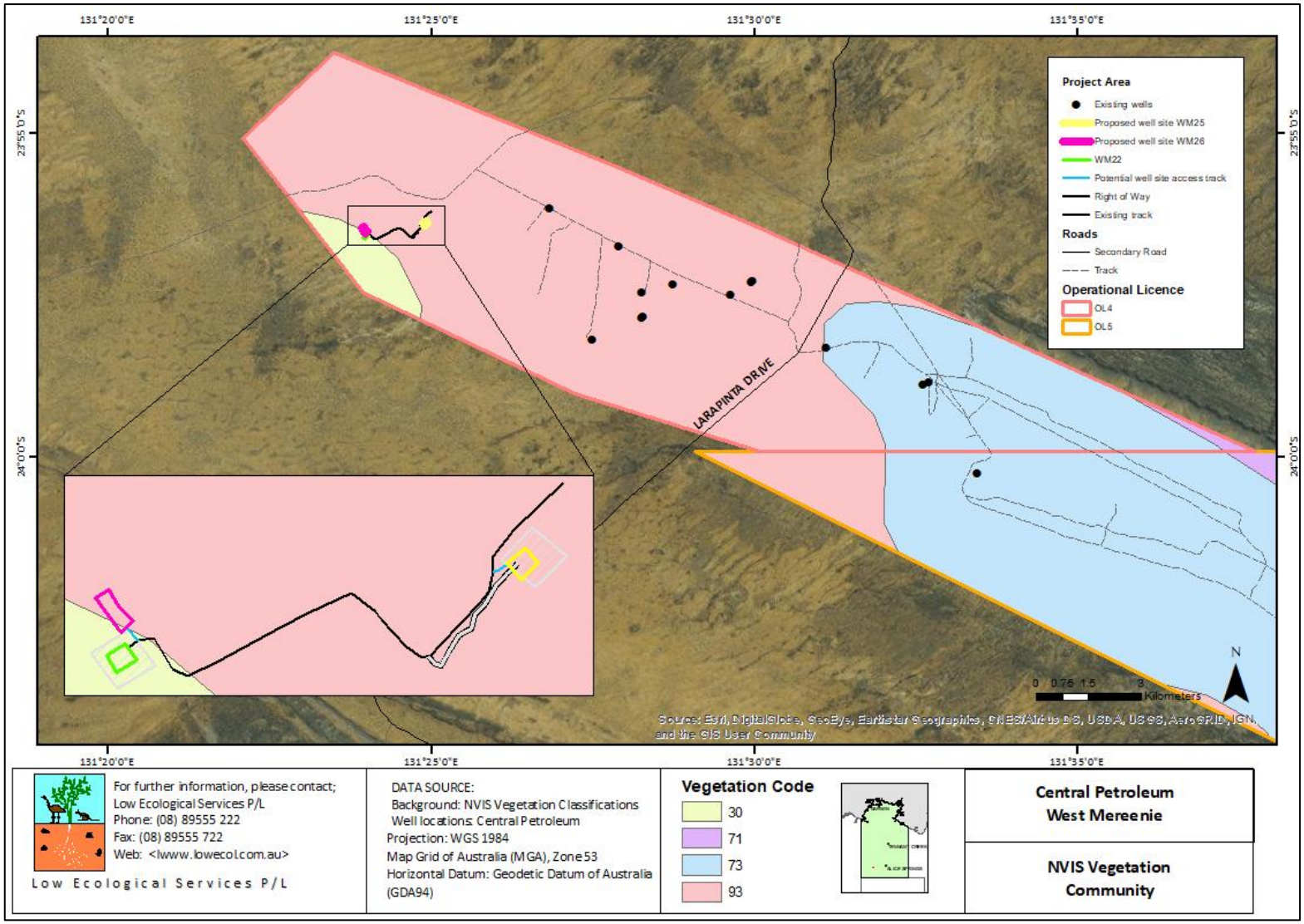

Figure 7-8. Vegetation types in the proposed WM-25 and WM-26 sites as mapped by (Wilson, et al., 1991)

7.2.2 Flora

7.2.2.1 Flora species of conservation significance

The NT Flora Atlas identified 453 records of 246 flora species within 20km of the proposed well sites. (PMST report is available in Appendix 2)

A flora species is considered in this report to be of conservation significance if it is:

- Listed as Critically Endangered (Cr), Endangered (En) or Vulnerable (Vu) under the *TPWC Act* and has been recorded in the NT Flora Atlas within a 20km buffer of the proposed WM-25 and WM-26 areas or has been recorded in field surveys of the area; or
- Listed as Cr, En, Vu or Conservation dependent under the *EPBC Act* and is identified by a Protected Matters Search Report (PMSR) within a 20km buffer of the proposed WM-25 and WM-26 areas; or has been recorded on field surveys of the area.

One species of conservation significance, *Santalum acuminatum,* listed as vulnerable (Vu) under the *TPWC* Act was recorded within 20km of the proposed well sites and has a high likelihood of occurrence. Nine species listed as near threatened (NT) and three data deficient (DD) species were recorded within 20km of the proposed well sites.

A summary of flora species of conservation significance and species listed as near threatened (NT) and data deficient (DD), identified having a moderate or high likelihood of occurring within the proposed well sites, is provided in Table 7-6. A map of flora records within 20km of the proposed WM-25 and WM-26 areas from the NT Flora Atlas is presented in Figure 7-9. Species identified in the desktop assessment within 20km of the site and determined to have a low likelihood of occurrence based on available habitat within the proposed well sites are not included in this report.

Table 7-4. Flora species of conservation significance identified by the TPWC Act as occurring within 20 km of the proposed WM-25 and WM-26 sites

Family	Scientific name	Status		NT Flora Atlas	Habitat	Description	Likelihood
		TPWC	EPBC				
ASPARAGACEAE	*Laxmannia arida*	NT	-	X	Occurs on crests, slopes and swales of dunefields.	Small evergreen perennial lily. Distinctive appearance due to presence of aerial stilt roots.	High
ASTERACEAE	*Calotis cuneifolia*	DD	-	X	Grows in river floodplains	Perennial forb to 60cm tall, leaves alternating up stem. Flowers blue to mauve or purple.	Moderate
FABACEAE	*Acacia nyssophylla*	NT	-	X	Grows in health and mallee communities in sandy soil and on clay lake beds.	Prickly shrub or tree (rarely), 0.5 – 3m high. Yellow flowers.	Moderate
	Gompholobium simplicifolium	NT	-	X	Sand dunes with *Triodia*	0.7m tall shrub, leaves pinnate, flowers yellow-orange	High
GOODENIACEAE	*Goodenia glandulosa*	NT	-	X	Yellow or red sand on sand dunes, rocky hillsides.	Erect perennial herb, 0.2-0.5m high. Flowers yellow	Moderate
HALORAGACEAE	*Haloragis odontocarpa f. octoforma*	DD	-	X	Sandplain with Desert Oak dominant.	Often multi-stemmed annual herb to ~50cm. Flowers borne in clusters, green to reddish.	High
HEMEROCALLIDACEAE	*Corynotheca licrota*	NT	-	X	A dune specialist, frequently on dune crests and never on sandplains.	Minutely roughened grass like leaves arising from a basal tuft.	Moderate
LOGANIACEAE	Orianthera centralis	NT	-	X	Sandplains and dunefields	Stiffly erect, multi-stemmed perennial shrub to 50cm high. Flowers white.	High
NYCTAGINACEAE	*Commicarpus australis*	NT	-	X	Occurs in red or brown/pink sand, alluvium, clay or limestone in sand dunes and mangrove swamps.	Scrambling or prostrate shrub, 0.3-3m high. Pink/purple-blue flowers.	High
POACEAE	*Eragrostis sterilis*	NT	-	X	Sands and sandy loams, often near watercourses and waterholes.	Perennial, 60-90cm tall. Leaf blades strait. Leaf blade surface glabrous	Moderate

Family	Scientific name	Status		NT Flora Atlas	Habitat	Description	Likelihood
		TPWC	EPBC				
POLYGALACEAE	*Comesperma viscidulum*	DD	-	X	Occurs predominantly on sandplains and dunefields (sometimes perched).	Shrub to 2m high. Glabrous stems, alternate bluish leaves. Flowers white with yellow and sometimes purple markings.	High
PROTEACEAE	*Grevillea pterosperma*	NT	-	X	Yellow or red sand. Sand plains.	Erect shrub 1.5-4m high. Flowers white-cream.	High
SANTALACEAE	Santalum acuminatum	VU	-	X	Gravelly rises, intermittent watercourses, fertile alluvial plains, mulga-dominated red-earth plains, sandplains and low sandy rises and dunefields.	Distinctive small tree to about 8m high with roundish canopy. Flowers orange disc and cream segments, fruit red.	High

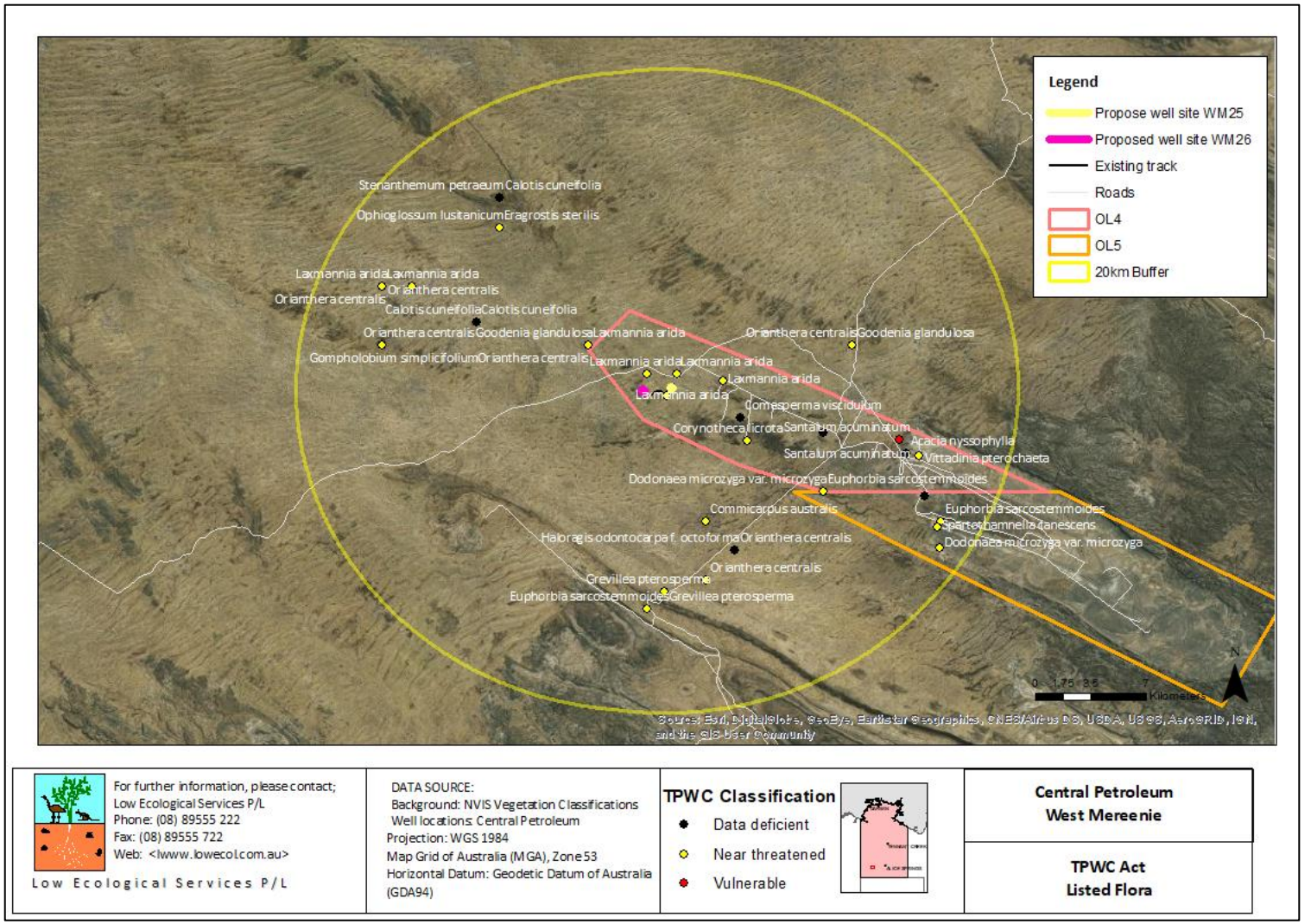

Figure 7-9. TPWC listed Flora records from the NT Flora Atlas identified within 20km of the proposed WM-25 and WM-26 sites

7.2.2.2 On-Ground Survey

An on-ground walkover survey of the proposed WM-25 and WM-26 and associated access tracks and right of way was completed by LES, accompanied by Diana Gomez, Environmental Manager CTP. No flora species of conservation significance were recorded during the on-ground survey (see Appendix 4 for a complete list of species recorded). Flora species identified were consistent with the vegetation communities typical of sandplain communities and are considered widespread. The dominant vegetation community was open desert oak (*Allocasuarina decaisneana*) woodland. Localised clearing associated with the proposed well sites is considered unlikely to have a significant impact on vegetation or habitat availability.

7.2.3 Threatened Ecological Communities

No threatened ecological communities were identified within 20km of the proposed WM-25 and WM-26 sites.

7.2.4 Sites of Conservation Significance

Operations at the proposed well sites are not located within a Site of Conservation Significance (SoCS) and are not considered likely to impact the neighbouring SoCs.

7.2.5 Sites of Botanical Significance

The proposed new well sites fall within the Lay Cock's Sandplain SoBs and lies approximately 2km to the north-west of the Mereenie SoBS (see Figure 7-10).

Given the small, localised nature of vegetation clearing required for the development of the proposed well sites, it is considered unlikely this project will have a significance impact on either of these SoBS.

7.2.6 Introduced and Weed Species

There are no declared weeds or WoNS identified within 20km of the proposed well sites in the NT Flora Atlas or identified during on ground surveys. Three species listed as introduced or invasive were identified as occurring within 20km of the proposed WM-25 and WM-26 areas by the NT Weeds Atlas.

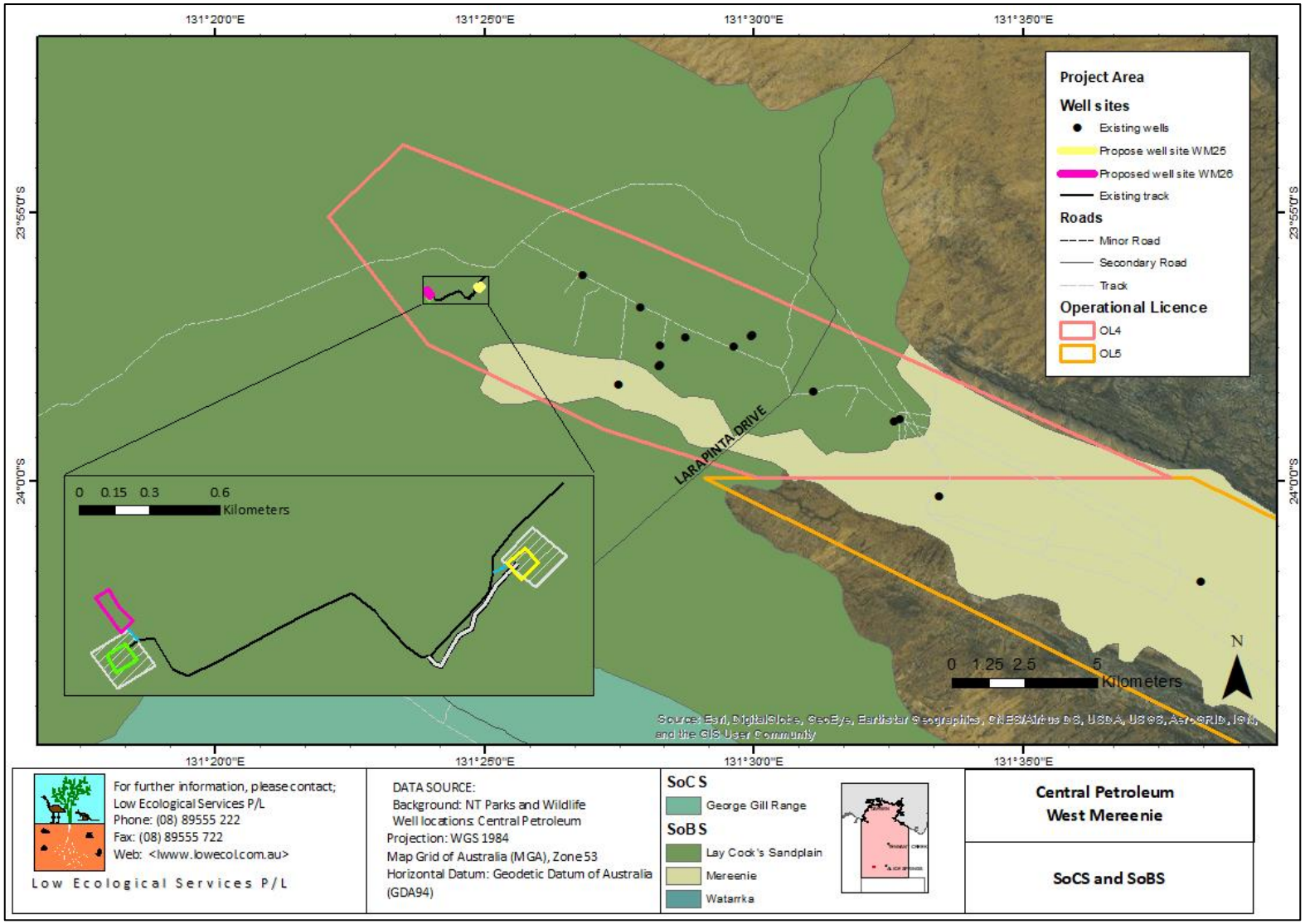

Figure 7-10. Sites of Conservation Significance (SoCs) and Sites of Botanical Significance (SoBs) in relation to the proposed WM-25 and WM-26 sites.

7.2.7 Fauna

7.2.7.1 Fauna Species of Conservation Significance

A search of the DENR managed NT Fauna Atlas and an EPBC Protected Matters Search Tool was conducted within a 20km radius of the proposed drill sites. A total of 457 records of 101 fauna species within 20 km of the project. Records of conservation significant species within 20km of the project area are mapped in Figure 7-11.

Conservation significant species identified through desktop searches as likely to occur within 20km of the proposed well sites, were assessed for the likelihood of occurrence within the proposed WM-25 and WM-26 areas based on the availability of suitable habitat, distance to the nearest record and the known distribution of each species. Species were assigned a likelihood of occurrence ranking as "low", "moderate" or "high" (see Appendix 3 for an assessment of the likelihood of occurrence of each species). The preferred habitat and likelihood of occurrence of species identified in the desktop assessment are summarised in Table 7-7.

One species listed as critically endangered under the EPBC Act is considered moderately likely to occur:

- Night parrot (*Pezporus occidentalis*)

Two species listed as vulnerable under the EPBC Act are considered moderately likely to occur:

- Princess parrot (*Polytelis alexandrae*); and
- Great desert skink (*Liophilis kintorei*).

Two species listed as vulnerable under the TPWC Act are considered moderately or highly likely to occur within the proposed WM-25 and WM-26 areas:

- Brush-tailed mulgara (*Dasycercus blythi*); and
- Southern marsupial mole (*Notoryctes typhlops*).

Five species listed as near threatened or data deficient are considered moderately or highly likely to occur within the proposed WM-25 and WM-26 areas:

- Australian bustard (*Ardeotis australis*) near threatened -NT;
- Grey honeyeater (*Conopophila whitei*) data deficient -NT;
- Emu (*Dromaius novaehollandiae*) near threatened - NT;
- Red throat (*Pyrrholaemus brunneus)* near threatened - NT*;* and
- King brown snake (*Pseudechis australis*) near threatened – NT.

Table 7-5. Threatened or near-threatened fauna species of conservation significance identified by the EPBC PMST and NT Fauna Atlas as recorded or potentially present within 20km of the proposed WM-25 and WM-26 sites

Species name	Common name	Status		PMST	NT Fauna Atlas	Habitat	Likelihood of Occurrence	Notes
		TPWC	EPBC					
Mammals								
*Dasycercus blythi**	brush-tailed mulgara	VU	-			Species occurs in a range of vegetation types, primarily mature hummock grasslands of Spinifex species in sandplains and drainage lines between dunes.	High	
*Lagorchestes hirsutus^*	mala	EW	EN		X	Extinct in the wild.	Nil	Extinct in the wild – will not be considered further.
*Leporillus apicalis^*	lesser stick-nest rat	EX	EX		X	Extinct	Nil	Extinct – will not be considered further.
Macrotis lagotis	greater bilby	VU	VU	X	X	Occurs in a wide variety of habitats, classified into three major groups; sparse grassland/forbland on uplands and hills with low fire frequency, mulga scrub/woodlands on ridges and rises with an infrequent fire interval and hummock grassland/mixed shrub or woodland steppe on plains and alluvial areas with a high (4-10 year) fire frequency)	Low	Nearest record is from pre-1970. Current known distribution extends as far south as Kintore.
*Notoryctes typhlops**	southern marsupial mole	VU	-			Occupies dunes, sandy plains and river flats; requiring soft sandy substrates to tunnel through.	Moderate	Whilst no records occur in the vicinity of the proposed WM-25 and WM-26 areas, the species is known to be cryptic and difficult to survey. It is considered like the species is more

Species name	Common name	Status		PMST	NT Fauna Atlas	Habitat	Likelihood of Occurrence	Notes
		TPWC	EPBC					
								widespread than records suggest.
Petrogale lateralis	black-footed Rock-wallaby	NT	VU	X	X	The species favours steep slopes, cuestas, deep gorges and boulder scree slopes, common in quartzite and sandstone ranges.	Low	No suitable habitat in proposed WM-25 and WM-26 areas
Trichosurus vulpecula vulpecula	common brushtail possum	EN	-		X		Low	No suitable habitat in proposed WM-25 and WM-26 areas
*Zyzomys pedunculatus^*	central rock-rat	EN	EN	X		Confined to high elevation (>1000m) quartzite ridges and mountain peaks in the West MacDonnell Ranges.	Low/Nil	No suitable habitat in proposed WM-25 and WM-26 areas. Considered locally extinct – will not be considered further.
Birds								
Ardeotis australis	Australian bustard	NT			X	Inhabits grasslands, spinifex, open scrublands, grassy woodlands, sandhills, pastoral lands, burned ground and occasionally crops and airfields.	High	
Calidris ferruginea	curlew sandpiper	VU	CR	X			Low	No suitable habitat in proposed WM-25 and WM-26 areas
Conopophila whitei	grey honeyeater	DD			X	Inhabits mature mulga woodland, open mulga with spinifex, tall open acacia scrubland and sand hills with red mulga, cane grass, beefwood and desert bloodwood.	Moderate	

Species name	Common name	Status		PMST	NT Fauna Atlas	Habitat	Likelihood of Occurrence	Notes
		TPWC	EPBC					
Dromaius novaehollandiae	emu	NT			X	Inhabits plains, scrublands, open woodlands, coastal heaths, alpine pastures, semi-deserts, margins of lakes and pastoral and cereal growing areas.	High	
Erythrotriorchis radiates	red Goshawk		VU		X		Low	No suitable nesting habitat in proposed WM-25 and WM-26 areas
Pezoporus occidentalis	night parrot	CR	EN	X		Records are primarily from spinifex hummock grasslands on stony or sandy areas and chenopod shrublands on floodplains, salt lakes and clay pans.	Moderate	Whilst there are no recent confirmed records near the proposed WM-25 and WM-26 areas, a recent increase in sightings and unconfirmed recordings of the species suggest its current distribution is more widespread than previously considered.
Polytelis alexandrae	princess parrot	VU	VU	X		Recorded from sandplain environments with vegetation characterised by *Eremophila, Grevillea* and *Hakea* shrubs with scattered trees.	Moderate	
Pyrrholaemus brunneus	redthroat	NT			X	Inhabits inland scrubs with mulga and other acacias, mallee associations with spinifex, eucalypt regrowth, tea-tree, saltbush and bluebush.	High	
Rostratula australia	Australian painted snipe		EN	X		May occur in any shallow ephemeral wetlands in central or southern NT, either fresh or brackish, which may be temporarily or ephemerally filled.	Low	No suitable habitat in proposed WM-25 and WM-26 areas

Species name	Common name	Status		PMST	NT Fauna Atlas	Habitat	Likelihood of Occurrence	Notes
		TPWC	EPBC					
Reptiles								
Liopholis kintorei	great desert skink	VU	VU	X		Predominantly found in sandplains and adjacent swales contains *Triodia* grassland vegetation and scattered shrubs, but can occupy a range of vegetation types including lateritic paleo-drainage channels and *Melaleuca* shrubs.	Moderate	
Liopholis slateri slater	slater's skink		EN		X	Occurs on plains in the valleys of major drainages. Inhabits shrubland and open shrubland on alluvial soils close to drainage lines.	Low	No suitable habitat in proposed WM-25 and WM-26 areas
Pseudechis australis	king brown snake	NT			X	Inhabits a wide variety of habits. Occupies abandoned burrows, soil cracks and hollow logs.	High	

*LES identified. EW: extinct in wild, EX: extinct, CR: critically endangered, EN: endangered, VU: vulnerable, NT: near threatened, DD: data deficient.

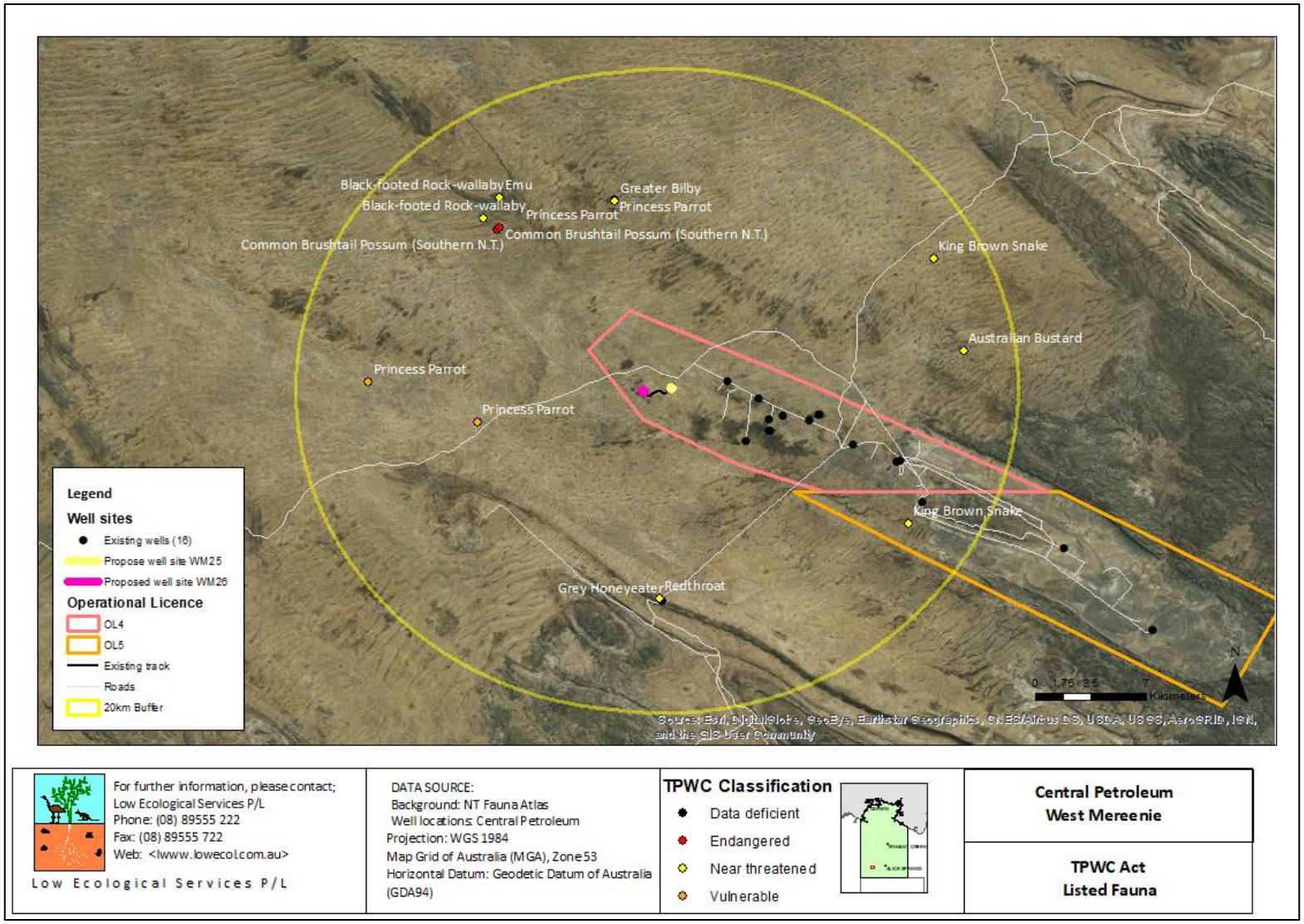

Figure 7-11. TPWC listed Fauna records from the NT Fauna Atlas identified within 20km of the proposed WM-25 and WM-26 sites

7.2.7.2 Migratory and Marine Species

The EPBC PMST identified 14 migratory and/or marine species as occurring or potentially occurring within 20km of the proposed well sites (table 7-7). One of these 14 species was recorded in the NT Fauna Atlas within 20km of the proposed well sites, the Rainbow bee-eater. The Rainbow bee-eater is a commonly recorded migratory species in the Northern Territory. There is a high likelihood that this species will occur. There is a moderate likelihood of occurrence of two species:

- Fork-tailed swift (*Apus pacificus*); and
- Barn swallow (*Hirundo rustica*)

Table 7-6. Fauna species listed as migratory under the EPBC Act as identified by the PMST as having potentially suitable habitat within 20km of the proposed WM-25 and WM-26 sites, their listing under international agreements, and likelihood of occurrence

Scientific name	Common name	EPBC	PMST	International agreement	Likelihood
Actitis hypoleucos	Common sandpiper	Mi, Ma	X	J, C, R	Low
Apus pacificus	Fork-tailed swift	Mi, Ma	X	J, C, R	Moderate
Ardea alba	Great egret	Ma	X	-	Low
Ardea ibis	Cattle egret	Ma	X	-	Low
Calidris acuminate	Sharp-tailed sandpiper	Mi, Ma	X	J, C, R	Low
Calidris ferruginea	Curlew sandpiper	Mi	X	J, C, R, B	Low
Calidris melanotos	Pectoral Sandpiper	Mi, Ma	X	J,C,R,B	Low
Charadrius veredus	Oriental plover	Mi, Ma	X	C, J, R, B	Low
Glareola maldivarum	Oriental pratincole	Mi, Ma	X	C, J, R	Low
Hirundo rustica	Barn swallow	Mi, Ma	X	C, J, R	Moderate
Merops ornatus	Rainbow bee-eater	Ma	X	-	High
Motacilla cinerea	Grey wagtail	Mi, Ma	X	C, J, R	Low
Motacilla flava	Yellow wagtail	Mi, Ma	X	C, J, R	Low
Rostratula benghalensis	Painted Snipe	Ma	X	C, J, R	Low

EPBC Listing: Mi: Migratory; Ma: Marine International Agreement: J: Japan-Australia Migratory Bird Agreement; C: China-Australia Migratory Bird Agreement; R: Republic of Korea-Australia Migratory Bird Agreement; B: Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals)

7.2.7.3 On-Ground Survey

One species of conservation significance was recorded during the on-ground walkover survey, mulgara (*Dasycercus blythi*), listed as vulnerable under the TPWC Act. Secondary signs of the species (i.e. tracks, scats or burrows) was recorded within the proposed appraisal well site. An additional nine species were recorded including two mammal species, three reptile species and five bird species (see Appendix 5 for full list of species recorded).

Intact habitat suitable for mulgara is considered widespread in the area surrounding the proposed appraisal well sites. Clearing of 120m x 120m is considered unlikely to have a significant impact on the species. Individuals may be at risk from clearing and earthworks associated with the project development. A complete risk assessment and mitigation measures is presented in Section 6 to minimise risk to individual animals as a result of the project.

Two introduced species were recorded.

7.2.8 Introduced Fauna Species

An introduced fauna species is considered in this report to be of management concern if it is:

- Listed in the NT Fauna Atlas as "Introduced" and has been recorded within a 20km buffer zone of the proposed WM-25 and WM-26 areas; or
- Identified as an invasive species by a PMSR report for the area within a 20km buffer of the proposed WM-25 and WM-26 areas; or
- Has been recorded on field surveys of the area.

In total of eight introduced fauna species were identified by the EPBC PMST or NT Fauna Atlas as occurring or potentially occurring within 20km of the proposed well sites (Table 7-7).

Two of these species, camel (*Camelus dromedarius)* and horse (*Equus caballus*) were recorded within the proposed well site areas. Mitigation measures to reduce the environmental impacts of attracting increasing these species presence within the proposed well site areas are summarised in Section 7.

Table 7-7. Introduced fauna species identified as occurring or potentially occurring within 20km of the proposed WM-25 and WM-26 sites, by the NT Fauna Atlas or the EPBC PMST

Species name	Common name	PMST	NT Fauna Atlas
Bos Taurus	Domestic Cattle	X	
Camelus dromedarius	Camel	X	X
Canis lupus familiaris	Dog	X	
Equs caballus	Horse	X	X
Felis catus	Cat	X	X
Mus musculus	Mouse	X	X
Oryctolagus cuniculus	Rabbit		X
Vulpes vulpes	Fox	X	

7.2.9 Fire History

Mapping obtained from the North Australia Fire Information website (North Australia and Rangelands Fire Information, 2017) indicates that the proposed well sites have been burnt only one year over the past ten years (see Figure 7-12). The 2011 fires occurred after several years of above average rainfall. No fire has been recorded in the proposed well site areas since.

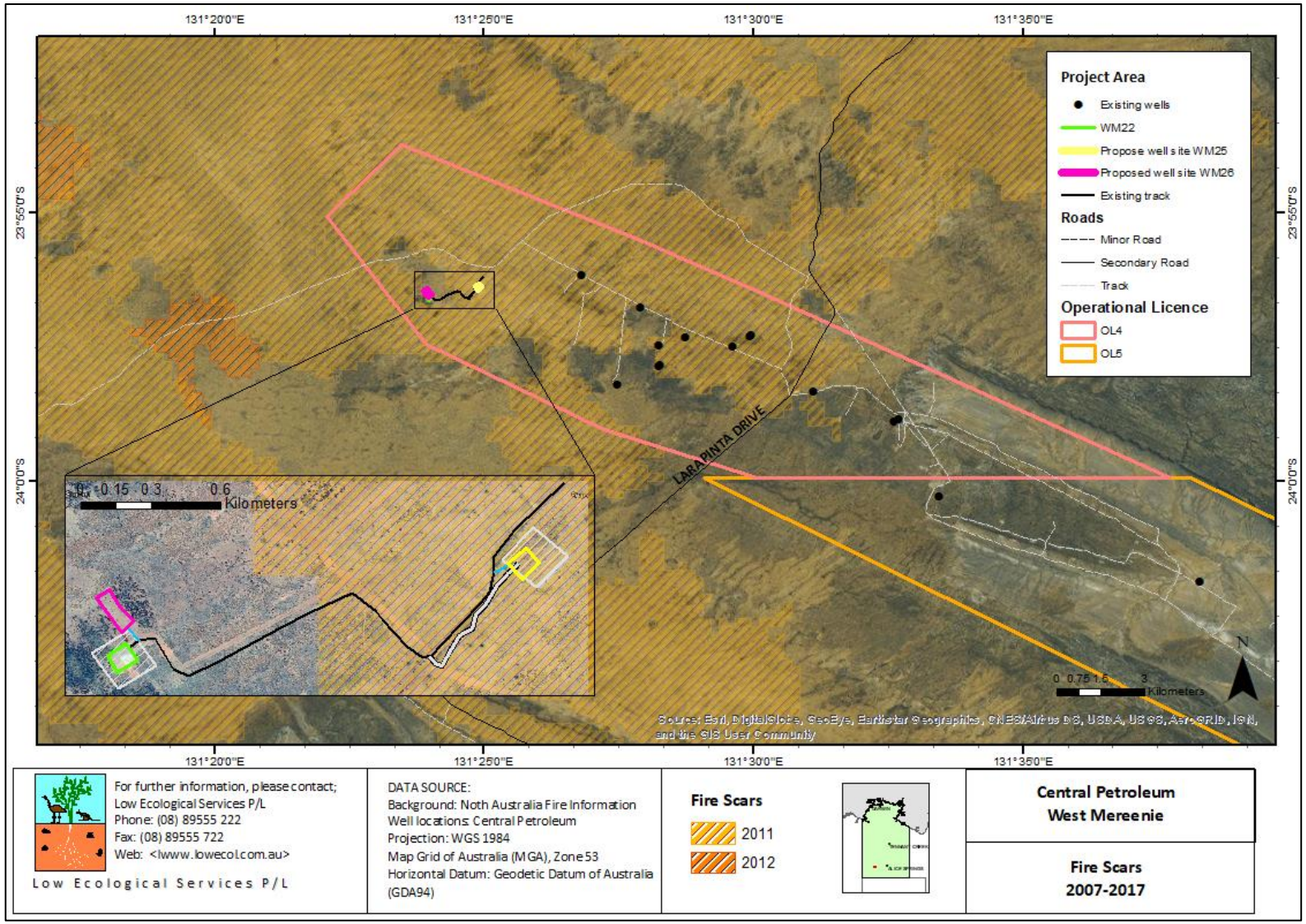

Figure 7-12. 2007-2017 Fire scars in the proposed WM-25 and WM-26 sites from the Northern Australian Fire Information (NAFI) records

7.3 Social Environment

7.3.1 Surrounding Land Tenure

OL4 and the surrounding area is Aboriginal land, belonging to the Kukatja (Luritja) traditional owners under the Aboriginal Land Rights Act (NT) who are represented by Haasts Bluff Aboriginal Land Trust.

Pastoral grazing activities within the surrounding area is managed by Aboriginal interests and undertaken by outstation communities.

Land access agreements with surrounding land holders are current and as approved in the MRN FEMP. (refer to Section 12 "Stakeholder consultation" of the FEMP). Furthermore, Central has received approvals specifically from landowners and the CLC to drill WM25 and WM26

7.3.2 Historic and Current Land Use

The proposed appraisal well sites are within country belonging to the Kukatja people who, along with Mantutara people, are now more commonly known as Luritja. It is bounded to the east by Western Arrente country, to the south by Mantutara country, to the west by Pintupi country and to the north by Ngalia country.

The traditional owners (TO's) of the proposed WM-25 and WM-26 areas are Kukatja people, living permanently at Hermannsburg and outstations at Undandita, Underana, Kulperjara and Camel's hump. Conditions of the establishment of the MRN outlined in the 2003 Mereenie Agreement included maintenance of the right of the TOs to move freely through the OL4 area, this agreement will be honoured.

7.3.3 Surrounding Populated Places

The proposed appraisal well sites are located within one of the most remote and sparsely populated regions of Australia. Seven Aboriginal communities are near:

- Kulpidjara;
- Areyonga;
- Underana;
- Undandita;
- Haasts Bluff;
- Papunya; and
- Ipolera.

The nearest population to the wells is located in Kings Canyon at an approximate distance of 40km. There is also a community of 600-800 people at Ntaria (Hermannsburg), located 140km north-east. The nearest major centre is Alice Springs, with a population of approximately 26,000, located 250km by road.

7.3.4 Heritage Areas identified EPBC PMSR

No national heritage areas were identified within the proposed appraisal well sites by the EPBC PMST.

7.3.5 Archaeological Surveys

As the area is on Aboriginal Land Trust, a CLC clearance is required before any new works are commenced. CLC completed the appropriate on site clearance reviews and an authorisation of SSC certificate to conduct drill pad preparation and clearance has been conducted.

Central has also consulted with AAPA for the clearance of the area and letters recognising CLC SSC certificate has been received.

7.3.6 CLC Sacred Sites Clearance Certificate

CTP work in close conjunction and have regular consultation with the CLC in relation to activities at the MRN. Please refer to the MRN FEMP for more details on the current agreements (refer to Section 12 “Stakeholder consultation” of the FEMP). CTP is applying for an Aboriginal Area Protection Authority (AAPA) certificate to carry out the proposed drilling program at WM-25 and WM-26.

8 ENVIRONMENTAL RISK ASSESSMENT AND MITIGATION MEASURES

8.1 Scope

The scope of the environmental impact and risk assessment covers all aspects of the activities associated with exploration drilling at the proposed appraisal well sites not already covered in the MRN FEMP (refer to section 7 "Environmental Impact and Risk Assessment" of the FEMP). Environmental impacts resulting from activities associated with the proposed drilling program include:

- Flora and fauna
- Soil and landform
- Surface hydrology
- Groundwater
- Waste
- Air and noise emissions

The management and mitigation measures are in accordance with CTP Health, Safety and Environmental Management System (HS&E MS).

8.2 Environmental Hazard Identification, Risk Assessment and Management

Activities (or elements of activities) that have the potential for environment impact[1] have been identified and assessed for the proposed well sites in accordance with *MSTD09-01 v1 – Hazard Identification, Risk Management and Control*. The risk assessment process defined under *MSTD09-01* includes:

- Identification of all environmental hazards associated with operations;
- Consideration of the pathway of impact upon environment receptors for each hazard and the potential maximum consequence if no control measures are implemented;
- Consideration of controls that are appropriate, industry best practise and implemented to manage each hazard;
- Consideration of the likelihood (probability) of the consequence occurring with these controls in place;
- Re-consideration of the final maximum consequence that is credible once controls are implemented;
- Calculation of the environmental risk; and
- Assessment to determine if the risk is ALARP. If it is not, then consideration of further risk control measures will be implemented to reduce the risk to ALARP or to an otherwise acceptable risk level.

[1] An environmental impact is any change to the environment, whether adverse or beneficial, resulting from an activity.

The following activities are addressed:

- Land clearing
- Road and track construction, maintenance and access
- Well drilling and associated exploration activities
- Water supply and use
- Well bore management
- Campsite and associated accommodation facilities
- Fuel and chemical management
- Waste management

8.3 Key Definitions

Key definitions relating to risk management are provided in Table 8.1.

Table 8-1. Key definitions in relation to risk management.

Key Definitions	
Incident Event	An event capable of causing critical, major, moderate or minor damage to the environment or negligible damage with no significant environmental effect.
Hazard	A physical situation with the potential for damage to the environment, human injury, damage to the property or some combination of these.
Risk	The likelihood of specific undesired event occurring within a specified period or in specified circumstances. It may be either a frequency (the number of specified events occurring in a time unit) or a probability (the probability of specified event following a prior event), depending upon circumstances.

8.3.1 Risk Assessment Methodology

The purpose of this risk assessment is to identify hazards and develop risk-reducing measures to prevent and mitigate impacts from operational activities. The ratings used and resulting scores were determined in accordance with the risk assessment matrix in Table 8-1. This assessment also outlines recommended management actions that help to reduce the risk to ALARP.

Environmental risk assessment consists of five basic steps:

1. Hazard identification;
2. Risk analysis;
3. Risk evaluation;
4. Risk management; and
5. Residual Risk Analysis.

These steps are described briefly below.

8.3.1.1 Hazard Identification

Hazard identification involves identifying the sources of risk i.e. those activities or incidents that could result in an environmental impact. Hazards are categorised into those arising from routine operations, and those arising from incidents.

8.3.1.2 Risk Analysis

Risk analysis determines the likelihood of an activity or event occurring, and the consequences of that activity or event on the environment. The risk ranking matrix (Table 8-2) was used to assess the consequence and likelihood of all identified events. The matrix is based on six classifications of consequences and six for the likelihood of a hazard.

8.3.1.3 Risk Rating

Risk evaluation prioritises the risks i.e. determining if the risk of an activity or incident is acceptably low, or if management actions are required to reduce the risk to ALARP. The risk evaluation presented in Table 8-3 takes existing safeguards/management measures into consideration i.e. represents the residual risk with existing or planned safeguards in place. If there are any uncertainties in the risk rating then a safety factor has been applied to the score, increasing the risk rating.

8.3.1.4 Risk Management

Table 8-3 presents the detailed assessment of risks, impacts and their management for the proposed exploration wells. These management measures will reduce the risks to ALARP by implementing industry best practice standards and the APPEA onshore oil and gas environmental code of practice.

8.3.1.5 Residual Risk Analysis

Residual Risk is the risk rating once additional management measures have been implemented. This rating will be ALARP.

8.4 Cumulative Impacts

Cumulative impacts of the construction of the proposed exploration wells are low due to the lack of surrounding developments and industry. The surrounding communities have small population and limited infrastructure with most of the services provided in Alice Springs. The other major development in the area is related to TOs mustering of feral animals in which CTP has a significant role in developing and supporting. The only potential cumulative impacts would be in relation to flora and fauna, which are discussed in more detail in Table 8-3.

8.5 Risk Assessment and Mitigation Measures

Table 8-2. Risk Assessment Matrix

		Low Risk / Moderate Risk / High Risk	LIKELIHOOD – Probability of Harm / Loss					
			1	2	3	4	5	6
		Environmental Impact	Unlikely / Unknown Not expected to occur	Remote Potential May occur only on exceptional circumstances	Possible Could occur at some time	Probable Expected to occur at some time	Frequent Likely to occur regularly	Highly Likely Ever present; occurs in most circumstances
CONSEQUENCES – Severity of Harm / Loss	1	Alteration/disturbance within the limits of natural variability; effects not transmitted or accumulating; resources not impaired. Minimal pollution effect, contained locally.	1	2	3	4	5	6
	2	Temporary alteration/disturbance beyond natural variability; effects confined to site and not accumulating; resources temporarily affected. Minor pollution, slight or negligible impact, negligible remedial or recovery work. Short term, localised and insignificant impacts to habitat or populations. Rapid recovery – measured in hours.	2	4	6	8	10	12
	3	Alteration/disturbance of a component of an ecosystem; effects not transmitted or accumulating. Pollution with some onsite impact and recovery work; possible outside assistance to contain. Incidental changes to abundance/biomass of biota in affected area; insignificant changes to overall ecological function. Recovery period measured in days – months.	3	6	9	12	15	18
	4	Alterations to one or more ecosystems or component levels, but which are recoverable; effects can be transmitted/accumulating. Significant pollution with offsite impact and recovery work. Impact that will cause a detectable effect in local ecosystem factors. Recovery period measured in months.	4	8	12	16	20	24
	5	Irreversible alteration to one or more ecosystems or several component levels; effects can be transmitted, accumulating; lost sustainability of most resources. Massive site impact and recovery work. Detrimental effect that will cause a significant effect on local ecosystem factors. Recovery period measured in years.	5	10	15	20	25	30
	6	Irreversible alteration to one or more ecosystems or several component levels; effects can be transmitted, accumulating; lost sustainability of most resources. Massive pollution with significant recovery work. Large scale detrimental effect that is likely to cause a highly significant effect on local ecosystem factors such as water quality, nutrient flow, community structure and food webs, biodiversity, habitat availability and population structure. Long term recovery period measured in decades	6	12	18	24	30	36

Table 8-3. Detailed risk assessment for the proposed WM-25 and WM-26 sites.

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
Soil and topography	Loss of nutrient rich top soil from poor top soil management and clearing operations	4	3	12	All roads and cleared areas designed with erosion and sediment control devices as required to meet IECA and Department of Land Resource Management (DLRM) guideline and best practise principles. All roads and tracks developed along the contour where possible.	2	2	4 - Low
	Degradation to infrastructure and existing roads from erosion	3	3	9	Diversion bunds and roll over banks developed across the contour to disperse run-off away from the tracks. Diversion bunds and roll over banks to be designed in accordance with DLRM and IECA best practise guideline principles.	2	1	2 - Low
	Change in water courses and drainage channels due to land clearing and access tracks	3	2	6	All top soil (top 30 cm of soil profile) stored around the edges of the lease area in low profile mounds under 1.5-2m high for reinstatement as soon as required. (see section 6.3.1) All drains to be flat bottom and cleaned out following significant rainfall events, to ensure that laminar surface flow is maintained.	2	1	2 - Low
	Increase in sediment loads in water courses	3	2	6	Roads, tracks and lease area to be checked for any signs of erosion following significant rainfall. No watercourse or significant drainage channels in the vicinity of WM-25 or WM-26. Ensure site environmental inductions for all site personnel and contractors include the requirement to use only approved access tracks.	2	1	2 - Low
	Uncontrolled release of water and hydrocarbon (liquid or gas) to surface contaminating soil	4	3	12	No off road driving. Driving will be avoided where practical following significant rainfall. Baseline soil testing will be conducted within the well site and mud sump area, characterising soil profile prior to disturbance.	2	2	4 - Low
	Soil contamination due to spills/leaks from vehicles, fuel and chemical storage, drilling fluid, lubricants, mud, cuttings and produced water.	3	3	9	Release of hydrocarbons will be reported to the DME as required: 80L or greater to inland waters, 300L or greater to land; and 500m^3 of petroleum in gaseous state. Ensure adequate bunding and other forms of containment and diversion around fuel and chemical storage locations, drilling fluid mud tanks, mud sumps, flare pits and waste	2	2	4 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Erosion caused from run-off from access tracks and cleared well pads	3	2	6 - Med	pits as per MRN FEMP (Refer to section 7.6 "Risk Assessment - Mitigation Measures" of the FEMP). Waste management measures will be implemented (including for drilling cuttings) as per Appendix 1 and the MRN FEMP Section 6.5.12 All drill cuttings to be contained in the flare pit or mud sump during operation. Soil testing before rehabilitation will determine if suitable for burial on site or if disposal off-site is required. All contaminated soil will be rehabilitated in accordance with the MRN FEMP Section 7.6 and NEPM 2013 guidelines. The bio-remediation pits on MRN will be utilised when appropriate in accordance with the MRN FEMP Section 6.5.12.2. Emergency spill response plans in place and adhered to as per MRN FEMP (Section 7.6 and Spill response plan). Regular inspections will be conducted to identify erosion and repair where observed. This will include an audit conducted during the drilling program Maintain or secured permanent watering points away from stock	2	1	2 - Low
	Sedimentation of watercourses from uncontrolled run-off	3	1	3 - Low		2	1	2 - Low
	Increase in feral animals causing erosion	3	2	6 - Med		2	2	4 - Low
Surface water	Change in water courses and drainage channels from well pad and access tracks clearing	3	1	3 - Low	No watercourse or significant drainage channels in the proposed clearing area for either WM-25 or WM-26. Strict adherence to CTP engineering standards and relevant government department requirements for technical drilling activities. Ensure adequate bunding and other forms of containment and diversion around fuel and chemical storage locations, drilling fluid mud tanks, mud sumps, flare pits and waste pits as per MRN FEMP. Monitoring local weather and climate information to make informed decisions regarding site operations. Develop diversion bunds or roll over banks at the top of entry and exit from water course crossings to reduce erosion; following IECA and DLRM guidelines and best practise. Ensure all cleared surface have appropriate erosion and sediment controls in place in accordance with IECA best practise principles ad DLRM guidelines.	2	1	2 - Low
	Contamination to surface water from waste disposal or spill	3	1	3 - Low		2	2	4 - Low
	Uncontrolled release of water and hydrocarbon (liquid or gas) to surface contaminating surface water	3	1	3 - Low		2	2	4 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Disruption to natural surface flow impacting downstream receptors	3	2	6 - Med	Testing of drilling cuttings should be conducted once fluids have evaporated from the mud sumps, to determine if salinity and heavy metals are below NEPM 2013 trigger guideline concentrations to be buried on site without impacting surface water in the area. The drill sites are approximately 3 kilometres away from the nearest water course (refer to Figure 7.7).	2	1	2 - Low
Ground water	Contamination due to cross aquifer flow from drilling operations	5	4	20 - High	Appraisal well to be constructed and tested to comply with industry best practise standards. . The well will be drilled and constructed in accordance with the DPIR approved Drilling program Strict adherence to CTP engineering standards and the regulatory department requirements including installation of cement casing to protect water bearing rock formations encountered. (API 2009 recommends the depth of casing should be at least 22m below the bottom of the lowest aquifer to be protected). Two casing strings will be cemented across this known Mereenie water aquifer The proposed exploration holes will be developed by air drilling predominately to minimise damage to encountered formations and reduce the risk of contamination due to loss of drilling fluids and chemicals. Drill casing tested for integrity through a Formation Integrity Test (FIT) prior to drilling below surface and prior to drilling the production hole to determine the strength and integrity of open hole formation and the liner shoe. Testing of cement integrity behind the Liner and Surface casing by running a Cement Bond Long (CBL). Wells will be plugged with cement plug over porous formations and any hydrocarbon bearing zones to a minimum 100m above and 50m below any significant gas or fresh water zones for P&A. Any water required for drilling operations will be abstracted from CTPs existing owned bore field with abstraction recorded by inline flow meters. Aquifer of average 200m depth, so no groundwater dependant ecosystem likely to be impacted No other users of groundwater directly within the proposed drill locations.	3	2	6 - Med
	Contamination due to loss of drilling fluids and chemicals	5	4	20 - High		3	2	6 - Med
	Contamination from mud sump, flare pit or improper storage and handling of wastes	4	3	12 - Med		3	1	3 - Low
	Drawdown of aquifer impacts to other users from abstraction	3	3	9 - Med		2	2	4 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Drawdown on aquifer due to abstraction, impacts on vegetation	3	3	9 - Med	Soil testing of solid drilling cuttings will be conducted once fluids have evaporated from the mud sumps, to determine if salinity levels and heavy metals are below NEPM 2013 trigger guideline concentrations to be buried on site without impacting groundwater. Soil and cuttings will be tested for compatibility before backfilling and burying the cuttings. Limits to be defined at time of sampling by independent soil expert All chemicals used are biodegradable where possible. A full list of all chemicals used in the drilling program and their MSDS is available and will be provided to the DPIR on a daily basis in the daily mud reports.	2	1	2 - Low
Air quality	Air drilling releasing dust from drilled rock formations into air	3	3	9 - Med	All air drilling cuttings to be wet down with de-dusting device on Blooie line before release of cuttings into flare pit. Vehicles maintained and operated in line with Work Safe NT guidelines and Motor vehicle NT registry requirements. Amount of gas flared recorded for greenhouse gas calculations and reported through the National Greenhouse and Energy Reporting system. Routine inspection of any flow lines and well heads. Flaring only used during testing and in case of an emergency. Flaring into designated flare pit. Appropriate personal protective equipment used in areas of low air quality. Dust suppression by water truck used as required. Only minimal amount of land cleared as necessary for safe operation. Vehicles properly maintained and not left idling.	2	2	4 - low
	Increase in dust particles reducing air quality	2	3	6 - Med		2	2	4 - Low
	Increase in greenhouse emission from flaring	2	3	6 - Med		1	3	3 - Low
	Fugitive emissions	2	2	4 - Low		2	1	2 - Low
	Pollution from vehicles	2	2	4 - Low		2	1	2 - Low
	Impact to human health and safety from reduced air quality	4	3	12 - Med		3	1	3 - Low
Fire	Impact to human health and safety from increased frequency of bushfires	4	3	12 - Med	Appropriate firefighting equipment maintain around site and staff trained in its use. Regular fire and emergency drills conducted as per approved emergency response plan. Mobile fire truck located on site in case of emergency. Internet weather and fire monitoring websites checked daily to assess fire danger. No open flames.	2	2	4 - Low
	Destruction of infrastructure due to increase in bushfire due to activities involved with the proposed exploration wells	4	3	12 - Med		3	1	3 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Loss of conservation significant flora	4	2	8 - Med	Designated smoking area. Flaring restricted to as required, preferable in low wind conditions. Fire break of at least 4m around all buildings and infrastructure. Fire management as per MRN FEMP guidelines.	3	1	3 - Low
	Loss of conservation significant fauna	4	2	8 - Med		2	2	4 - Low
Noise and vibrations	Impacts to surrounding stakeholders	2	1	2 - Low	Only surrounding stakeholders are the aboriginal corporation that works in conjunction with CTP to occasionally herd feral horses from the area. Consultation and access agreements have been undertaken with these stakeholders. Proposed drilling program is of temporary nature and any impacts on local fauna will be short lived (maximum 36 days) All populations of native fauna are mobile and will be able to relocate to adjacent undisturbed habitat during drilling activities.	1	1	1 - Low
	Disturbance to local fauna from activities	3	2	6 - Med		2	1	2 - Low
	Impacts to health and safety of workforce	4	3	12 - Med		2	2	4 - Low
	Impacts on surrounding industry and business	2	1	2 - Low		1	1	1 - Low
Cultural heritage	Disturbance to known cultural significant site	4	2	8 - Med	AAPA approval and certificate obtained based on a ground survey before any proposed activities on ground Any area of cultural significance signed and fenced off so as to not be damaged Consultation with CLC before any works undertaken and authorisation obtained Proposed drilling activities to occur completely within the MRN lease area that has been surveyed by CLC Staff inductions to highlight any areas of cultural significance and no-go zones Upon identification of ay potentially identified culturally significant object, work will cease until the supervisor has investigated and called the CLC to wait for further advice. Either a permit to remove and destroy will be sought if no other alternative exists, or an alternative location will be sought for transferral	2	2	4 - Low
	Impacts to unknown culturally significant site	4	3	12 - Med		2	2	4 - Low
Stakeholders	Impacts to surrounding stakeholders due to lack of consultation	3	2	6 - Med	A full stakeholder consultation log will be maintained by CTP in accordance with the MRN FEMP. This will indicate all consultations and meetings with impacted stakeholders	3	1	3 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Disturbance or impedance of surrounding stakeholder's regular activities	3	2	6 - Med	on proposed rig mobilisation and drilling program and any resolutions or conflicts resolved through the process. Access agreements are in place with the traditional owners.	2	1	2 - Low
Flora	Significant impact to flora of conservation significance due to the proposed drilling operations	4	3	12 - Med	Flora survey conducted prior to mobilisation to site to identify any threatened species. Environmental site inductions to include identification of potential threatened species in the area. Where possible all mature trees will be avoided or left in place and fenced off	2	2	4 - Low
	Spread of weed species due to proposed drilling operations	4	3	12 - Med	Mud sump will be positioned a minimum of 3 meters or at least two canopy lengths (whichever is greatest) from mature desert oak individuals. Soil testing of solid drilling cuttings will be conducted prior to burying onsite to ensure surrounding significant vegetation will not be impacted.	3	1	3 - Low
	New infestations of weeds due to proposed drilling activities	4	3	12 - Med	No off road driving. Vehicle wash down either in Alice Springs or on a sealed road before mobilisation to site. Travel to occur on sealed roads only from wash down location to site (excluding Mereenie loop road)	3	1	3 - Low
	Increase in feral animals causing degradation to native flora	4	3	12 - Med	Any area of existing weed infestation noted and clearing to occur into this area to stop further spread, where it cannot be avoided Any weeds removed by Tjwaumpa rangers or LES and disposed appropriately as detailed in the MRN FEMP.	2	2	4 - Low
Fauna	Significant impact to population of fauna of conservation significance due to the proposed drilling operations	4	2	8 - Med	Fauna survey completed prior to any mobilisation conducted on site identified no threatened species in the area and a low likelihood of impact of any significant impact on a population of threatened species due to the proposed drilling activities. Environmental site inductions to include identification of potential threatened species in the area and ensure all personnel are aware of obligations and responsibilities for any fauna encounters If any species is recorded on site LES to be called For removal of any fauna from the area either LES or CLC ranger to be called to remove.	2	2	4 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Open unfenced water sources encouraging feral animals into new areas of the OL4 competing with native fauna	4	3	12 - Med	Fauna strike register developed and maintained. Avoid driving at night, dawn and dusk. Speed limits enforced. No off-road driving. Feral animal control as per MRN FEMP guidelines. Any open water fenced (ensure if barbed wire leave top wire unbarbed for local avifauna). Ensure all waste receptacles are fauna proof. Call CLC or Tjwumpa rangers to remove feral animals as required.	2	2	4 - Low
Waste	Contamination to land or water due to unapproved release of wastes including hazardous materials, domestic or industrial wastes and wastewater	4	2	8 - Med	Waste managed as per the MRN FEMP. Ensure site environmental inductions for all site personnel and contractors include the appropriate storage of wastes according to MRN FEMP. All waste receptacles to have lids closed and fauna proof. All waste removed as required and transported to the main MRN waste management facility for disposal off site in accordance with the MRN FEMP. Any waste to be burnt to be removed to the MRN burn pit, only green waste, wood and cardboard to be burnt. All hazardous waste managed in accordance with the MRN FEMP guidelines and the *Waste Management and Pollution Control Act*. No waste to be stored within 100m of a watercourse. Waste to be separated in accordance with MRN FEMP All waste to be removed from site on completion of the proposed drilling program.	2	2	4 - Low
	Contamination to fauna from unsealed waste or unapproved disposal	3	3	9 - Med		3	1	3 - Low
	Contamination due to none compliant segregation	3	3	9 - Med		1	2	2 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Impact to flora from unapproved disposal of wastes	4	3	12 - Med	Any liquid waste to be contained in either self-bunded containers or in a container in a bund that is capable of containing 120% of stored volume. Transport of waste off-site in accordance with MRN FEMP guidelines and *Waste Management and Pollution Control Act* (including listed wastes). No disposal of wastes on site unless in accordance with this EMP, the FEMP or approved by the DPIR. If disposal occurs across territory or state borders, transport will be by an NT EPA approved contractor following NEPM 2013 guidelines.	2	2	4 - Low
	Improper disposal of waste resulting in contamination soil	4	4	16 - Med		2	2	4 - Low
Visual amenity	Loss of visual amenity to surrounding stakeholders	2	2	4 - Low	Remote location entirely within the MRN OL4. No public access. Only temporary infrastructure.	2	1	2 – Low
	Impact other industry and stakeholder's operations	2	2	4 - Low		2	1	2 - Low
Rehabilitation	Erosion and sediment issues impacting surrounding soil, landscape and water courses due to final landform	4	3	12 - Med	Ensure topsoil stripped and preserved prior to civil works. Ensure all compacted areas are deep ripped. Any external fill removed. Topsoil is re-spread over entire cleared area. All vegetation stockpiles are respread to enhance moisture retention and capture surrounding seed stock as a final layer. Lightly scarify all rehabilitated surface to encourage moisture retention and seed capture. Remove all waste from site on completion of the proposed drilling program for disposal in accordance with the MRN FEMP. Ensure soils are free of contamination and stable. Follow up inspection following first wet season for erosion and development of weed species.	2	2	4 - Low
	Lack of regrowth of vegetation due to poor top soil	3	4	12 - Med		2	2	4 - Low
	Infestations of weeds from poor weed hygiene	4	4	16 - Med		3	1	3 - Low

Environmental aspect	Potential Impacts	C	L	Risk Rating	Mitigation Measures	C	L	Residual Risk
	Contamination of soil from unapproved disposal of wastes	4	4	16 - Med	Follow up on second year wet season to assess signs of native vegetation regrowth of perennial native species, if extensive bare areas, assess for seeding or spreading of local topsoil. If any weed species identified they are to be removed in accordance with the MRN FEMP guidelines Any erosion to be corrected using control devices in accordance with the IECA and DLRM guidelines and best practise principles All infrastructure removed and cleared areas rehabilitated unless another agreement is reached with the landholder/traditional owners. Only small area near the drill pad and access will remain.	2	2	4 - Low
	Contamination of soil and groundwater from mud sump not properly rehabilitated	4	3	12 - Med		3	1	3 - Low

9 ENVIRONMENTAL OUTCOMES, PERFORMANCE STANDARDS AND MEASUREMENT CRITERIA

This EMP has been developed to specifically protect and ensure the integrity of the existing and surrounding environment from risks associated with the proposed drilling activities at WM-25 and WM-26. This is achieved through establishment and implementation of:

- Environmental Objectives;
- Environmental Performance Standards; and
- Measurement Criteria.

The principles and practises developed in this EMP are based on Ecologically Sustainable Development (EcSD).

- Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased' (Ecological Development Steering Committee, 1992).

This EMP provides measurable procedures and practises, implemented at defined frequencies to reduce the identified risks in Section 8 to residual risks that are ALARP and acceptable by CTP management and the DPIR for operations to proceed. This will ensure that the proposed drilling operations will have as minimal negative environmental impact as possible, and at completion of operations, the environment within the OL4 area will be returned to a suitable landscape conductive to future rehabilitation success and utilisation by stakeholders.

This EMP is a legally binding document and CTP will provide full disclosure of this EMP and result of audits and conformance checks against this EMP to the DPIR as required.

9.1 Environmental Objectives and Outcomes

CTP operation standards requires that environmental objectives be developed, each with corresponding targets against which performance can be measured. The environmental objectives relevant to the proposed drilling activities at WM-25 and WM-26 are presented in Section 8.2 of the MRN FEMP (Table 8-1).

The implementation of the mitigation and preventative measures to reduce environmental risks presented in Section 8 of this EMP are as prescribed in the MRN FEMP. The relevant sections for each environmental risk are:

- Biodiversity – Flora and fauna (Table 8-2 of the MRN FEMP);
- Land and soil – Erosion and sediment control (Table 8-3 of the MRN FEMP);
- Water – Hydrology and hydrogeology (Table 8-4 of the MRN FEMP);
- Waste – Operational and produced (Table 8-5 of the MRN FEMP);
- Air and noise – Emissions, vibration and lighting (Table 8-6 of the MRN FEMP);
- Fire – Bushfire and operational (Table 8-7 of the MRN FEMP); and
- Culture and heritage – Indigenous and non-indigenous (Table 8-8 of the MRN FEMP).

10 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION SYSTEM

10.1 CTP Health, Safety and Environment Integrated Management System

The feasibility, planning and assessment of the proposed drilling operations are undertaken within the framework of the CTP HS&E MS, which incorporates environmental management. These operating procedures are maintained as controlled documents and are available electronically. Key elements and structures associated with this system are expanded on in the MRN FEMP, section 9.1.

10.2 Roles and Responsibilities

All field operations are managed by CTP. The roles and responsibilities associated with all levels of operation are described in Section 9.2 of the MRN FEMP.

10.3 Training and Awareness

CTP will take all steps to ensure ongoing training and awareness is conducted with all personnel and contractors. This will enable CTP, its workforce and contractors to cooperate effectively in developing and promoting measures to ensure a high level of HS&E knowledge and compliance. CTP's HS&E MS training and awareness include:

- Compulsory site inductions;
- Activity specific inductions;
- Pre-start (Toolbox) meetings);
- Routine HS&E meetings and reports;
- Shift handovers; and
- Dissemination and display of HS&E related information.

Details of these are provided in the MRN FEMP Section 9.3.

10.4 Monitoring

The CTP Superintendent is responsible for organising and reporting on all monitoring undertaken at the proposed appraisal well sites.

The specific activities to be monitored internally by CTP in relation to potential impacts on environmental aspects are provided in Table 10-1 and supplemented in Section 8.2 of the MRN FEMP.

10.5 Auditing

Environmental audits against the performance standards and measurement criteria set out in this EMP will be conducted by a suitably qualified person.

Results of these assessments form the basis for targeted improvement initiatives during the current drilling operation as well as succeeding drilling operations. The results of these audits will also be submitted to the DPIR should they be requested.

Corrective actions raised from audits and inspections are entered into the audit database for action assignment and tracking of action progress to closure.

- Audit conducted during operations
- Audit conducted following completion of operations
- Audit conducted after completion of rehabilitation activities
- Audit conducted 1 year after rehabilitation activities and if necessary, 2 years after.

The specific activities to be monitored externally by a suitably qualified environmental consultant in relation to potential impacts on environmental aspects are provided in Table 10-1 and supplemented by Section 8.2 of the MRN FEMP. Auditing conducted after completion of rehabilitation activities and one year post rehabilitation will include auditing of all activities outlined in Section 12.3 of this EMP.

Table 10-1. Monitoring and auditing requirements for the proposed WM-25 and WM-26 sites.

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
ALL				
Site inductions	Records of site inductions show 100% participation by all personnel, contractors and visitors	For all new staff members and visitors before access to the site	Internal audit	At beginning of drilling operations and end of drilling program
SOIL AND TOPOGRAPHY				
Erosion and sedimentation on site	Records of location and size	Site inspection at beginning of operation and then following any significant rainfall events (>10mm in 24 hours)	Internal audit	Directly after site pack up and rig removal Depending on outcome of the well after rehabilitation Then one year after rehabilitation
Topsoil storage	Ensure topsoil stockpiled around edge of well pad clearing in mounds between 1.5-2m	Once after site preparation is complete	Internal audit	If required during drilling operations
	Top soil re-spread over all cleared areas no longer required for safe operation	Once after rehabilitation, depending on outcome of the well, following rehabilitation	Internal audit	1-year post rehabilitation
Erosion control	Visual inspection ensuring adequate control devices in place in accordance with DENR and IECA best practice guidelines No erosion occurring	Site inspection at beginning of operation to ensure all devices are adequate and then following any significant rainfall events (>10mm in 24 hours) to ensure integrity	Internal audit	1 year post rehabilitation
Compaction	All areas of compaction deep ripped	Once at completion of rehabilitation activities depending on outcome of the well.	Internal audit	1-year post rehabilitation
Soil contamination	Soil testing conducted in mud sump before onsite burial Soil testing on any area of remediation following spill or leak if applicable	One soil sampling event in mud pit before burial A further soil sampling event directly after clean up at any location where spill has occurred	Internal audit	1-year post rehabilitation and/or spill soil contaminating event.

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
		Follow up sampling if required until soil is classified as remediated in accordance with the NEPM 2013 guidelines for contaminated sites		
SURFACE WATER				
Water storage	Record weekly checks of freeboard to ensure sufficient clearance	Weekly check of water levels to maintain free board.	Internal audit	Two weeks into drilling program
	Record any access by fauna	Daily check to ensure no fauna access		Two weeks into drilling program
Surface water contamination	No evidence of contamination of surface water as a result of operations	If water course or drainage line in the area, then soil to be tested once, 1-year after rehabilitation if records of a spill or incident indicate potential for surface contamination	External audit	If required
GROUNDWATER				
Groundwater extraction	Quantity recorded on flow meters and static water level (SWL)	Daily summation of water extracted and weekly SWL during extraction period	Internal audit	At completion of drilling operations
Groundwater contamination	No evidence of groundwater contamination as a result of operations	As per MRN FEMP, a round of water quality samples taken from existing water within a 10km radius of the existing proposed wells before operations, at completion of operations, then 1 year after rehabilitation. If results indicate no impact to quality, routine sampling as per MRN FEMP guidelines to continue.	Internal audit	On completion of drilling program
AIR QUALITY				
Gas flare	Amount and frequency	Daily records kept of occurrence and amount of gas flared as required	Internal audit	At completion of drilling operations
Dust suppression	Evidence of dust suppression activities in daily reports	Daily records taken when applicable	Internal audit	At completion of drilling operations
Complaints	Records of complaints from surrounding land users in regards to air quality or	Whenever a complaint is received and when complaint is closed out	Internal audit	At completion of drilling operations

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
	visual amenity and subsequent investigations kept			
FIRE				
Fire drills and training	Records show fire drills and training carried out and at what frequency	Frequency of at least once for each well during drilling operations	Internal audit	At completion of drilling operations
Gas flare combustion	Regular inspection of flare pit to determine if any contamination occurring from unburnt fuel or external incidents.	Daily check of flare pit after flaring	Internal audit	At completion of drilling operations
Existing firebreaks maintained to 4m	Visual inspection of fire breaks	Once post pad construction	Internal audit	At completion of drilling operations
Evidence of designated smoking areas, diesel vehicles only and firefighting equipment on site.	Visual inspection	Once at start after rig mobilisation and set-up	Internal audit	At completion of drilling operations check records
Unauthorised open fires	Visual inspection	Daily site inspection to include if any open fires have occurred outside of designated areas	Internal audit	At completion of drilling operations check records
Fires resulting from operations	No fires as a result of CTP's operations	Daily monitoring over during drilling and well pad construction	Internal audit	At completion of drilling operations
NOISE AND VIBRATIONS				
Vehicle/generator/pump servicing	Compliance with vehicle manufactures specifications	Before mobilisation of vehicle to site as required	Internal audit	At completion of drilling operations
Complaints	Records of complaints from surrounding land users in regards to noise and vibrations from operations and subsequent investigations	Records kept of any incident when applicable	Internal audit	At completion of drilling operations check records

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
CULTURAL HERITAGE				
Cultural heritage clearance	Conducted prior to disturbance	Once prior to well pad construction	Internal audit	At completion of drilling operations check records
Interference with Aboriginal sacred sites, places or objects of archaeological significance.	Records kept of any incidents	Records kept of any incident when applicable	Internal audit	At completion of drilling operations check records
FLORA				
No unauthorised land clearing	All earthworks clearing in the field is conducted by external contractors and personnel are prohibited to enter the site until approvals are received All personnel movements are monitored daily through the ITV (Intention to Visit) process and by Site Supervisor	Once prior to construction activities	Internal audit	At completion of drilling operations check records
No unauthorised off-road driving, all drivers inducted into the potential impacts of off road driving on soil	Site inspection for evidence	Weekly site inspection	Internal audit	At completion of drilling operations
Change in health of existing vegetation and flora	Monitoring of existing flora and vegetation health to ensure no adverse impacts from operations	Pre-disturbance assessment and 1-year post rehabilitation	Internal audit	1-year post rehabilitation
Weed wash downs	Every vehicle to have approved weed free certificate	Once before each mobilisation to site	Internal audit	At completion of drilling operations
Weed infestations	Location of any new weed infestations during internal and external Environmental audits. Personnel have been train in weed management	Weekly during operations	Internal audit	Post rehabilitation and 1-year post rehabilitation

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
Declared weeds	Declared weeds managed in accordance with the *Weed Management Act* As per MRN FEMP Section 5.1.12	Weekly during operations	Internal audit	Post drilling operations if required
FAUNA				
Presence of introduced fauna	Record number and location	Daily during drilling operations as required	Internal audit	Post drilling operations
Fauna strike	Records kept in a fauna register of any sightings, near misses or strikes	Daily during drilling operations as required	Internal audit	Post drilling operations
Zone designated speed limits	Records of any failures to comply and corrective action taken	Daily during drilling operations as required	Internal audit	Post drilling operations
WASTE				
Mud sumps and flare pits	Record distance from mud sump to existing trees canopy	Once after well pad construction	Internal audit	Post drilling operations
Disposal of drill cuttings	Soil testing conducted of drilling cuttings prior to disposal or burial to quantify salinity, heavy metals and radioactive content.	Once per sump after drilling operation completed, before rehabilitation	Internal audit	Post drilling operations
Containment of drilling cuttings	Visual inspection of mud sump and flare pit to ensure adequate bunding and containment strategies implemented	Daily during drilling operations, reported if breach occurs	Internal audit	Post drilling operations
Waste streams	Records kept of quantities in and out from site	Daily during drilling operations or as required if removal frequency is less	Internal audit	Post drilling operations
Wastewater treated and amount removed or disposed on site	Records kept of quantity and frequency	Daily during drilling operations or as required if removal frequency is less	Internal audit	Post drilling operations

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
Grey water treatment and disposal	Records kept of quantity and disposal location, visual inspection of sprinkler movement.	Daily during drilling operations or as required if removal frequency is less	Internal audit	Post drilling operations
Waste receptacles	Visual inspection of waste receptacles to ensure no fauna accessing waste storage locations	Daily inspection during drilling operations	Internal audit	Post drilling operations
Clean up materials	Records of when clean-up material was removed from site	As required when applicable	Internal audit	Post drilling operations
CHEMICAL AND HAZARDOUS SUBSTANCE MANAGEMENT				
Hazardous chemical register	Records kept of quantities in and out from site	Daily during drilling operations or as required if removal frequency is less	Internal audit	Post drilling operations of monitoring records
	All hazardous chemicals stored in either ICBs or in a bunded area in accordance with the MRN FEMP guidelines	Daily during drilling operations or as required if removal frequency is less		Post drilling operations of monitoring records
Emergency Response and Oil Spill Contingency Plans	Visual evidence of plans on site	Once at start of drilling operations	Internal audit	Post drilling operations of monitoring records
Storage of fuel, chemicals and drilling fluid mud tanks.	Visual inspection to ensure adequate bunding and containment strategies implemented	Daily during drilling operations or as required if addition/removal frequency is less	Internal audit	Post drilling operations of monitoring records
Spills and leaks of hazardous materials	Routine visual inspection of waste and chemical storage areas to ensure no leaks or spills	Weekly during drilling operations	Internal audit	Post drilling operations of monitoring records
	Records kept of location, clean-up procedure and communication with DPIR regarding any leaks or spills	As required when applicable		

Activity	Monitoring		Auditing	
	Action	Frequency	Internal/External	Frequency
REHABILITATION				
P&A	Check for weeds, erosion and vegetation re-establishment	Once post rehabilitation Once again, 1-year post rehabilitation	Internal audit	Post rehabilitation 1-year post rehabilitation
Suspended	Check for weeds, erosion and vegetation re-establishment	Twice a year	Internal audit	Annually
Production	Check for weeds, erosion and vegetation re-establishment. Check cleared area reduced to 50mx50m	Twice a year	Internal audit	Annually

10.6 Continuous Improvement and Adaptive Management

CTP is committed to continual improvement and adaptive management in its HS&E MS performance. Activities undertaken as part of this commitment are summarised in Section 9.6 of the MRN FEMP.

10.7 Incident and Non-conformance Management

CTP's incident and non-conformance management procedures and strategies are outlined in Section 9.7 of the MRN FEMP.

10.8 Emergency Preparedness

CTP's emergency planning and preparedness relevant to operations at the proposed appraisal well sites are presented in section 9.8 of the MRN FEMP. In addition to this, CTP has a Site Specific Drilling Safety Management Plan and Emergency Response plan as submitted to the DPIR.

10.9 Communication

Communication and consultation mechanisms undertaken by CTP in relation to the proposed appraisal well sites are summarised in section 9.9 of the MRN FEMP.

10.10 Commitments Table

Environmental commitments are detailed in Section 8 of the MRN FEMP for each environmental aspect.

11 REPORTING

11.1 Daily Drilling Reports

Will be supplied to the DPIR in accordance with schedule 334 of the Onshore Petroleum Exploration and Production Requirements 2017.

11.2 Routine Reporting

CTP's routine reporting requirements are in accordance with routine reporting requirements of the MRN FEMP (section 10.2.1 of the MRN FEMP).

11.3 Incident Reporting

11.3.1 Recordable

CTP's incident recordable requirements under the *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (the Schedule) are in accordance with section 10.2.1 of the MRN FEMP.

11.3.2 Reportable

CTP's incident reporting requirements under the *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (the Schedule) are in accordance with section 10.2.1 of the MRN FEMP.

Any reportable incident will be notified to the 24/7 Contact Number: Petroleum Duty Officer – Ph 1 300 935 250 within 24 hours of a reportable incident as stipulated by the *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (the Schedule).

11.4 Emissions and Discharge Reporting

Greenhouse gas emission reporting under the *National Greenhouse and Energy Reporting Act* 2007. Any unauthorised discharges or emissions would constitute a recordable or reportable incident as per section 11.3.

11.5 Operations Annual Environmental Reporting

Annual reporting requirements for this project are consistent with the requirements outlined in section 10.3 of the MRN FEMP.

12 REHABILITATION MANAGEMENT PLAN

12.1 Scope

Limited to disturbances caused by the proposed appraisal well sites operations at WM-25 and WM-26.

12.2 Objectives

To ensure that all disturbed areas no longer required for safe operation of the proposed drill sites are returned to, as close as possible, the pre-exiting environmental condition.

12.3 Environmental Actions and Monitoring

Environmental audits required at the following frequency:

During operations

- Topsoil stockpiles stored around the edge of the well site lease in low profile mounds (<2m), on the upslope side if terrain is sloped
- Vegetation stockpiles stored separately in low profile mounds (<2m)
- Erosion and sediment control devices installed in accordance with DLRM and IECA best practice principles and guidelines
- All waste stored in accordance with the MRN FEMP
- Weed management measure in place in accordance with the MRN FEMP

Directly after cessation of drilling operation and rehabilitation

- Any imported material is removed
- Hardstands deep ripped
- Topsoil evenly respread over any cleared area no longer required for safe operation
- Vegetation stockpiles respread
- Surface lightly scarified
- No weeds or invasive species
- Temporary erosion and sediment devices installed where required in accordance with IECA and DLRM best practice principles and guidelines
- No wastes or infrastructure remaining
- Mud sump, flare pit and water storage filled in if no longer required
- If required, well head removed and well P&A in accordance with industry best practice

Following first wet season

- No erosion or sedimentation occurring
- No weeds or invasive species
- Establishment of vegetation

One year after rehabilitation

- No erosion or sedimentation occurring
- No weeds or invasive species
- Establishment of vegetation

12.4 Reporting

Results of audits specified in Table 10-1 in relation to rehabilitation will be supplied to the DPIR with information on any corrective actions taken if required.

13 STAKEHOLDER CONSULTATION

13.1 NT Government Approval

CTP has sought all required NT government approvals and will supply copies of all relevant approvals to the DPIR before any on ground work commences.

13.2 Approvals Process

Proposed drilling activities at sites WM-25 and WM-26 in the MRN area are undergoing a separate approvals process as required under the Schedule and as stated in the MRN FEMP (refer to Section 12 of the FEMP) as the new drilling activities are not covered by the MRN FEMP. As such additional project-specific information has been provided to the DPIR and approvals are being sought.

13.3 Commonwealth Approval

It has been determined that the proposed drilling activities at WM-25 and WM-26 is unlikely to cause a significant impact on any listed threatened species or ecological communities and therefore the *EPBC Act* will not be triggered for this project. No other matters of national environmental significance as defined under the EPBC Act were identified within a 20km buffer of the proposed WM-25 and WM-26 areas and therefore the act will not be triggered.

13.4 Traditional Owner Approvals

Approval from TO's has been sought and received by CTP for the proposed drilling activities at sites WM-25 and WM-26 as per the requirement detailed under Clause 5.2 and Clause 5.3 of the Mereenie Agreement (2003). All communications with TO's in relation to the proposed developments can be found in the communication log in Appendix 6.

13.5 Stakeholder Management

CTP is actively engaged with all stakeholders for the OL4 area under the conditions as outlined in the MRN FEMP (refer to Section 12 of the FEMP).

13.6 Stakeholder Approvals

CTP has sought and gained approval from the CLC and Haasts Bluff Aboriginal Trust. Communication with stakeholders can be found in the communication log in Appendix 6.

13.7 Communication Log

A communication log similar to that used for the MRN FEMP (refer to Appendix 8 of the FEMP) will be maintained detailing all stakeholder consultations.

13.8 Written Responses from Stakeholders

All written responses from stakeholders will be maintained in the communication log.

14 REFERENCES

Ashton, L. & McKenzie, N., 2001. *Conversion of the Atlas of Australian Soils to the Australian Soil Classification (ASC),* s.l.: CSIRO Land and Water (unpublished).

Benshemesh, J., 2006. *Marsupial mole recovery plan,* Alice Springs: Northern Territory Department of Natural Resources, Environment and the Arts.

Bureau of Meteorology, 2017. *Climate Data Online.* [Online] Available at: http://www.bom.gov.au/climate/data/ [Accessed 30 October 2017].

Dickinson, C. & Moser, A., 2001. *Conceptual Hydrogeological Assessment: Mereenie Oil and Gas Field and MASP Brewer Estate, Northern Territory,* Salisbury, QLD: Water Studies Pty Ltd.

Ecological Development Steering Committee, 1992. *National Strategy for Ecologically Sustainable Development - Part 1 Introduction.* [Online] Available at: http://www.environment.gov.au/about-us/esd/publications/national-esd-strategy-part1 [Accessed 5 July 2016].

Gibson, D. F., 2000. Distirbution and conservation status of the black-footed rock-wallaby, Petrogalle lateralis (MacDonnell Ranges Race), in the northern Territory. *Australia Mammology,* Volume 21, pp. 213-236.

Gibson, L. A., 2001. Seasonal changes in the diet, food availability and food preference of the greater bilby (Macrotis lagotis) in south-western Queensland. *Wildlife Research,* Volume 28, pp. 121-134.

Isbell, R. & National Committee on Soil and Terrain, 2016. *The Australian Soil Classificatoin 2nd ed.,* s.l.: CSIRO Publishing.

Kortner, G., Pavey, C. & Geiser, F., 2007. Spatial ecology of the mulgara in arid Australia: impact of fire history on home range size and burrow use. *Journal of Zoology,* 273(4), pp. 350-357.

Lau, J. & Jacobson , G., 1989. Aquifer Characteristics and Groundwater Resources of the Amadeus Basin. In: R. &. K. J. Korsch, ed. *Geological and Geophysical Studies in the Amadeus Basin Central Australia.* s.l.:Bureau of Mineral Resources, pp. 563-578.

Masters, P., 2003. Movement patterns and spatial organisation of the mulgara, Dasycercus cristicauda, in central Australia. *Wildlife Research,* Volume 30, pp. 339-344.

Masters, P., Dickman, C. R. & Crowther, M., 2003. Effects if civer reduction on mulgara Dasycercus cristicauda rodent and invertegrate populations in central Australia: implications for land management. *Austral Ecology,* Volume 28, pp. 658-665.

McAlpin, S., 2001. *A Recovery Plan for the Great Desert Skink (Egernia kintorei) 2001-2011,* Alice Springs: Arid Lands Environment Centre.

McDonald, P., 2012a. *Threatened species of the Northern Territory: Slater's skink Liopholis slateri,* s.l.: Northern Territory Government.

North Australia and Rangelands Fire Information, 2017. *North Australia and Rangelands Fire Information website.* [Online]

Available at: www.firenorth.org.au [Accessed October 2017].

Northcote, K., 1968. *Atlas of Australian Soils.* Melbourne: CSIRO and Melbourne University Press.

Pavey, C., 2004. *Recovery Plan for Slater's Skink 2005 - 2010,* Darwin: Northern Territory: Department of Infrastructure, Planning and Environment.

Pavey, C., 2006a. *National Recovery Plan for the Greater Bilby Macrotis lagotis,* s.l.: Northern Territory Department of Natural Resources, Environment and the Arts.

Pavey, C., 2006b. *Threatened species of the Northern Territory - Black-footed Rock-wallaby Petrogale lateralis lateralis,* s.l.: Northern Territory: Parks and Wildlife Commission.

Pavey, C., 2006b. *Threatened Species of the Northern Territory - Night Parrot Pezoporus occidentalis,* Northern Territory: Parks and Wildlife Commission.

Pavey, C., 2006c. *Threatened Species of the Northern Territory - Princess Parrot Polytelis alexandrae,* Northern Territory: Parks and Wildlife Commission.

Pavey, C., 2006d. *Threatened Species of the Northern Territory - Great Desert Skink Tjakura Egernia kintorei,* Northern Territory: Parks and Wildlife Commission.

Pavey, C. R. et al., 2014. The breeding and foraging ecology and abundance of the Princess Parrot (Polytelis alexandrae) during a population irruption. *Emu,* Volume 114, pp. 106-115.

Pavey, C. & Ward, S., 2012. *Threatened species of the Northern Territory: Common brushtailed possum (Central Australian population) Trichosurus vulpecula vulpecula,* s.l.: Northern Territory Government.

Perry, R. A., Mahbbutt, J. N., Litchfield, W. H. & Quinlan, T., 1960. *Land Systems of the Alice Springs Area, Northern Territory, Australia: CSIRO Land Research Series No. 6,* s.l.: CSIRO.

Pyke, G. H. & Ehrlich, P. R., 2014. Conservation of the Holy Grail: The Story of the Night Parrot. *Pacific Conservation Biology,* Volume 20, pp. 221-226.

Slatyer, R. O., 1962. Climate of the Alice Springs area. In: *Lands of the Alice Springs area, Northern Territory.* Melbourne: CSIRO.

Southgate, R. & Carthew, S. M., 2006. Diet of the bilby (Macrotis lagotis) in relation to substrate, fire and rainfall characteristics in the Tanami Desert. *Wildlife Research,* Volume 33, pp. 507-219.

Southgate, R. I., 1990. Habitat and diet of the greater bilby Macrotis lagotis Reid (Marsupiala: Peramelidae). In: *Bandicoots and Bilbies.* s.l.:Surrey Beatty & Sons, pp. 303-309.

Southgate, R. I., Christie, P. & Bellchambers, K., 2000. Breeding biology of captive, reintroduced and wild greater bilbies, Macrotis lagotis (Marsupialia: Peramelidae). *Wildlife Research,* Volume 27, pp. 621-628.

Southgate, R., Paltridge, R., Masters, P. & Carthew, S., 2007. Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. *Ecography,* Volume 30, pp. 759-776.

Taylor, R., Chatto, R. & Woinarski, J., 2013. *Threatened species of the Northern Territory: Australian Painted Snipe Rostratula australis,* s.l.: Northern Territory Government.

Ward, S., 2012. *Threatened species of the Norther Territory: Curlew sandpiper Calidris ferruginea,* 2012: Northern Territory Government.

Wilson, B. A., Brocklehurst, P. S., Clark, M. J. & Dickinson, K. J. M., 1991. *Vegetation Survey of the Northern Territory Australia.* Darwin: Conservation Commission of the NT.

Woinarski, J., 2006. *Threatened species of the Northern Territory: Red Goshawk Erythrotriorichis radiatus,* 2006: Northern Territory Government.

15 APPENDICES

Appendix 1. Disposal of drilling muds.

Low Ecological Services P/L
Grouped with WA Low Ecological Services
ABN 55 064 311 502
PO Box 3130, Alice Springs, NT 0871, Australia
25 Isotoma Rd, Connellan, NT 0873
Phone: (08) 89 555 222
Email: LowEcol@LowEcol.com.au Web: www.LowEcol.com.au

Central Petroleum LTD.,
Level 7/369 Ann Street, Brisbane, QLD 4000
PO Box 292 Brisbane, Qld 4001

Attention; James van Rooyen,

Re: disposal of drilling muds and water in drilling sump following drilling of well

Historically, gas and oil wells at Mereenie have used unlined sumps in the Tenosol sand plains comprising most the West Mereenie OL4 area for disposing of drilling muds at conclusion of drilling. Assessment of vegetation recovery at the wells over the sump areas is mostly not possible as the sumps are within the area retained around the well heads.

Well drilling with muds may be done for a third of the drilling operation for each well to assist with removal of cuttings from the lower half of the vertical shaft. The operation using mud will run the recovered fluid through tanks in order to separate cuttings and fluid so the fluid can be recirculated. Cuttings will be removed to the unlined sump.

The calculated amount of materials used in the muds shown in the following table is determined using a realistic assessment based on known geological structures through which drilling will take place, rather than a worst case scenario.

At the conclusion of the drilling operation, all of the remnant mud and cuttings will be disposed of in the mud sump. The sump will not be lined but the bentonite and polypropylene fibres and 15% natural clays in the Tenosol soils will retard drainage of water into the porous subsoil and evaporation will be encouraged by spreading the mud and cuttings in the 10m x 29m x 2.5m sump.

Quantities of additives to be used in the mud is shown in the table 1 below

The total of additives, in a rough estimate, would add 1cm of material to the calculated 1.3cm of KCl (4000kg, 3% solution) which will be used if the additives were to be allowed to spread evenly over the sump floor in the 2500 cm (2.5m) deep sump. Three scenarios of level of KCL use are shown in Table 2 and this would not significantly change the impact of salt in the sump as the volume of mud additives is minute compared to the volume of cuttings. If 1/3 of the 800

ggg

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At the conclusion of the drilling operation, all of the remnant mud and cuttings will be disposed of in the mud sump. The sump will not be lined but the bentonite and polypropylene fibres and 15% natural clays in the Tenosol soils will retard drainage of water into the porous subsoil and evaporation will be encouraged by spreading the mud and cuttings in the 10m x 29m x 2.5m sump.

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The total of additives, in a rough estimate, would add 1cm of material to the calculated 1.3cm of KCl (4000kg, 3% solution) which will be used if the additives were to be allowed to spread evenly over the sump floor in the 2500 cm (2.5m) deep sump. Three scenarios of level of KCL use are shown in Table 2 and this would not significantly change the impact of salt in the sump as the volume of mud additives is minute compared to the volume of cuttings. If 1/3 of the 800

bbls (say 42000L or 42 m^3) of cuttings for the drill hole may be removed with mud, mixing of cuttings and muds will result in approximately 1.6m of fill in the 290 m^2 sump. This would allow the 2.5m of subsoil removed from the sump to be spread over the top (with 10cm of top soil on top), after the sump has been allowed to dry, in a mound about 1m above the pre-existing ground level. This would reduce potential for water to run into the buried sump thus slowing the rate of leaching of leachable salts into the substrate which overlies the 190m deep aquifer in the area. It is likely the mud sump cap will subside, which will reduce the final height of the mud sump closer to the pre-existing surface. The bentonite and polypropylene fibres when added to the 15% natural clays in the Tenosol soils will slow the natural permeability of the soils to allow a slower leaching and dispersion of the low level of salts. The estimated 190 m depth to the water table (based on hydrological studies conducted at MRN) and complex geology and soil structure will result in a very low risk of contamination of the already slightly saline soils and water in the aquifer.

The amount of materials expected to be used is shown in the following table along with .

- The toxicity
- The description/composition of the chemical
- Effect on the environment short term (while drying) and long term (when disposed and buried in earthen pits 2m below ground level) is not expected to be different, but to avoid large animal (horse, camel) use of the moist soil in the pit, the pit should be securely fenced.
- Extra comments. e.g. estimate chemical residual before dumping into the sump, estimate time of biodegradation or oxidation, use of biodegradation enhancers, what could limit the degradation, worse case contamination scenario, rehabilitation, etc.

Chemical composition and break down of materials left to dry in the sump pit during spreading and drying is shown in the Table of impacts below. In most cases the materials biodegrade to inert material and only the salts and polypropylene fibres will remain as potentially low impact but will be unavailable buried under 2m of clean soil.

Table 1. Additives in drilling muds showing concentration and quantity in realistic final volume of fluids, biodegrability, possible toxicity, effects on environment.

Product	Final Concentration	Biodegradability in accordance with OECD test 301 TG D	Total Weight of Additives in Final Volume	Toxicity	Description of the chemicals/additives	Effect on the environment while drying and when dried and buried	Comments
AMC Biocide G	0.26 ppb	Readily biodegradable, > 60% ThQD removal within 28 days	94 kg	Fish (96 hours) LC50: >250mg/L Crustacea (48 hours) EC50: >40mg/L	Tetrakis (hydroxymethyl) phosphonium sulfate	Low risk	
AMC Pac LV	1.76 ppb	Inherently biodegradable, 20 - 60% ThQD removal within 28 days	639 kg	Oral LD50: 27000mg / kg (rat) Dermal LD50: >2000mg / kg (rabbit) >5800mg / m 3 / 4H (rat)	Cellulose	Low risk	
AMC Xtra-Sweep	0.03 ppb	Inorganic, not biodegradable	11 kg	No Data available	Polypropylene fibres	Low risk	See note 4 below
Aus-Ben A	1.53 ppb	Inorganic, not biodegradable	555 kg	Rat (oral) LD50: 5,000mg / kg Fish (96hours) LC50: 10,000mg / L	Bentonite	Low risk	See note 3 below
Caustic Soda	Negligible ppb	Inorganic, not biodegradable	0.03 kg	Fish (96 hours) LC50: 125mg / L	Sodium Hydroxide	Low risk	See note 1 below
Potassium Chloride	11.0 ppb	Inorganic, not biodegradable	3991 kg	Rat (oral) LD50: 2,600mg / kg	Potassium Chloride	Low risk	Will form a layer in the bottom of the sump about 13mm

Product	Final Concentration	Biodegradability in accordance with OECD test 301 TG D	Total Weight of Additives in Final Volume	Toxicity	Description of the chemicals/additives	Effect on the environment while drying and when dried and buried	Comments
				Fish (96 hours) LC50: 880mg / L Crustacea (48 hours) EC50: >140mg / L Algae (96 hours) EC50: >1,200mg / L			thick if unmixed with other materials. If 1/3 of cuttings will be removed with mud, mixing of cuttings and muds will result is about 1.6m of fill in the sump. See note 5 below
Sodium Sulphite	0.06 ppb	Inorganic, not biodegradable	20 kg	Rat (oral) LD50: >2,100mg / kg	Sodium Sulphite	Low risk	See note 2 below
Xan-Bore	2.02 ppb	Readily biodegradable> 60% ThOD removal within 28 days	733 kg	Rat (oral) LD50: >5,000mg / kg	Xanthan Gum	Low risk	
Residrill	5 ppb	Inherently biodegradable, 20 - 60% ThOD removal within 28 days	1814 kg	No specific data is available on the ecological effects of AMC RESI DRILL, however given it is a natural, cellulose based	Cellulose	Low risk	

Product	Final Concentration	Biodegradability in accordance with OECD test 301 TG D	Total Weight of Additives in Final Volume	Toxicity	Description of the chemicals/additives	Effect on the environment while drying and when dried and buried	Comments
				product it is not expected to pose Eco toxicological issues.			

Note 1
Assuming final pH of 9.0, the concentration of Hydroxyl Ion (OH -) is 0.1 mg/l.
That is equivalent to :
15.9 mg/bbl (159 litres to a barrel), or
12720 mg/800 bbls, or
12.72 grams/800 bbls, or
0.01272 kgs in the entire system.
Therefore, there would be a total of .029920 kg of NaOH in the final system.
(Atomic Weights :
Sodium 22.997
Oxygen 16.0
Hydrogen 1.008)

Note 2
Assume there will be 100 mg/l sulphites left in the mud (likely to be less, but it is the minimum specification).
That is equivalent to :
15,900 mg/bbl, or
15.9 grams/bbl, or
12,720 grams/800 bbls, or
12.72 kg of Sulphite in the entire system
OR
157.5 mg/l Sodium Sulphite, or
25,043 mg/bbl, or
25 grams/bbl, or
20,000 grams/800 bbls, or
20 kg in the entire system
Therefore, there would be a total 20 kg of Sodium Sulphite remaining in the system.
However, note that the by-products of the sulphite reaction with oxygen would likely still remain as Sulphate in
the system, which we do not measure.
(Atomic Weights :
Sodium 22.997
Oxygen 16.0
Sulphur 32.06)

Note 3
Bentonite will help form a filter cake and Residrill's chemistry also binds up clays, so I am making an estimation
that only 50% will remain in the mud system before dumping.

Note 4
It is more likely the this product (AMC Xtra-Sweep) will be used for hole cleaning purposes when and if losses

occur downhole, as it becomes a highly effective LCM, and as such, I am estimating that only a third of the
product will return to surface. Note that this product is cleared from the mud with the shale shakers, so unless
cuttings are skipped way, this portion will still end up in the sump.

Note 5
The World Health Organization (WHO) identifies KCl as non-toxic in common environmental background concentrations. Potassium Chloride (KCl) is toxic at high concentrations; however it is non bio-accumulating. Dilution of the muds in the cuttings will reduce risk and covering of the cuttings and salts will allow slow leaching to the surrounding environment; minimising the potential impacts.

Using the calculated amount of KCL that would be used under realistic operations would result in 13mm thick layer of material if unmixed with other materials on the base of the mud sump. The total of additives, in rough estimate, would add another 10mm layer of material. If 1/3 of the 800 bbls (say 42000 L or 42 m3) of cuttings will be removed with mud, mixing of cuttings and muds will result is about 1.6m of fill in the sump. This would allow the 2.5m of subsoil removed from the sump to be spread over the top in a mound about 1m above pre-existing ground surface height which would reduce potential for water to run into the buried sump thus slowing the rate of leaching of leachable salts into the substrate which overlies the 190m deep aquifer in the area. It is likely the mud sump will subside, which will reduce the final height of the mdu sump closer to the pre-existing surface. The bentonite and polypropylene fibres when added to the 15% natural clays in the Tenosol soils will slow the naturally high permeability of the soils to allow a slow leaching and dispersion of the low level of salts. The estimated 190 m depth to the water table (based on hydrological studies conducted at MRN area) will result in a very low risk of contamination of the already saline water in the aquifer.

Table 2. Characteristics of Potassium Chloride concentrations under three scenarios.

Product	Final Concentration	Biodegradability in accordance with OECD test 301 TG D	Total Weight of Additives in Final Volume	mg/l Chlorides	Toxicity	Description of the chemicals/additives	Effect on the environment	Conductivity / Comments
Potassium Chloride (3%)	11.0 ppb	Inorganic, not biodegradable	3991 kg	14,900 mg/l	Rat (oral) LD50: 2,600mg / kg Fish (96 hours) LC50: 880mg / L Crustacea (48 hours) EC50: >140mg / L Algae (96 hours) EC50: >1,200mg / L	Potassium Chloride	Nil	45,000 Micromhos @ 25°C
Potassium Chloride (2%)	7.1 ppb	Inorganic, not biodegradable	2582 kg	9600 mg/l	Rat (oral) LD50: 2,600mg / kg Fish (96 hours) LC50: 880mg / L Crustacea (48 hours) EC50: >140mg / L Algae (96 hours) EC50: >1,200mg / L	Potassium Chloride	Nil	30,000 Micromhos @ 25°C
Potassium Chloride (1%)	3.5 ppb	Inorganic, not biodegradable	1273 kg	4750 mg/l	Rat (oral) LD50: 2,600mg / kg Fish (96 hours) LC50: 880mg / L Crustacea (48 hours) EC50: >140mg / L Algae (96 hours) EC50: >1,200mg / L	Potassium Chloride	Nil	15,000 Micromhos @ 25°C

Yours sincerely,

Bill Low,
Senior consultant and Director

Appendix 2. EPBC Protected Matters Search Tool (PMST) Report produced for the proposed WM-25 and WM-26 sites with a 20km buffer.

Australian Government
Department of the Environment and Energy

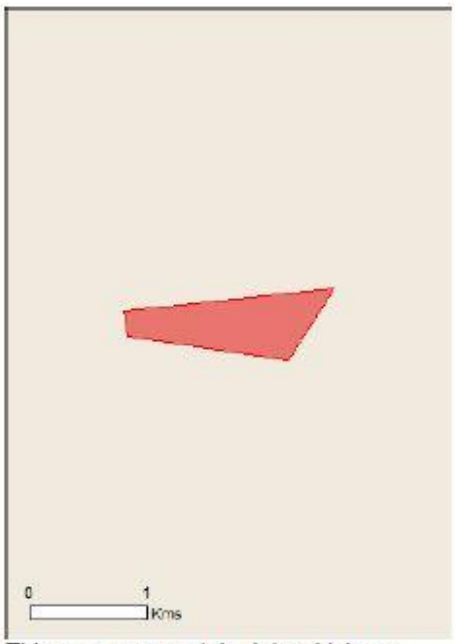
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

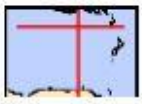
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 27/10/17 16:28:06



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	11
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Insects		
Croitana aestiva Desert Sand-skipper, Aestiva Skipper [26238]	Endangered	Species or species habitat may occur within area
Mammals		
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis MacDonnell Ranges race Warru, Black-footed Rock-wallaby (MacDonnell Ranges race) [66649]	Vulnerable	Species or species habitat likely to occur within area
Zyzomys pedunculatus Central Rock-rat, Antina [68]	Endangered	Species or species habitat may occur within area
Reptiles		
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area
Liopholis slateri slateri Slater's Skink, Floodplain Skink [83163]	Endangered	Species or species habitat may occur within area

Listed Migratory Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-23.94053 131.39898,-23.93898 131.41503,-23.94387 131.41155,-23.94225 131.3993,-23.94053 131.39898

Appendix 3. Assessment of Likelihood of Occurrence of TPWC/EPBC listed fauna species identified by the NT Fauna Atlas and/or EPBC PMST report within 20km of proposed WM-25 and WM-26 sites.

Mammal species of conservation significance

The likelihood of occurrence of the five threatened mammals identified in the desktop assessment, is presented below. Likelihood of occurrence is determined based on habitat characteristics preferred by each species, existing habitat within the proposed WM-25 and WM-26 areas and proximity to nearest records.

Brush-tailed mulgara (*Dasycercus blythi*)

The brush-tailed mulgara is primarily nocturnal, burrowing animal, sheltering in burrows approximately 0.5 m deep. The species occurs in a range of vegetation types, primarily mature hummock grasslands of spinifex, especially *Triodia basedowii* and *T. pungens*. Home range size is highly variable with extremes of 1 to 14.4 hectares recorded (Masters, 2003). Brush-tailed mulgara is known to inhabit both the Western and Simpson deserts as well as the Tanami Desert and as far south as Uluru. The species was once widespread and common throughout the Central Deserts region, but since the 1930s, the species' distribution has declined and is now more restricted and fragmented. Whilst threatening processes are unknown, it is likely that processes of environmental degradation, introduced herbivores, changes to fire regimes and increased predation have likely negatively affected the mulgara (Masters, et al., 2003).

While there are no records of brush-tailed mulgara within 20 km of the project, habitat in the proposed WM-25 and WM-26 areas is consistent with habitat typically occupied by the species. Nearest records of the species are 64km north of the proposed WM-25 and WM-26 areas near Mt Liebig and 85km east near Areyonga. Given the potential habitat within the proposed WM-25 and WM-26 areas, there is a high likelihood of *D. blythi* occurring.

Greater Bilby (*Macrotis lagotis*)

The greater bilby is a nocturnal medium-size marsupial, originally distributed across 70% of the Australian mainland but now restricted to 20% of its former range in south west QLD and an area extending from the western deserts of the NT and WA north to the Pilbara and Kimberley regions (Pavey, 2006a). Greater bilby occur in a wide variety of habitats that can be classified into three major groups; sparse grassland/forbland on uplands and hills with a low fire frequency, mulga scrub/woodlands on ridges and rises with an infrequent (20-50 year) fire interval and hummock grassland mixed shrub or woodland steppe on plains and alluvial areas with a high (4-10 year) fire frequency (Southgate, 1990). In the sandy deserts, the greater bilby appears to exhibit low site fidelity and high mobility and it is thought that movement of groups is in response to spatial and temporal variability in resource availability (Southgate, et al., 2007). Greater bilby is an opportunistic omnivore with a diet consisting of termites, ants, beetles, larvae, grasshoppers, spiders, bush onion (*Cyperus bulbosus*) bulbs, seeds, fruit and fungi (Gibson, 2001; Southgate & Carthew, 2006). It appears that the species can breed at any time of the year in response to resource availability (Southgate, et al., 2000). Threats to the greater bilby include predation by introduced predators, habitat degradation by introduced herbivores, altered fire regimes, drought, road mortality and habitat destruction and degradation resulting from mining and other development (Pavey, 2006a).

There is one record of the greater bilby within 20 km of the proposed WM-25 and WM-26 areas 12 km to north of the new wells site. The records is from prior to 1970. Currently the distribution of the greater bilby is thought to extend as far south as Kintore. Kintore lies approximately 218km west-northwest of the proposed WM-25 and WM-26 areas. Given the proposed WM-25 and WM-26 areas is outisde the current known distribution of the species, its is considered a low-moderate likelihood that the species will occur within the proposed WM-25 and WM-26 areas despite the presence of suitable habitat.

Southern marsupial mole (*Notoryctes typhlops*)

The southern marsupial mole is a small mammal, highly distinctive in shape and appearance (Johnson 1995). It occurs in the sandy deserts of central WA, northern South Australia (SA) and the NT. Within the NT, it has been recorded in locations concentrated in the south-western quarter but has been collected as far north as Barrow Creek (Benshemesh, 2006). Southern marsupial moles are found in the sandy deserts where they occupy dunes, sandy plains and river flats. Underground sign is most common on well vegetated dunes. Marsupial moles are thought to require soft sand and cannot tunnel through hard or loamy substrates that occur in swales between widely spaced dunes (Benshemesh, 2006).

No records of the Southern marsupial mole were found within 20 km of the new wells proposed WM-25 and WM-26 areas, however records are thought to be significantly lower than actual distribution of the species. There is a cluster of records of the species approximately 40km south of the proposed WM-25 and WM-26 areas in a similar habitat type. Appropriate habitat for marsupial moles including sand dunes and other sandy soils dominates the new wells proposed WM-25 and WM-26 areas and their presence at the site is considered moderately likely. Given their likelihood of being underground and not detectable from the surface, they are considered at moderate risk to development activities.

Black-footed rock-wallaby (*Petrogale lateralis MacDonnell Ranges race*)

The distribution of the black-footed rock-wallaby spans from the Davenport and Murchison Ranges in the north, east to the Jervois Range, west to the WA border and south to the SA border (Pavey, 2006b). The species is also present in the Gibson Desert of WA and in the AnanguPitjatjantjara land of northern SA (Pavey, 2006b). Habitat preferences of the black-footed rock-wallaby appears to be steep slopes, cuestas, deep gorges and boulder scree slopes, which are common in quartzite ranges where the majority of the species records are from (Gibson, 2000).

The closest record of the black footed rock wallaby to the proposed new wells site is approximately 14km north-west in the Middleton land system and 19 km south in the Gillen land system. The Middleton land system is characterised by sandstone ridges and plateaux up to 300ft high whilst the Gillen land system is described as rugged sandstone and quartzite ranges. Given that the proposed WM-25 and WM-26 areas falls entirely within the sandplains and dunes of the Simpson land system, habitat within the proposed WM-25 and WM-26 areas is considered unsuitable for the black-footed rock-wallaby. It is therefore considered a low likelihood that the species would occur within the proposed WM-25 and WM-26 areas and the species will not be discussed further in this report.

Common brushtail possum (*Trichosurus vulpecula vulpecula*)

The common brushtail possum (subspecies *T.v.vulpecula*) occurs in isolated populations in southern NT, with the West MacDonnell National Park a known stronghold of the species. Prior to European

settlement the species spanned extensively across the Northern Territory, with the most extreme phase of decline recorded in the 1940s and local extinctions continuing through until the early 2000s (Pavey & Ward, 2012). The common brushtail possum is predominantly occupies riverine habitat that is close to rocky outcrops and most gullies within the ranges or rocky slopes (Pavey & Ward, 2012). The presence of caves, rock holes and tree hollows for shelter are characteristic of habitat areas.

One record of the common brushtail possum was identified within 20km of the proposed WM-25 and WM-26 areas. The 1983 record is located in the Middleton land system, characterised by sandstone ridges and plateaux interspersed with sandy lowlands. With no ridges, creeklines or other suitable habitat identified within the new wells proposed WM-25 and WM-26 areas, it is considered a low likelihood that this species will occur and the species will not be discussed further in this report.

Bird species of conservation significance

Curlew sandpiper (*Calidris ferruginea*)

The curlew sandpiper inhabits intertidal mudflats in sheltered coastal areas such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast and ponds in salt works and sewage farms. Inland sightings have been reported from around ephemeral lakes, dams, waterholes and bore drains, usually with bare areas of mud or sand (Ward, 2012).

The closest record of the species to the proposed WM-25 and WM-26 areas is approximately 175 km south east of the proposed new well sites. Whilst there is no suitable habitat in the proposed WM-25 and WM-26 areas, the project would involve the creation of water storage locations therefore creating potentially suitable habitat for the species. Given the wide distribution of records and nomadic nature of the species, there is a moderate likelihood that the species may occur on the site following the installation of permanent or ephemeral water sources on site.

Red Goshawk (*Erythrotriorchis radiatus*)

The red goshawk is a large reddish-brown hawk with conspicuous dark streaks from chin to belly and barring on the underwing and tail (Woinarski, 2006). It is listed as vulnerable under the TPWC Act and EPBC Act. The red goshawk occurs across much of northern Australia where it generally occupies tall open eucalypt forest and riparian areas characteristic of higher rainfall areas (Woinarski, 2006).

The closest record of the red goshawk to the proposed WM-25 and WM-26 areas is 130 km north-east near Hermannsberg. Given the lack of suitable habitat within the proposed WM-25 and WM-26 areas, the likelihood of the species occurring is considered low.

Night parrot (*Pezoporus occidentalis*)

Night parrots are restricted to arid and semi-arid Australia. The distribution of the night parrot has not been well documented but late 19th and early 20th century records are known from northern WA, SA, New South Wales and western QLD (Pavey, 2006b). Prior to the discovery of a specimen of the night parrot in north western QLD in 1990, the species was widely considered to be extinct (Pavey, 2006b). More recently, a small popualtion of the night parrot has been detected in western QLD and another in Western Australia, confirming its persistence (Pyke & Ehrlich, 2014). The species was apparently relatively common in central Australia prior to the 1920's; however there are only unconfirmed records post-1950 (Pavey, 2006b).

Records of the night parrot are primarily from spinifex (*Triodia* sp.) hummock grasslands in stony or sandy areas and chenopod shrublands on floodplains, salt lakes and claypans, likely being more common in the former (Pavey, 2006b; Pyke & Ehrlich, 2014).

The closest record of the night parrot to the proposed WM-25 and WM-26 areas is approximately 182 km south east if the proposed well site. The record is from 1929. A "probable" detection of the species was recorded in 2017 north of Alice Springs, however as the observation was based on sound recording along it remains unconfirmed. Multiple observations of the species from QLD, WA, SA and NT over the past 5 years suggests the species is persisting and more widespread than previously considered. Given this increase in recent observations of the species and the presence of suitable habitat within the proposed WM-25 and WM-26 areas, there is a moderate likelihood that the species could occur.

Princess parrot (*Polytelis alexandrae*)

The princess parrot has a patchy and irregular distribution in the arid zone of WA, NT and SA (Pavey, 2006c; Pavey, et al., 2014). Within the NT, the species has been recorded from the southern Tanami in the north, south to Yulara and Angas Downs and east to Alice Springs (Pavey, 2006c). The exact distribution within the NT range is unclear as records are irregular and patchy, and there may be long intervals (up to 20 years) between them (Pavey, 2006c). Originally referred to as nomadic or migratory, it is now generally accepted that the princess parrot is irruptive, with a core range that is possibly centred on the Great Sandy Desert or the eastern Gibson Desert and western Great Victoria Desert (Pavey, et al., 2014).

The princess parrot has been recorded from sandplain environments with vegetation characterised by *Eremophila, Grevillea* and *Hakea* shrubs with scattered trees and less frequently in riverine forest, woodland and shrubland habitats (Pavey, 2006c).

Three records of princess parrots are recorded within 20km of the proposed WM-25 and WM-26 areas. The closest record of the princess parrot to the proposed new well sites is approximately 8 km west (undated) with a 2010 record located 17km east. Whilst nesting habitat within the proposed WM-25 and WM-26 areas is unlikely due to the lack of hollow bearing *Eucalypt* species, the species still has a high likelihood of occurrence due to the presence of suitable foraging habitat and the close proximity of recent records.

Australian Painted Snipe (*Rostratula australis*)

The Australian painted snipe is a wading bird that is found throughout Australia, though mostly recorded in south-east Australia (Taylor, et al., 2013). In the NT the species have been recorded in the Barkly Tablelands, but may also occur on any shallow ephemeral wetlands in central or southern NT (Taylor, et al., 2013). The species inhabits shallow, vegetated, freshwater swamps, claypans or inundated grassland (Taylor, et al., 2013). There are no sites where they are known to be resident or even regular in occurrence, suggesting the species may be nomadic.

The closest record of the Australian painted snipe to the survey areas is 135 km east. Whilst there is no suitable habitat in the proposed WM-25 and WM-26 areas, the project would involve the creation of water storage locations therefore creating potentially suitable habitat for the species to pass through. Given the wide distribution of records and nomadic nature of the species, there is a moderate

likelihood that the species may occur on the site following the installation of permanent or ephemeral water sources on site.

Reptile species of conservation significance

Great Desert Skink (*Liopholis kintorei*)

The great desert skink is an endemic arid zone skink, occurring from Uluru-Kata Tjuta National Park north to Rabbit Flat in the Tanami Desert (Pavey, 2006d). The species also occurs in north western SA and in the Gibson Desert and sections of the Great Sandy Desert in WA (Pavey, 2006d). The great desert skink is predominantly found in sandplains and adjacent swales containing *Triodia* grassland vegetation and scattered shrubs, but can occupy a range of vegetation types such as lateritic palaeodrainage lines within *Melaleuca* shrubs in the Tanami Desert (McAlpin, 2001).

The closest records of the species to the proposed WM-25 and WM-26 areas are approximately 37 km south-east, recorded in 1992 and 1995. Given the presence of suitable habitat within the proposed WM-25 and WM-26 areas, there is a high likelihood that the great desert skink occurs in the proposed WM-25 and WM-26 areas.

Slater's skink (*Liopholis slateri slateri*)

Slater's skink includes two subspecies, L. slateri slateri in southern NT and L. slateri virgata in northern SA (McDonald, 2012a). The southern subspecies has been recorded from the Finke and MacDonnell Ranges bioregions where it occurs on plains in the valleys of major drainages (Pavey, 2004). At most sites, Slater's skink inhabits shrubland and open shrubland on alluvial soils close to drainage lines (McDonald, 2012a). The species has also been recorded in an isolated dune supporting shrubland, low rolling calcareous rises with 60% spinifex cover, and on an elevated, narrow, rocky creek-line (Pavey, 2004).

The closest record of Slater's skink to the proposed new well sites is from 1964, approximately 60 km north east. A more recent 2014 record lies approximately 88km south-east of the proposed WM-25 and WM-26 areas. Given the absence of significant drainage lines or floodplains and associated habitats within the proposed WM-25 and WM-26 areas, there is a low likelihood of this species occurring.

Appendix 4. Flora recorded during walkover survey of proposed sites WM-25, WM-26 and associated tracks.

Family	Species	Location Recorded	
		Project Area	Incidental
Asteraceae	Helichrysum apiculatum	X	
Boraginaceae	Bonamia erecta		X
Casuarinaceae	Allocasuarina decaisneana	X	
Chenopodiaceae	Sclerolaena johnsonii	X	
Cyperaceae	Fimbrystylis species	X	
	Schoenoplectus species		X
Fabaceae	Acacia aneura	X	
	Acacia ligulata	X	
	Acacia maitlandii	X	
	Acacia melleodora	X	
	Leptosema chambersii	X	
	Senna artemesioides filiformis	X	
	Senna pleurocarpa	X	
Goodeniaceae	Scaevola parvifolia	X	
Myrtaceae	Calytrix estipulate		X
	Corymbia opaca		X
	Melaleuca pauperiflora	X	
	Thryptomene maisoneuvii	X	
Poaceae	Amphipogon caricinus		X
	Aristida holothera	X	
	Aristida inaequiglumis		X
	Eragrostis eriopoda	X	
	Eragrostis setifolia	X	
	Monachather paradoxus	X	
	Triodia pungens	X	
	Triodia schinzii	X	

Portulaceae	Calandrinia pumila	X	
Proteaceae	Grevillea junicifolia	X	
	Grevillea striata	X	
Rubiaceae	Canthium latifolium	X	
Scrophulariaceae	Eremophila christophori	X	
	Eremophila latrobei	X	
	Eremophila longifolia	X	
Solanaceae	Solanum ellipticum	X	

Appendix 5. Fauna recorded during walkover survey of proposed sites WM-25, WM-26 and associated tracks.

Species		Status	Location	
Scientific name	**Common name**	**TPWC**	**Project Area**	**Incidental**
Mammals				
Camelus dromedarius	Camel	Int	X	X
Canis lupis dingo	Dingo	LC	X	X
Dasycercus blythi	Brush-tailed mulgara	Vu	X	
Equus caballus	Horse	Int	X	X
Pseudomys species	Mouse species	-		X
Sminthopsis species	Dunnart species	-		X
Reptiles				
Ctenophorus nuchalis	Central netted dragon	LC		X
Pseudonaja species or *Pseudechis* species	Brown snake	-	X	
Birds				
Artamus cinereus	Black-faced woodswallow	LC	X	X
Lichenostomus keartlandi	Grey-headed honeyeater	LC	X	
Lichenostomus vierscens	Singing honeyeater	LC		X
Manorina flavigula	Yellow-throated miner	LC	X	X
Ocychaps lophotes	Crested pigeon	LC	X	X

Appendix 6. Communications Log

COMMUNICATION LOG (Mereenie)					
Date	**Topic**	**Type of engagement (e.g. email)**	**CP contact**	**Stakeholder**	**Outcomes**
1960's - 2003	Routine meetings with the effected stakeholders and Traditional owners as required	Engagement Meetings	Santos, AGL and appropriate Operators	Traditional owners and key stake-holders	Appropriate stakeholder engagement meetings as required.
Oct-16	Annual meeting with CLC.	Face to Face Meeting	Mike Herrington, James Van Rooyen	CLC and Laritja people (TO of this land)	Informal meeting about Central's word during its first year of Operatorship of the field
Nov-16	Attended White ribon day march at Herrmannsberg	Public march	Rolf Schulte, Gary Armstrong	Herrmannsberg community	Went to support the march agaist domestic violence
Apr-17	Organising Travel to Adelaide for Anselum Impu Snr	Phone/email	David Liddle/Mark Hensel	Impu family/Centrecorp/Ian Conway	Organised funds for Anselum Impu Snr to travel to Adelaide to support Anselum Impu Jnr in hospital.
May-17	Organise living expenses for Anselum Impu Snr in Adelaide	Phone/email	David Liddle	Impu family/Ngurratjuta/Ian Conway	Organised living expenses for Anselum Impu Snr in Adelaide.
17/10/2017	Proposed 2 well program. WM 25/26	Formal application (via Email)	James van Rooyen	CLC / Traditional Owners	Proposed work scope, well locations and formal Sacred Site Clearance applied for throught the CLC for the Wm 25/26 Wells.
25/10/2017	Meeting with Traditional Owners and CLC (Liaison Committee meeting)	Meeting in Alice Springs	Richard Cottee, Mike Herrington and Rolf Schulte	CLC and Laritja people (TO of this land)	Formal yearly meeting held betweent he traditional owners, the CLC and Central Petroleum. The past years operations were discussed and the future years operations planned. Maps and details of the two new wells WM 25 and WM 26 were reviwed and discussed with them at this point.
21/11/2017	New Wells - WM 25/26	Formal Letter	James van Rooyen	CLC and Laritja people (TO of this land)	Formal letter of approval indicating that the owners of the land had been consulted and the work request (two wells) had been approved.

Appendix 7. Temporary Drilling Camp Sewage treatment discharge specifications

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Manufacturers of: OZZI KLEEN Waste Water Systems

OZZI KLEEN EFFLUENT STANDARDS

Typical Raw Sewage Standard	
Parameter	**Sewage Characteristics**
Wastewater hydraulic flow convention	EP (equivalent persons) rated at 200 L/person/day)
BOD_5	350 mg/litre or 70 g/day/person
Suspended Solids	350 mg/litre or 70 g/day/person
Total Nitrogen	75 mg/litre or 15 g/day/person
Total Phosphorous	12.5 mg/litre or 2.5 g/day/person
Total grease and oils	75 mg/litre For restaurant applications, a grease trap must be fitted upstream of the treatment plant to remove grease and oils.
pH	$6 \leq pH \leq 8.5$
Wastewater temperature range	10°C to 40°C

Typical Effluent Standards for Sewage Treatment Plants			
Parameter	**Primary Effluent* Characteristics [mg/litre]**	**Secondary Effluent^ Characteristics [mg/litre]**	**Advanced Secondary# Effluent Characteristics [mg/litre]**
BOD_5	120 – 140	≤ 20	≤ 10
Suspended Solids	65 – 180	≤ 30	≤ 10
Total Nitrogen	36 – 45	≤ 30	≤ 10
Total Phosphorous	6 – 10	≤ 10	≤ 5
Thermotolerant Coliforms	N/A	≤ 10 colonies per 100 ml (median value)	≤ 10 colonies per 100 ml (median value)
Residual Chlorine	N/A	0.5 ≤ Chlorine ≤ 2.0	0.5 ≤ Chlorine ≤ 2.0

* **Primary effluent** is typical of effluent from a septic tank anaerobic system.
^ **Secondary effluent** is typical of effluent from an aerobic wastewater treatment system.
# **Advanced secondary effluent** is typical of effluent from an aerobic wastewater treatment system with biological nutrient removal.

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