

Exploration Permit (EP)-161 2016
Stratigraphic Corehole Program
Environment Plan Summary



Facility: McArthur Basin Exploration
Project Title: EP-161 2016 Stratigraphic Corehole Program



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1 INTRODUCTION

1.1 Project Description and Operations

NT Exploration Permit (EP)-161 is located in the McArthur Basin in the far north-east of the Northern Territory. EP-161 is centred approximately 350 kilometres south-east of Katherine (refer Figure 1-1).

Santos, as the Operator of EP-161, proposes to drill one stratigraphic corehole in the Permit. This corehole is designed to broaden the understanding of the possible extent of the field. There is one existing well within the permit, Tanumbirini-1, which was drilled by Santos in 2014. Based on the outcomes of the 2014 program Santos propose to drill a stratigraphic corehole named Marmbulligan-1. Two options have been considered to allow flexibility. Two potential locations for the proposed Marmbulligan-1 corehole and associated civil works (the Program) are shown on Figure 1-2.

Pursuant to the requirements of the *Petroleum Act 2016*, the Program is subject to a Project Application for approval by the Department of Mines and Energy (DME). The Environment Plan, summarised in this document, was developed to meet the NT DME Guideline 'Environmental Plan (EP) Requirements' and covers the preparatory civil works and corehole drilling.

No hydraulic fracture stimulation activities are to be undertaken at Marmbulligan-1 as part of this program.

1.2 Civil Activities

The civil activities subject to this Environment Plan are:

- Site preparation for 1 well pad, with the well pad inclusive of temporary camp site
- Up to 2 kilometres of new access roads and a maximum of 45 kilometres of upgraded access roads
- Site preparation of laydown areas
- Use of one existing council borrow pit
- Dedicated area for equipment storage
- Installation of temporary fencing, gates and motor grids

Existing roads will be used where possible, although the Program will require new access roads and upgrade of existing roads to allow for increased traffic and heavy drilling equipment/vehicles. Water will be sourced from a local on-site water bore and power will be generated on-site using portable generators.

1.3 Drilling Activities / Down-hole Operations

The well will be drilled using either water based mud or air hammer but this will be dependent on the formation properties. The well will be drilled/cored to a notional total depth (TD) of ± 720 metres below ground level (mbGL).

Where possible, drill core and/or cutting samples will be collected for geological assessment and analyses. Wireline logs will be acquired over the open hole section as per Santos and Northern Territory Government requirements.

Following completion of logging, the well will be decommissioned and cement plugs will be spotted as per Northern Territory legislative requirements. The wellhead will be removed, leases and roads rehabilitated and signed posted properly as per Northern Territory Government requirements.

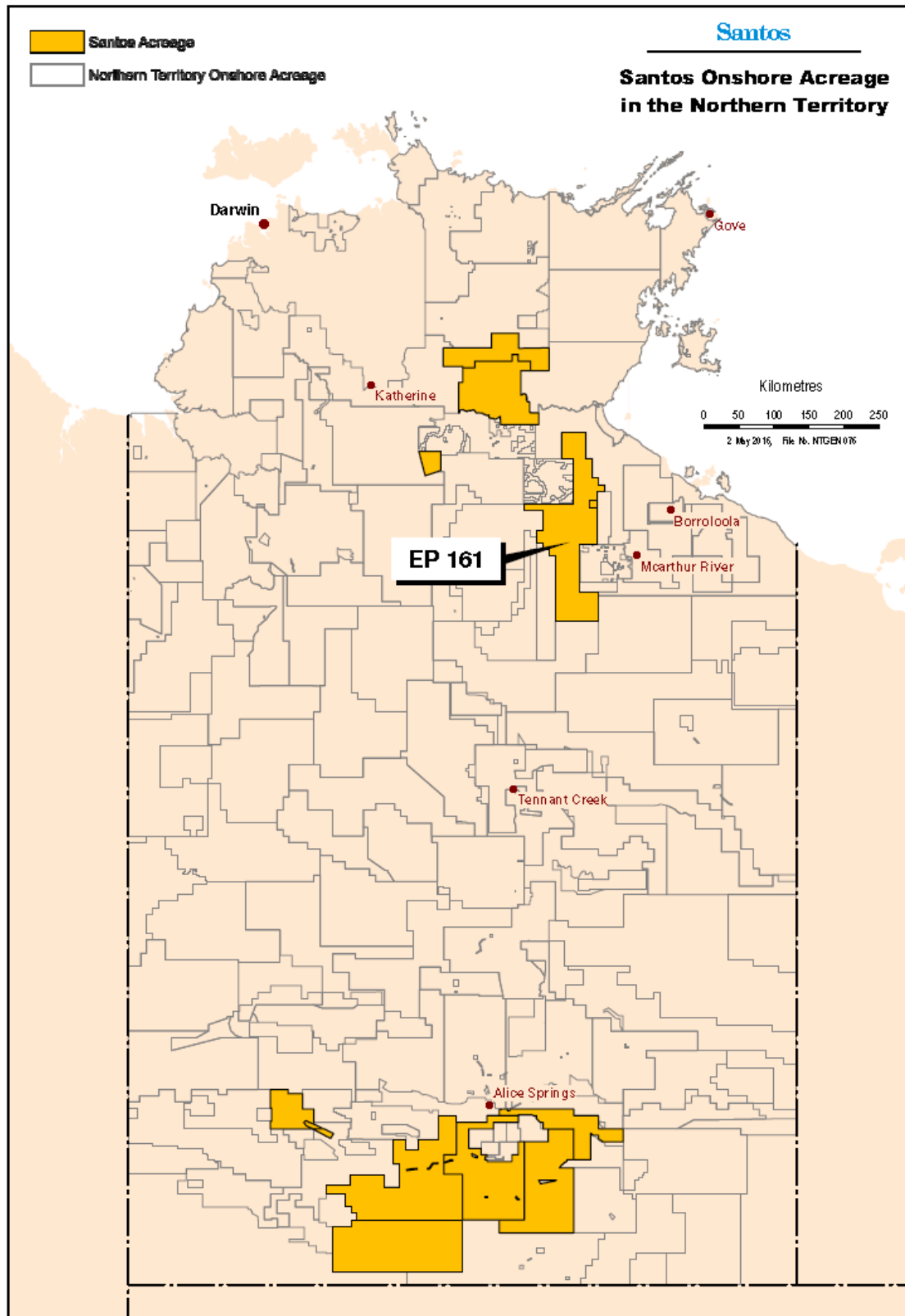


Figure 1-1 Santos onshore acreage in the Northern Territory 2016

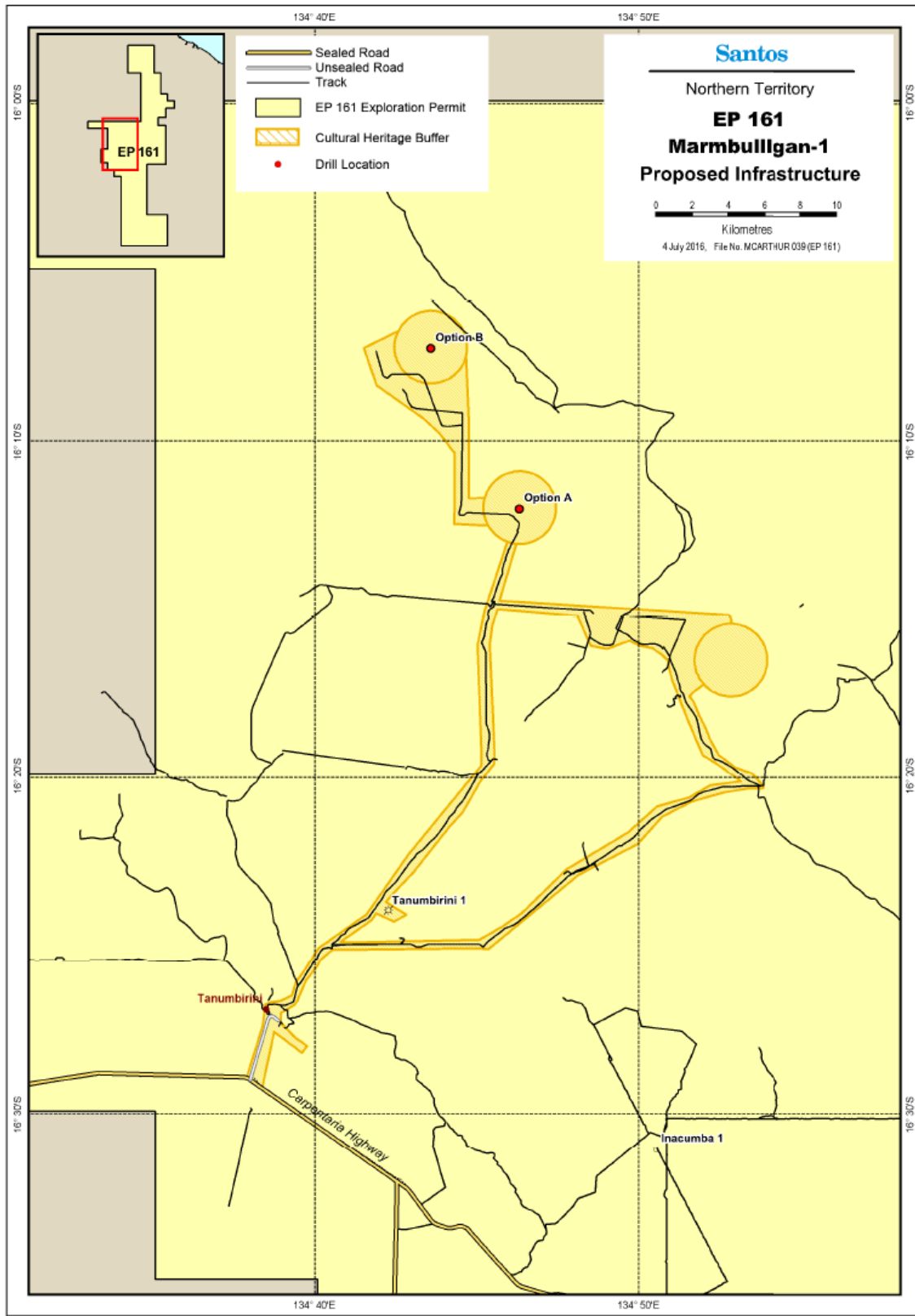


Figure 1-2 Proposed infrastructure for the EP-161 Corehole Program – Marmbulligan-1

2 ENVIRONMENT DESCRIPTION

2.1 Physical Environment

4.1.1 Climate

The region covered by EP-161 experiences a 'Grassland' climate, based on the Köppen classification system (BOM 2013a). This classification consists of two distinct seasons: the wet season which lasts from December to March; and the generally dry conditions which last for the remainder of the year (winter drought).

Mean maximum temperature ranges from 29.7°C in June to 38.6°C in November and historically the highest temperatures recorded have been in November. The mean minimum temperature ranges from 12.2°C in July to 24.9°C in December-January. Coolest temperatures occur in June-July.

4.1.5 Hydrology

The majority of the catchments within EP-161 drain north-easterly towards the Gulf of Carpentaria. Major rivers include the Limmen Bight River, October Creek and Cox River. The highest flows for these rivers occur during the wet season, predominantly due to cyclones and monsoonal rainfall. In contrast to these larger rivers, smaller streams and drainage lines such as the Lansen, Inacumba, Tanumbirini and Lagoon Creeks are largely ephemeral and usually run dry during the dry season. Ephemeral rivers and streams are subject to short flow duration and high turbidity.

There is also a range of small wetlands associated with sinkholes and minor depressions in the generally flat landscape. Riparian zones of these rivers and wetlands are generally in fair to good condition, affected mostly by access by livestock and feral animals and weeds.

2.2 Biological Environment

4.2.1 Bioregions

EP-161 overlies the Sturt Plateau and the Gulf Falls and Uplands bioregions. The Sturt Plateau bioregion dominates most of the southern part of EP-161, south of the Carpentaria Highway. The Gulf Falls and Uplands bioregion occurs in the northern half of EP-161, north of the Carpentaria Highway, and on the southern boundary of the EP.

4.2.2 Flora

Vegetation types within EP-161 include woodland, open woodland, open forest, tussock grassland and hummock grasslands. The dominant species within the vegetation communities present include Darwin Stringybark *Eucalyptus tetradonta* and Variable-barked Bloodwood *C. dichromophloia* with spinifex understorey, and woodland dominated by Kullingal *Eucalyptus pruinosa* or *Melaleuca* spp. with tussock grass understorey. There are also large areas of Lancewood (*Acacia shirleyi*) thickets, Bullwaddy (*Macropteranthes keckwickii*) woodlands and Acacia shrub lands on deep sands.

4.2.3 Fauna

The region supports a diverse range of fauna. Over 435 vertebrate species have been recorded from the Gulf Falls and Uplands bioregion, including 24 species that are rare or threatened (Connors *et al.* 1996). Ten species in this bioregion are listed as threatened at a Territory or national level (DLRM 2013c). The Sturt Plateau bioregion is known to support over 350 vertebrate species, including six species listed as threatened at a Territory or national level (Connors *et al.* 1996, DLRM 2013c).

3 ENVIRONMENTAL RISKS AND IMPACTS, DESCRIPTION AND ASSESSMENT

Activities (or elements of activities) that have the potential for environment impact have been identified and assessed for the EP-161 Corehole Program. In addition, Table 3-1 to Table 3-6 outline the management approach for the following specific environmental issues relevant to the EP-161 Program activities:

- Air quality
- Water
- Noise
- Land
- Flora and fauna
- Community
- Waste management

3.1 Management of Specific Issues

Table 3-1: Environmental Values and Objectives – Air Quality

Environmental Values	<ul style="list-style-type: none"> • Rural air environment with qualities conducive to suitability for the life, health and wellbeing of humans. 	
EP-161 Program Objectives	<ul style="list-style-type: none"> • Minimise environmental nuisance due to dust for sensitive receptors as a result of petroleum activities. • Minimise greenhouse gas emissions. 	
Environmental Aspects	Potential Impacts	Management Controls
<ul style="list-style-type: none"> • Civil works • Drilling activities • Rig moves 	<ul style="list-style-type: none"> • Dust emissions • Release of atmospheric contaminants • Aesthetic impacts 	<p>Santos may apply one or more of the following dust suppression methods:</p> <ul style="list-style-type: none"> • Dust shrouds around drilling collar and dedicated dust extraction system. • Reducing the speed of vehicles on field roads. • Watering of roads when appropriate and agreed. • Ensuring plant and equipment is maintained to reduce potential fugitive emissions and gas leaks; • Minimising flaring or burning of waste products. <p>Complaints will be investigated and responded to appropriately. Emergency response systems will be in place.</p>
Performance Measures	<ul style="list-style-type: none"> • Minimal complaints regarding dust/air quality. • Amicable resolution of complaints. 	
Records	<ul style="list-style-type: none"> • All complaints and subsequent actions are to be recorded in the EHS Complaints Register in the Santos EHS Toolbox. 	

Table 3-2: Environmental Values and Objectives – Water

Environmental Values	<ul style="list-style-type: none"> • Biological integrity of modified riverine ecosystems and natural waterways. • Suitability for recreational use. • Suitability for agricultural use. • Suitability for human consumption. • Suitability for industrial use. 	
EP-161 Program Objectives	<ul style="list-style-type: none"> • Minimise impacts to and maintain surface and groundwater values. • Minimise erosion and sedimentation of waters as a result of petroleum activities. 	
Environmental Aspects	Potential Impacts	Management Controls
<ul style="list-style-type: none"> • Blowout • Equipment failure • Down hole problems • Casing failure • Explosion or fire • Cement failure • Drill pipe failure • Loss of containment of gas during testing 	<ul style="list-style-type: none"> • Aquifer contamination • Loss of aquifer pressure • Uncontrolled release of water and hydrocarbon (liquid or gas) to surface • Contamination of soil, shallow groundwater or watercourses 	<ul style="list-style-type: none"> • Strict adherence to Santos engineering standards, the DCMS and DME requirements. • Baseline Water Study undertaken. • Ecological assessment to be undertaken to identify environmentally sensitive areas. • Appropriate action will be undertaken during weather and flood warnings to minimise damage and environmental impact. • Established Santos spill response procedures shall be implemented for spills or leaks.

<ul style="list-style-type: none"> Leak or loss of containment during drilling Leak or loss of containment onsite Disposal of waste – cuttings, associated water and produced water Extreme weather activity results in flooding Loss of radioactive source Groundwater usage 	<ul style="list-style-type: none"> Emergency response systems shall be in place for responding to contaminant release. Dangerous goods will be stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. Hazardous goods will be stored in bunded areas away from watercourses. Refuelling of equipment will not occur within 100m of a water course. Fixed plant such as pumps will have appropriate bunding. Waste which cannot be recycled will be transported to a designated, approved disposal site. Spills of dangerous goods will be collected for treatment and disposal at an approved facility. Spill kits will be made available where hazardous materials are used and personnel will be trained in correct use. All refuelling of equipment will have spill kits available. Plant and equipment shall be inspected and maintained regularly to detect and prevent leakage of liquid contaminants. Earthworks disturbance to drainage lines will be minimised/avoided wherever possible. No discharges to watercourses. All grey and treated sewerage waste will be appropriately managed.
Performance Measures	<ul style="list-style-type: none"> No unacceptable risk to surface and/or groundwater resources.
Records	<ul style="list-style-type: none"> Records of releases, leaks and associated clean ups are to be managed using the Santos Incident Management System. Rectification work requirements and actions will be recorded using the Santos Incident Management System.

Table 3-3: Environmental Values and Objectives – Noise

Environmental Values	<ul style="list-style-type: none"> A rural acoustic environment conducive to the wellbeing of the community, including its social and economic amenity, and an individual, including the opportunity to have sleep, relaxation and conversation without unreasonable interference from intrusive noise. 	
EP-161 Program Objectives	<ul style="list-style-type: none"> Minimise the environmental nuisance for sensitive receivers as a result of petroleum activities. 	
Environmental Aspects	Potential Impacts	Management Controls
<ul style="list-style-type: none"> Civil works Drilling activities 	<ul style="list-style-type: none"> Noise generation causing and environmental nuisance 	<p>Due to the location of the Program wells and distance from sensitive receptors, it is anticipated that minimal noise impacts will occur.</p> <ul style="list-style-type: none"> Complaints shall be recorded (in Santos’ EHS Toolbox), investigated and responded to appropriately. The community shall be advised the likely timing and duration of noisy activities. Campsites sites shall be located a sufficient distance from residences to limit impact.
Performance Measures	<ul style="list-style-type: none"> Minimal noise-related complaints received from noise-sensitive place, including landowners. Amicable resolution of complaints. 	
Records	<ul style="list-style-type: none"> All complaints and subsequent actions are to be recorded in the EHS Complaints Register in the Santos EHS Toolbox. 	

Table 3-4: Environmental Values and Objectives – Land

Environmental Values	<ul style="list-style-type: none"> Suitability and stability of land for existing uses. Stability of land to preserve existing water quality, landscapes and ecosystems. 	
Objectives	<ul style="list-style-type: none"> Minimise disturbance to land and land use (including soils and terrain, flora and fauna). Avoid site contamination and remediate land areas disturbed by petroleum activities, including contaminated land. Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal and remove and disposal of regulated waste as soon as practicable to a licensed waste disposal facility or recycling facility. Return disturbed areas to a stable condition such that they are returned to a condition as close as practicable to the surrounding area (or pre-disturbance state) within an acceptable time frame. 	
Environmental Aspects	Potential Impacts	Management Controls

<ul style="list-style-type: none"> • Civil works • Drilling activities • Storage and transportation of wastes • Sewerage treatment and disposal • Disposal of drill cuttings and muds to excavated sumps • Fuel and chemical handling and storage 	<ul style="list-style-type: none"> • Localised soil contamination 	<ul style="list-style-type: none"> • Ecological assessment to be undertaken to identify environmentally sensitive areas. • Hazard management measures relating to Road, Track and Lease Construction, Maintenance and Access will be implemented. • Erosion control measure to be implemented and maintained. • Regular inspections will be conducted to identify erosion and repair where observed. • Associated water production will be minimised through drilling techniques. • All well site operations to be undertaken within the boundary of the lease pad. • Specified laydown areas to be used. • Fuel, lubricants and chemicals will be stored appropriately in bunded areas and transported, handled and used in accordance with the relevant SDS. • Emergency response systems and Spill Contingency Plan will be in place and appropriate release clean-up equipment will be onsite and available in relevant areas. • Release of hydrocarbons will be reported to DME as required: 80L or greater to inland waters; 300L or greater to land; and 500m³ or greater of petroleum in gaseous state. • Impacts to areas outside of the areas covered by environmental clearance will be rehabilitated. • No off lease or off road driving. • Waste management measures will be implemented (including for drilling cuttings). • Following completion of works, disturbed areas to be restored and/or rehabilitated. • Clay borrow material will be removed from surface and returned to borrow pits. • All compacted areas will be ripped to promote regeneration of vegetation. • Disturbed areas to be restored will be monitored for weed infestation, and progress towards specified rehabilitation goals.
Performance Measures	<ul style="list-style-type: none"> • Land disturbance minimised • Rehabilitation of disturbed areas 	
Records	<ul style="list-style-type: none"> • The extent of disturbances will be measured and uploaded to the Santos' Geographic Information System (GIS) 	

Table 3-5: Environmental Values and Objectives – Flora and Fauna

Environmental Values	<ul style="list-style-type: none"> • Maintain the integrity of significant ecosystems. 	
Objectives	<ul style="list-style-type: none"> • Minimise disturbance to flora and fauna. • Minimise disturbance to sensitive areas. 	
Environmental Aspects	Potential Impacts	Management Controls
<ul style="list-style-type: none"> • Rig moves • Travel to and from camp and rig • Camp set-up 	<ul style="list-style-type: none"> • Disturbance to environmentally sensitive areas and/or flora and fauna species. 	<ul style="list-style-type: none"> • Ecological assessment to be undertaken to identify environmentally sensitive areas (flora and fauna habitat) • Hazard management measures outlined relating to Road, Track and Lease Construction, Maintenance and Access will be implemented. • No off lease or road driving • Weed control measures will be implemented. • All equipment will have certified equipment wash-down completed prior to entry to the field. • Weed identification awareness training will be included in Icebreaker inductions and pre-spud toolbox. • Weed identification posters will be available in the site office and camps, as appropriate. • New activities will be planned to address prevention of weed or non-indigenous plants spread. • Routine inspections and periodic audits will be conducted to identify and report weed outbreaks. • Weeds will be actively controlled in cleared/ hardstand areas; • Major equipment moves will be planned from weed-free areas to infested areas and not the other way around.

		<ul style="list-style-type: none"> Personnel will be prohibited from bringing firearms or traps into the lease areas, with the exception of those required for feral animal control. Feral animal control measures will be implemented as required and in conjunction with landholders, Traditional Owners and local authorities (Parks and Wildlife). Personnel will be prohibited from interfering with wildlife; Personnel will be prohibited from bringing domestic pets onto the Program area. Adequate fire breaks shall be maintained around flares to minimise the risk of fire. Appropriate fuel and chemical handling and storage measures will be implemented. Fire extinguishers and firefighting equipment will be provided at operational sites and for vehicles. Emergency response systems will be in place and maintained. Fire bans will be complied with. The Bushfires Act 2009 will be complied with regarding obtaining permits for undertaking controlled burns.
Performance Measures	<ul style="list-style-type: none"> Lease located to minimise impacts to fauna habitat and sensitive vegetation No native fauna impacts (injury or fatality) reported in IMS during drilling related activities No loss of sensitive vegetation reported in IMS during drilling related activities. 	
Records	<ul style="list-style-type: none"> Santos internal environmental clearance by Environmental Advisers. Records of disturbance will be maintained within Santos' GIS. Records of inspections will be maintained. All incidents will be reported internally (in the Santos Incident Management System) and corrective action initiated. 	

Table 3-6: Environmental Values and Objectives – Community

Environmental Values	<ul style="list-style-type: none"> Livelihood and well-being of local communities and towns. Aboriginal and non-Aboriginal heritage. 	
Objectives	<ul style="list-style-type: none"> Minimise impacts upon environmental values of the local community. Minimise impacts on cultural heritage. Regularly measure regulatory compliance and company conformance, and undertake corrective actions as necessary. Minimise safety risks to the public and other third parties. Maintain and enhance partnerships with the local community. 	
Environmental Aspects	Potential Impacts	Management Controls
<ul style="list-style-type: none"> Drilling activities 	<ul style="list-style-type: none"> Disturbance to cultural heritage sites Damage to third party infrastructure Loss of visual amenity Possible danger to health and safety of the community. 	<ul style="list-style-type: none"> A Stakeholder Management Plan will be prepared. Emergency response systems will be in place. As soon as practicable, Santos will notify DME of an emergency or incident which results in the release of contaminants. A record of complaints and incidents causing environmental harm and the follow-up actions taken in response to each complaint or incident will be maintained in the Santos EHS Toolbox. All personnel and site visitors will complete the appropriate inductions. Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC) will be conducted prior to commencement of disturbance activities or operations. Work will cease immediately upon encounter of a site/suspected site or artefact. The discovery of a suspected Aboriginal heritage site, artefact or human remains will be reported immediately. Cultural Heritage Report forms will be completed for site/suspected site encountered. Operations personnel will avoid known heritage sites. Earthworks will be conducted in strict accordance with Santos standards and procedures. Activities will be conducted in accordance with the NLC Agreement. Permission for activities will be obtained from NLC and DME where required. Applicable personnel will complete Cultural Heritage Awareness training.
Performance Measures	<ul style="list-style-type: none"> No disturbance to cultural heritage sites 	

Santos

	<ul style="list-style-type: none">• No unresolved reasonable complaints
Records	<ul style="list-style-type: none">• Cultural Heritage Clearance documents• Complaints register in Santos' EHS Toolbox

4 CONSULTATION

Santos is committed to upholding its long-held reputation as a trusted Australian energy company. Santos seeks to establish and maintain enduring and mutually beneficial relationships with the communities of which it is a part; ensuring that Santos' activities generate positive economic and social benefits for and in partnership with these communities.

4.1 Stakeholder Identification

Stakeholder identification was conducted early in the McArthur Basin Exploration Program. Stakeholders include:

- Community
- Landholders
- Traditional Owners and Aboriginal Peoples
- Representatives of Local Government
- Northern Territory Government departments
- Media
- Other key non-commercial external stakeholders (e.g. NGOs and industry bodies)
- Industrial Relations stakeholders
- Other commercial external stakeholders
- Internal stakeholders

4.2 Stakeholder Consultation

Santos has undertaken consultation to ensure that the key stakeholders are aware of the components of the exploration program. The purpose of the consultation has been to:

- Educate and inform key stakeholders of the elements of the McArthur Basin Exploration Program and possible future production
- Build and maintain stakeholder confidence through key relationships
- Gain trust and acceptance in the local communities as a responsible member of society
- Listen to and address concerns or queries
- Educate the community, landholders, business operators and Traditional Owners on why and how Santos operates

The key components of the engagement program have been:

- Briefing sessions – face-to-face with key individuals and groups with timely feedback on issues and concerns
- Distribution of key information via media engagement, websites, social media and letter writing
- Community capacity building through employment (local and aboriginal), contracts and procurement

Santos also participated in the information roadshow conducted by APPEA and the Department of Mines and Energy throughout the Northern Territory. This included information sessions at Katherine and Mataranka.

Issues addressed during consultation include:

- Environmental disturbance and the use of chemicals
- Cultural heritage issues
- Potential impact on the groundwater
- Impact to roads through increased traffic
- Hydraulic fracture stimulation activity
- Well integrity
- Economic benefits from increased activity - including local employment and training, funding sponsorships and capacity building for local businesses
- Local procurement of goods and services