



PANGAEA

2015 AVAGO 2D SEISMIC SURVEY

**ENVIRONMENTAL MANAGEMENT PLAN
SUMMARY**

**2015 AVAGO 2D SEISMIC SURVEY
ENVIRONMENTAL MANAGEMENT PLAN SUMMARY**

TABLE OF CONTENTS

1. INTRODUCTION	3
2. DESCRIPTION OF ACTIVITY.....	4
3. DESCRIPTION OF THE ENVIRONMENT.....	4
4. DESCRIPTION OF THE ACTIVITY IN RELATION TO THE ENVIRONMENT	5
5. ENVIRONMENTAL RISKS OF PROPOSED ACTIVITY AND CONTROL MEASURES	5
6. CONSULTATION	6
7. PANGAEA LIAISON PERSONNEL	6

**2015 AVAGO 2D SEISMIC SURVEY
ENVIRONMENTAL MANAGEMENT PLAN SUMMARY**

1. INTRODUCTION

EP167 and EP168 are located approximately 350 km southeast of Darwin in the Northern Territory (NT) in the western McArthur Basin. The tenements fall within the Victoria-Daly, Roper-Gulf and Barkly Shires plus the Katherine Municipality. All activities described in this EMP Summary are in the Roper-Gulf Shire.

Pangaea intends to acquire approximately 380km of 2D, Vibroseis-sourced seismic data in the area of operations during 2015. This survey, known as the 2015 Avago 2D Seismic Survey, will comprise ten (10) seismic lines and has been designed to minimise impacts on the environment by utilising existing roads, tracks, fire-breaks and fence lines wherever possible.

A location map and coordinates of the activity are provided in Figure 1.

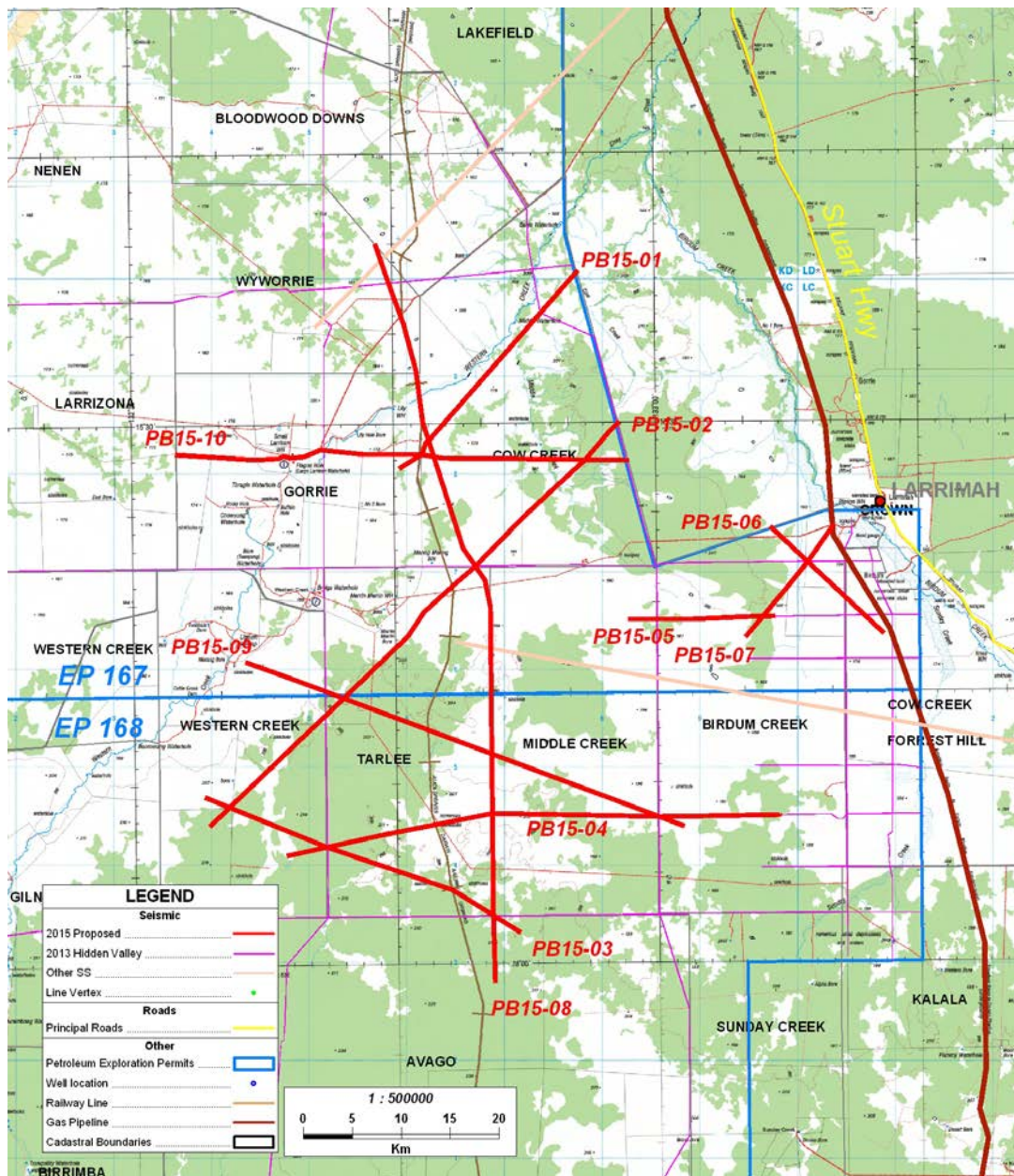


Figure 1: Location of the Avago 2D Seismic Survey

**2015 AVAGO 2D SEISMIC SURVEY
ENVIRONMENTAL MANAGEMENT PLAN SUMMARY**

2. DESCRIPTION OF ACTIVITY

The overall objective of the seismic program is to image subsurface geological formations across the stated tenements to increase the understanding of hydrocarbon prospectively within the area. The survey has been designed to image from the surface down to 4,000m of the subsurface to delineate critical areas of geological interest while also avoiding areas of environmental, cultural or archaeological importance.

3. DESCRIPTION OF THE ENVIRONMENT

The region's climate is *'semi-arid tropical, with rainfall concentrated in the wet season months between November and April. Though rainfall can be variable from year to year, there is a distinct gradient of decreasing mean annual falls from 850mm in the north to less than 500mm'* in southern areas of EP167 and EP168, with nearly all the rainfall occurring between November and April (see Williams *et al.* 1997¹, Hennessy *et al.* 2004²). The mean maximum temperature varies from 27°C in July to 40°C and beyond in November.

Condition is generally good across much of the bioregion. The portion of the seismic survey in EP-167 will intersect with the Forrest land system. The Forrest land system consists of gently sloping sandy surfaced plains with few indistinct drainage depressions on sandy red earth soils. Vegetation is dominated by eucalypt woodlands and perennial grasses, the systems are generally suitable for pasture improvement and have moderate to high grazing potential. The Forrest land system consists of vegetation that have a relatively low forage quality in the dry season but it can benefit from strategic burning to manage woody thickening (Northern Territory Government, no date³).

The portion of the seismic survey in EP-168 will intersect with the Banjo land system. The Banjo land system consists of almost level to gently undulating plains on the plateau surface that lack drainage lines. Consisting of variable depth red earth soils with or without gravel; mixed eucalypt woodlands and perennial grasses, the systems are generally suitable for pasture improvement and have moderate to high grazing potential. The Banjo land system consists of vegetation that has a relatively low forage quality in the dry season although can benefit from strategic burning to manage woody thickening (Northern Territory Government, no date⁴).

¹ Williams, R.J., Cook, G.D., Ludwig, J.L. and Tongway, D.L. (1997). Torch, trees, teeth and tussocks: disturbance in the tropical savannas of the Northern Territory (Australia). In: *Frontiers in Ecology. Building the Links*. Eds. N. Klomp and I. Lunt. Elsevier, Oxford: pp55-66.

² Hennessy, K., Page, C., McInnes, K., Walsh, K., Pittcock, B., Bathols, J, and Suppiah, R. (2004). *Climate Change in the Northern Territory*. Consultancy report for the Northern Territory Department of Infrastructure, Planning and Environment. CSIRO, Melbourne.

³ Northern Territory Government (no date) Land Condition Guide - Sturt Plateau District; Understanding the productivity of grazing lands. Produced in association with the Northern Territory Cattlemen's Association as part of the Caring for Our Country project "Grazing Land Management – Demonstration, Continuation and Evaluation".

⁴ Northern Territory Government (no date) Land Condition Guide - Sturt Plateau District, Understanding the productivity of grazing lands. Produced in association with the Northern Territory Cattlemen's Association as part of the Caring for Our Country project "Grazing Land Management – Demonstration, Continuation and Evaluation".

**2015 AVAGO 2D SEISMIC SURVEY
ENVIRONMENTAL MANAGEMENT PLAN SUMMARY**

4. DESCRIPTION OF THE ACTIVITY IN RELATION TO THE ENVIRONMENT

The Seismic Survey has been designed with due consideration of the surface and subsurface environments, and to minimise impacts on the environment by utilising existing roads, tracks, fire-breaks and fence lines wherever possible. The operations will utilise one centrally located camp site.

Line preparation may include 'stick raking' and vegetation management for technical, safety and visibility reasons. Stick raking displaces logs and large sticks from the chosen line that could create a hazard or barrier. Light grading may be required to smooth over very rough surfaces to make the line trafficable for the vibrator trucks and support vehicles.

Bull-dozers may also be employed as a last resort in areas where the terrain is especially rough and inaccessible by grader or front end loader. In all cases, equipment is kept off the ground surface ensuring that root stock and tufted grasses remain in situ wherever possible (minimising potential soil loss through erosion). Tree clearing is minimised by meandering the lines through heavily wooded areas and savannah woodlands around trees (>200mm diameter at breast height), however some tree losses and trimming is to be expected. All alternative options will be considered, including practical rerouting, before this occurs.

Where a line crosses a creek, watercourse or depression in the landscape, survey crews will search for naturally cleared crossings (in the immediate area) before the final lines are chosen in the field. Earthworks in riparian areas will be minimised at all times and rehabilitation is to follow immediately post data capture, or as soon as practically possible.

The collection of seismic data involves deploying over 10km of individual seismic nodes spaced every 10m along the lines. Energy waves are sent from vibrator trucks, which reflect off underground rock formations before being recorded by the nodes at the ground surface for analysis. The vibrators advance along the line and vibrate over a period of approximately eight (8) seconds every 10m. The data is downloaded from the nodes and sent to a data processing centre where it is processed to produce images of the subsurface.

5. ENVIRONMENTAL RISKS OF PROPOSED ACTIVITY AND CONTROL MEASURES

Fauna and flora

The seismic lines have been designed to minimise clearing and associated impacts on important vegetation communities that may be providing important fauna habitat. The seismic survey would comprise a minor and temporary barrier to movement of fauna, however the small scale of vegetation modification is unlikely to isolate any wildlife corridors or otherwise affect the migration or dispersal ability of any fauna. Weed and pest inspections on all vehicles & personnel clothing will be undertaken prior to arrival at site and the use of signage and appropriate fencing.

Noise and surface

Speed limits will be enforced on access tracks to limit and minimise dust and noise generation. Vehicular movements to and from the work sites will be minimised by travel during daylight hours and be compliant with land access agreements. Soil erosion will be minimised by the use of existing tracks, deviating around creeks, river banks and naturally formed depressions and not accessing roads in wet conditions.

Waste management

Waste will be stored in suitable receptacles and disposed of accordingly at municipal managed locations. Hazardous material shall be transported, stored and handled in accordance with the requirements of the relevant legislation and guidelines.

**2015 AVAGO 2D SEISMIC SURVEY
ENVIRONMENTAL MANAGEMENT PLAN SUMMARY**

6. CONSULTATION

During the past several months Pangaea has consulted with stakeholders, which has included:

- A detailed cultural heritage assessment and sacred site clearance process with the Northern Land Council and Traditional Owners;
- The negotiation and signing of voluntary access agreements with directly-affected Pastoralists;
- Direct engagement with communities and representative groups at exhibition booths during district and agricultural shows e.g. Katherine District Shows.
- Notification to local government councils, police authorities and local businesses of exploration activities; and
- Compliance with legislation and guidelines from the NT Department of Mines and Energy and other regulatory agencies e.g. Department of Transport and Department of Infrastructure.

Pangaea's engagement process is aimed to identify and address issues of concern, reach agreement and in general engage in goodwill communication.

Pangaea will continue this process with stakeholders throughout the life of the project.

7. PANGAEA LIAISON PERSONNEL

Sydney Office		
Executive Director	Tim Radburn	Phone: (02) 9017 9600