

Example environmental procedures for seismic operations in the Cooper and Eromanga Basins, South Australia

REPORT BOOK 2000/00041

by

K.R. Langley
Petroleum

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**PRIMARY INDUSTRIES AND RESOURCES
SOUTH AUSTRALIA**

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EXAMPLE ENVIRONMENTAL PROCEDURES FOR SEISMIC OPERATIONS IN THE COOPER AND EROMANGA BASINS, SOUTH AUSTRALIA

K.R. Langley

INTRODUCTION

This document relates to the publication titled “Statement of environmental objectives for seismic operations in the Cooper and Eromanga Basins, South Australia” which has been approved under Schedule 6 of the Petroleum Act 2000. Operators are required to comply with these objectives when undertaking seismic operations in the Cooper and Eromanga Basins of South Australia.

This document specifically focuses on issues relating to the Cooper and Eromanga Basin and complements the Australian Petroleum Production and Exploration Associations (APPEA) 1996 Code of Environmental Practice.

These example procedures have been prepared to highlight the types of environmental issues that may be encountered in the conduct of seismic operations for petroleum exploration. They are examples only and are not intended to be exhaustive or a substitute for professional advice on environmental compliance issues for seismic operations. Independent advice should be sought in respect to matters raised in this document before they are applied to a particular seismic operation. Ultimately, it is the responsibility of companies to ensure that the environmental procedures used by them are pertinent to their operations.

The prime aim of this document is to give examples, which may facilitate undertaking of field operations, which achieve the environmental objectives as required viz:

- the potential impacts are assessed within a planning process and incorporated into field management procedures;
- manage and monitor those activities that have, or are likely to have temporary impacts on the environment, groundwater or other land users, and facilitate rehabilitation to minimise such impacts if they occur; and
- avoid activities, which have, or are likely to have, long term significant impacts on biological diversity, cultural components of the environment, groundwater or other land users.

This document contains practices that are task specific and list points that may facilitate individuals involved in a field seismic program in the fulfilling of their environmental responsibilities.

A brief description of the land systems of the region is also included.

As seismic line preparation causes the most environmental impact of all the various elements of field seismic survey operations, careful attention to the planning and preparation of seismic lines is required.

Techniques, which to date, have proven to be effective in the preparation of seismic lines in each land system are included.

A BRIEF DESCRIPTION OF COOPER AND EROMANGA BASIN LAND SYSTEMS

The environmental impacts of seismic activities depend on the type of physical activity and the land unit in which it is undertaken. Land systems are composed of an association of land units (such as sand dunes and swales) and impacts will depend on individual land units and individual sites (for example there will be differences from the crest of the dune to its base).

While the planning of a survey should consider the land unit, for simplicity, this document includes a brief description to the land system level only. A more detailed description of land systems, and the natural history of the area can be found in the Natural History of the North East Deserts (Tyler *et al.*, 1990).

DUNEFIELDS

The landscape feature which is usually associated with the north east of South Australia and which is a dominant feature of the Strzelecki and Simpson Deserts is the dune field. These desert dunefields are typically made up of approximately north/south parallel trending sand dunes that vary in height between six to fifty metres (Laut *et al.*, 1977). The north/south orientation of the dunes is a result of the prevailing southerly winds. The colour of the dunes ranges from red to yellow to white. Pale-coloured dunes are clay rich where as iron-rich silica is the main component in red dunes. Long flat interdunal corridors that sometimes contain clay pans formed as a result of limited internal drainage separate the sand dunes. On the dunes, common plants include prickly wattle, sandhill canegrass and marpoo.

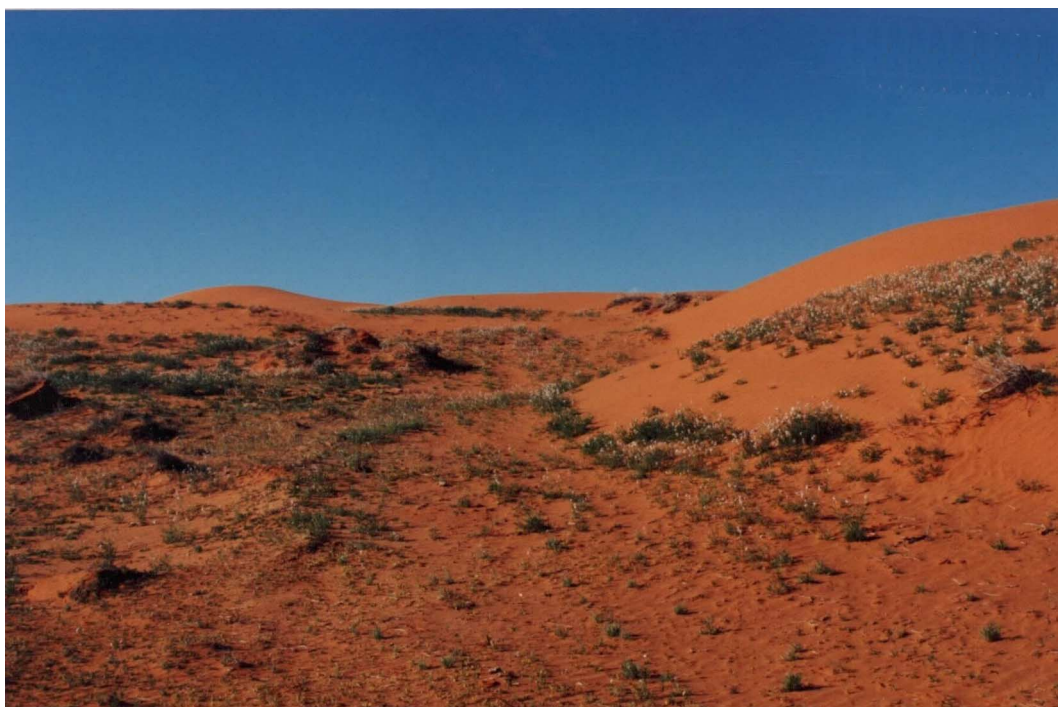


Photo 1 Iron-rich siliceous sand dunes of the Strzelecki Desert Photo No. (047660)

In some areas, the dunes are less regular in shape, and may occur more “jumbled” such as “Marquillpie country” to the south of Cordillo Downs.

WETLANDS

This landscape is made up of drainage features associated with the river systems that flow through the region and include river channels, waterholes, lakes and swamps. As some are a permanent source of water, they are highly valued as refuges for wildlife in periods of drought, and livestock watering points. Vegetation is typically river red gum, lignum and coolibah, which line watercourses, lakes and swamps. Goyder Lagoon, Boggy Lake, Tirrawarra Swamp, Diamantina River and Cooper Creek are examples of typical wetland features.



Photo 2 Cooper Creek lined with Coolbahs with Lake Coongie in the background
Photo No. (047661)

FLOODPLAINS

Surrounding the wetlands are floodplains. These are areas which are intermittently inundated by water overflowing from watercourses such as the Cooper and Strzelecki Creeks and Diamantina River. The dominant soil type is poorly draining, grey self-mulching clay, which gives rise to this type of terrain being described as “crab-hole country”. Floodplain vegetation in low-lying floodplain regions, which are subject to more frequent inundation, is most commonly coolibah woodland. The less frequently inundated floodplain areas are generally covered by sparse saltbush.



Photo 3 Floodplain with cover of Coolibahs and Queensland Bean Trees
Photo No. (047662)

SALT LAKES

Salt lakes, salinas or salt pans are a feature of an arid environment where the rate of evaporation vastly exceeds rainfall. Salts, which are dissolved by water flowing across the ground, are in turn, deposited as a crust on the surface of the lakes after the ponded water has evaporated.

Salt lakes are devoid of vegetation. However salt tolerant plants such as samphire and saltbush are found on the margins of the lakes. In the Cooper and Eromanga Basins, Lake Blanche and Lake Hope are typical examples of salt lakes.



Photo 4 Saltlake fringed with samphire vegetation Photo No. (047663)

GIBBER PLAINS

Gibber plains are flat or gently undulating plains paved with a densely packed mantle of silcrete rich stones. These stones are generally highly polished by the action of sand-laden wind and are relics of a Tertiary table land terrain from which the less resistant material has been eroded. The stones and the more resistant upper clay crust of the duplex soil act as a shield by protecting the underlying fragile loams. Removal of the protective mantle of stones and the layer of crusty clay can result in severe erosion and the creation of gullies and ravines.

Vegetation cover is sparse and is composed of a general cover of Mitchell grass and salt bush. Streamlines are fringed with red mulga, gidgee and mulga.

There are wide expanses of silcrete gibber plains throughout the basin. Gibber plains are a dominant landscape feature of the Sturt Stony Desert.



Photo 5 *"Desert Varnish" on stones and pebbles of gibber plains* Photo No. (047664)

TABLE LANDS (BREAKAWAYS)

Dissected tableland areas are composed of silcrete-capped mesas; escarpments and buttes that are remnants of a former Tertiary surface and are generally surrounded by gibber plains. The Tertiary was a period of relatively high humidity, which provided the necessary conditions for the formation of the silcrete. These are areas of active erosion, the rate of which is greatly accelerated if the protective mantle is removed and the fragile underlying loams exposed.

In the South Australian portion of the Cooper Basin, dissected tablelands are confined to the area to the north of Innamincka in the Merninie and Pinewirie Environmental Associations (Laut *et al.*, 1977).



Photo 6 Flat top mesas typical of the tableland country to the north of Innamincka
Photo No. (047665)

SEISMIC SURVEY MANAGEMENT

SURVEY PROGRAM PLANNING

Environmental and landowner concerns highlight the importance of the planning process in reducing the potential environmental effects of exploration. These include:

- line location and preparation techniques to avoid long term impact;
- the protection of European and Aboriginal heritage sites;
- the specific requirements of pastoralists, for example, organic beef production certification requirements; and
- the protection of geological monuments.

The only effective way of avoiding damage is to ensure that all areas and items of value are identified before operations commence. The Operator should therefore ensure the identification of environmental values and landowner concerns is an integral part of the planning process.

All available reference material, such as satellite imagery, recent aerial photography, topographic and other landform or survey maps, should be used. The identification of all environmentally and culturally sensitive areas onto a single base map or photograph is a useful tool for aiding the planning of each

seismic traverse. Utilising geographical information system (GIS) technology can facilitate this process.

The Operator should also explore the potential for the use of alternative seismic energy sources; vehicles or techniques to minimise ground disturbance, particularly in sensitive areas.

Environmental management data should form an integral part of the operational program and the information gained should be made available to all relevant personnel. Function and site specific procedures should be used to ensure appropriate environmental management.

Crucial to the identification of landowner concerns is early and effective consultation with landowners affected by the proposed operations.

LEGISLATIVE REQUIREMENTS

All activities undertaken in a seismic survey must comply with the applicable South Australian and Commonwealth Government Acts and Regulations.

The principal Act regulating seismic activities is the *Petroleum Act, 2000* and its Regulations. Legislation applying to areas set aside for special purposes, native vegetation protection and Aboriginal heritage is of particular relevance. It is the responsibility of the Operator to ensure compliance with the appropriate legislation and advise the seismic program coordinator and crew appropriately. PIRSA, acting as a “one stop shop” will coordinate, and where necessary, liaise with other relevant Government departments.

South Australian law protects native vegetation. However, regulations under *the Native Vegetation Act, 1991* exempt petroleum exploration activities. Even so, vegetation clearance should be kept to the absolute minimum necessary to enable access by survey equipment.

CONSULTATION WITH LAND OWNERS/OCCUPIER

Implicit in the environmental objectives for seismic operations in South Australia is that the title and rights of all legitimate land users shall be considered and respected. Therefore, effective consultation should be carried out with all local land owners/occupier or their nominees before the commencement of seismic survey operations on their land.

Consultation has two objectives:

- notification to meet statutory requirements under the Part 12 of the *Petroleum Act, 2000*; and
- continual liaison in order to exchange information and facilitate good working relations with land managers.

Liaison for information exchange and to promote understanding and reconciliation of competing interests is inherent in meeting statutory requirements and is considered by the Australian Petroleum Production and Exploration Association (APPEA Code of Environmental Practice 1996) and PIRSA to be "good business practice".

The Operator could employ an officer whose duties include:

- early and on-going contact with land owners/occupier;
- advice on the nature and timing of operations;
- the identification and consideration of matters of local concern such as the cutting of fences and access along station property tracks;
- consultations with owners/managers of properties holding organic beef production certification or other certification that requires special entry precautions;
- sources of water and conditions of existing tracks;

- fire prevention;
- responsibility for ensuring that controls to stop the introduction or spread of diseases or non-endemic species are implemented;
- responsibility for ensuring that post-operational clean up and restoration meet the standards agreed to with each landowner/occupier; and
- where appropriate, negotiations for payment of compensation.

Compensation is payable by the Licensee to every person having an interest in the land injuriously affected by operations of the Licensee (Section 62 of the *Petroleum Act 2000*).

The landowner/occupier should be advised if the commencement date for a survey is significantly delayed or modified. In this case, landowner /occupier should be contacted again before a survey is commenced, to ascertain whether local conditions have changed since the time of the initial notification.

CONSULTATION WITH ABORIGINAL PEOPLE

The Cooper and Eromanga Basins are covered by claims for native title. Where native title exists, the holders of such title are considered to be landowners in the context of the preceding sections.

Where there is an agreement with the native title holders/claimants or a determination under the *Native Title Act 1997*, there may be specific requirements and conditions placed on survey operations which may need to be adhered to. It is the responsibility of the Operator to ensure that these requirements are met.

The Division of State Aboriginal Affairs administers the *Aboriginal Heritage Act, 1988* (currently under review). The Act provides protection for Aboriginal cultural and archaeological sites, objects and remains. As part of this protection, the Act allows the Minister to delegate responsibility to Aboriginal people and communities for their sites, objects and remains.

The legislation encourages Operators to directly liaise with Aboriginal people and communities to ensure sites and objects of significance according to Aboriginal tradition are afforded protection. Pending the outcomes of Native Title negotiations and the review of the *Aboriginal Heritage Act 1988*, the Operator should contact PIRSA who will liaise with the Division of State Aboriginal Affairs on the matter.

ENVIRONMENTAL INDUCTION OF EMPLOYEES

The Operator should hold a formal induction of all field personnel prior to the start of field operations. The purpose of the induction is to brief personnel on their responsibilities in terms of their environmental and cultural procedures.

This induction would be an ideal time for the distribution of material that ensures that all personnel involved in the seismic survey understand their role in protecting the environment. Management should stress that protection of the environment is the responsibility of every individual and a requirement for all contractors. Material supplied should provide specific guidance to staff, agents and contractors. The material should also detail the manner in which their activities impact on the environment and give advice on the methods for conducting their operations so that the environmental objectives relating to seismic exploration activities in the South Australian portion of the Cooper and Eromanga Basins are achieved.

ACCESS

Before contract seismic crews enter the Cooper or Eromanga Basins from other operational areas, it is a requirement that all vehicles be adequately cleaned (eg. with steam) to prevent the introduction of non-endemic botanical species (particularly noxious weeds) and diseases eg Mundallah Yellows. Additional cleaning may be necessary before entry into pastoral properties that hold certification for the production of organic beef or other specialised agricultural products. Any quarantine restrictions relating to an area must be strictly complied with.

Access to an area of seismic operations should be made along existing tracks or roads or by way of seismic lines only. Off-line trafficking should be kept to the minimum necessary.

If tracks maintained by pastoralists are used for access, the pastoralist may expect the operator to either effect any repairs for wear and tear or provide for the payment of agreed compensation.

Campsites should be established in locations where the construction of a new access track is not necessary.

SURVEYING

Survey operations should be carried out with the objective of minimising any possible impact on the environment caused by pegging and flagging.

Measures that minimise possible impact include:

- leaving all gates as found (ie either open or shut);
- using vehicles fitted with appropriate fire extinguishers and fire fighting equipment;
- using suitable biodegradable paper flagging (It is good practice to recover all flagging, once the line has been recorded); and
- recovering pin flags and survey pegs other than permanent marks at the end of the survey.

SEISMIC LINE/ACCESS TRACK PREPARATION

Scientific research (eg Moss and Low, 1996; Woodburn and Fatchen, 1999) has shown that of all seismic operations, the location and nature of line/access track preparation is by far the most critical in terms of whether or not there are long term environmental impacts. Therefore seismic lines and access tracks should be carefully planned.

The following objectives, standards and guidelines (where absolute standards cannot be stated) are aimed at minimising impact, and apply to seismic line and access track preparation.

The prime objective is that all lines should be constructed to encourage natural and rapid rehabilitation of the seismic line traversed whilst also providing adequate access for survey equipment. Surface traversing with no line preparation is the preferred option.

Prior to commencing operations, operators of equipment used for line preparation should be trained in line preparation techniques appropriate to this prime objective.

Line widths should be kept to the minimum required for safe operations. This width should not exceed the width of a single bulldozer blade (that is no greater than 5 metres). The clearance of bypasses to allow traffic to pass vehicles operating on seismic lines is not allowed.

Rootstock should be left in place and seed bearing topsoil should not be removed from the seismic line. Isolated trees and clumps of vegetation should be avoided. In any case, perennial vegetation should only be removed when absolutely necessary.

In areas where vegetation consists of extensive stands of perennials, shrubs or trees and these cannot be avoided by using the full tolerances allowed in line placement, vegetation clearance for vehicle access should not be undertaken. Alternative techniques will need to be considered in these cases. For example, it may be appropriate to lay the seismic recording cable by hand and, as the energy source, use explosives placed into hand-augered shotholes.

To reduce the linearity and visual impact of seismic lines, techniques such as weaving around, rather than clearing shrubs, and offsetting sand dune crossings should be employed. The technique of using vegetation and natural features for disguising the line, particularly at line intersections with tracks and roads, should be employed.

Construction of seismic lines less than 100 m apart or multiple tracks should be avoided.

Wherever possible bulldozers should be “walked” along the line. The blade should only be used to create access across vehicular obstacles, such as sand dunes, crabholes in floodplain areas and drainage channels.

In other words, blading should only place take in those areas where the access for vehicles engaged in the seismic recording operations is unsafe or difficult.

On completion of the seismic survey, the material from any windrow created during blading will have to be spread on the surface of the line.

Fences should only be cut where no existing gates are located within reasonable proximity of the proposed seismic line. However, where it is necessary to cut fences to provide access for survey equipment, stock-proof temporary gates are to be erected until permanent repairs are undertaken (Pastoralists may prefer to have a permanent gate placed at point where a fence is cut).

Unless electric fences are easily laid down, they should be avoided by detouring through nearby gates. Where electric fences are located at property boundaries, "step downs" are permitted.

The flow of water in drainage systems should not be restricted, diverted or blocked.

Existing breaks in vegetation should be utilised at line and track intersections. Place doglegs or leave a short section of vegetation intact where a line intersects a road or track.

LAND SYSTEM SPECIFIC LINE PREPARATION PROCEDURES

DUNE FIELDS

If the cutting of sand dunes can not be avoided, the following measures can be implemented:

- limit the amount of cut to the minimum amount to enable vehicle access;
- not ramping sand onto the adjacent swales;
- stock pile sand on the prevailing wind side of the dune cut to enable rapid infilling of the cut;

- cut sand dunes orthogonally as possible (ie at an angle of ninety degrees to the dune) to reduce the length of cut;
- cut each sand dune with the least possible amount of vegetation removal;
- if side cuts are required on dunes, limit them to a depth of 1 metre on red dunes and 0.5 metres for yellow or grey clay-rich dunes;
- minimise visibility along the line by the offsetting sand dune crossings and weaving while still providing reasonable access by survey vehicles;
- cut sand dune ridges to a maximum depth of 2 metres in red dunes and 1 metre in yellow or grey clay-rich dunes; and
- as the likelihood of Aboriginal heritage sites is high on sand dunes located near sources of water, increased vigilance is necessary;

WETLANDS

Seismic line preparation measures specific to wetlands include:

- non-removal of perennial vegetation for vehicular access in thickly vegetated areas;
- keeping channels free of any debris so water flow is not impeded; and
- limiting cuttings at creek crossings to a maximum of 1 metre in depth and not removing any perennial vegetation.

FLOODPLAINS

Seismic line preparation measures specific to floodplains include:

- not impeding or redirecting water flow along seismic lines;
- minimal blading only in rough crabhole areas; and
- the removal of any windrows and rills formed during line preparation or recording;

SALT LAKES

Seismic line preparation procedures specific to salt lakes include:

- testing the surface of the lake for its capacity to support survey vehicles;
- not cutting, rutting or scarring of the salt crust; and
- filling in of any depressions, wheel tracks or shothole craters.

GIBBER PLAINS

Seismic line preparation measures specific to gibber plains include:

- not removing gibber mantle (if the gibber surface is disturbed and rills or windrows are formed then erosional gullies may form);
- not removing perennial vegetation;
- not blocking streamlines with debris; and
- not ripping gibber at road intersections and campsites.

TABLELANDS (BREAKAWAYS)

Seismic line preparation measures specific to tablelands include:

- not permitting vehicle access on areas of steep terrain and detouring around all table land features;
- not removing gibber mantle;
- not removing perennial vegetation;
- not blocking streamlines with debris; and
- not ripping gibber at road intersections and campsites.

SEISMIC LINE RECORDING OPERATIONS

The use of vibrators and other surface energy sources close to any well production facility, gas or oil pipeline, monument, building, heritage item or site or public utility must only occur if the safety and integrity of these facilities is not compromised. A specific written assessment covering the safety of any operations closer than twenty metres should be prepared.

The use of explosives within one hundred metres of any of the above facilities should only take place after a similar assessment process is carried out. In any case, to ensure the safety and integrity of these facilities, a final safety distance should be decided with due consideration of equipment and techniques being employed.

Care should be taken by all vehicles, especially drilling rigs, when operating near to electrical distribution lines or other overhead services to ensure that there is adequate clearance.

Vehicles should pass other vehicles by pulling off the track on existing cleared areas or over vegetation.

Sketch maps (mud maps) should be prepared and distributed to the crew and sign posts erected as necessary to help them adhere to detours.

Offline activity should be kept to an absolute minimum. Where survey lines have been deviated to avoid a sensitive landscape, all vehicle traffic is required to follow the deviated route and not the line-of-sight route. To avoid impact, such sensitive sites should be mapped with specific instructions included for the seismic crew.

Line operations during prolonged periods of wet weather are not allowed, as these are likely to require major restoration works to be undertaken.

All rubbish and work associated debris is to be picked up and disposed of in receptacles carried for this purpose by the crew. All personnel are responsible for ensuring that standards of "good-housekeeping" are maintained while operating on seismic lines.

As line traversing after abandonment is a safety hazard and prevents natural regrowth, the use of seismic lines by tourists and sightseers is to be discouraged. This is especially important in areas of high environmental sensitivity such as the Cooper Creek. If continued use is anticipated after abandonment, the placement of temporary signs, such as "No Access: Plant Revegetation Area", should be discussed with the landowner/occupier.

The Land Manager/Permit Person should make sure that nothing is left in such a hazardous state that it may result in some person or persons having an accident that could result in a subsequent claim for damages.

Existing gates should be used wherever possible and should be left as they are found (ie. open or closed). Where several days are liable to elapse between the various operational phases of the survey, the temporary gates should be checked periodically for stock security.

All temporary markers, particularly steel posts and wooden stakes that could puncture tyres and cause injury to stock should be removed.

SEISMIC LINE RESTORATION

The main objective of this process is that seismic lines are left in such a condition so that they recover to natural variability in the landscape in a relatively short time frame. This is expected to be within eight years. A useful reference, which can be used as a guide to assess the rate of seismic line recovery, is the PIRSA field guide for the goal attainment scaling of seismic lines in the Cooper and Eromanga Basins, South Australia (in prep).

Seismic lines and all other disturbed areas should be cleared of all rubbish and work associated debris such as fuel and oil drums, used grease cartridges, detonator wires and marker pegs (other than permanent markers) before abandonment.

As far as is practicable, lines should be concealed and rendered inaccessible to the public especially where lines cross public roads, and lead to, or are within designated environmentally sensitive areas, such as conservation parks, aboriginal and non-aboriginal heritage sites, water bores and private properties. To enable rehabilitation to occur in particular areas, there may be the necessity to exclude stock. Other restoration techniques used may also include:

- reinstating the initial profile of disturbed areas to match the surrounding landscape;
- tine-ripping, cultivation or blading (whichever is appropriate to the site) of the line either side of an access track or road;
- returning the cleared vegetation to the line where this is possible;
- resspreading of windrow material over the seismic line; and
- ripping significantly compacted soil to provide seed and water catchment for native vegetation (NB: No ripping in gibber areas.)

Where fencelines, gates, station tracks or other improvements are inadvertently damaged the landowner/occupier should be advised immediately. The method of repair should be agreed to and undertaken without delay. The landowner/occupier should be advised and given the opportunity to examine repairs before the final departure of the seismic survey contractors on completion of the program.

Temporary repairs should be carried out immediately in all instances. This is very important on a property where an infectious disease is present or a property holds organic beef production or other certification.

To this end:

- the Land Manager/Permit Person should negotiate and finalise compensation/restoration with the minimum of delay (Section 62 the *Petroleum Act, 2000*); and
- the Operator should undertake agreed restoration and make good any damage as soon as practicable. A final inspection should be made with the landowner/occupier of all station tracks, gates, fencelines, campsites and operational sites to ensure that they have been left in an acceptable condition.

UPHOLES/SHOTHOLES

Drilling operations should be carried out with due consideration of the possible impact of drilling muds and fluids on the environment. This is especially important when drilling on properties that are certified to produce organic beef that is free from any chemical contamination. If chemicals are present in drilling muds, any residue should be completely removed from the property.

Upholes/Shot holes should be located to the side of the survey line and back-filled and compacted after firing.

USE OF EXPLOSIVES

All users of explosives on seismic crews should be familiar with and comply with:

- *Explosives Act, 1936–1982*, and Regulations;
- IAGC Safety manual; and
- Regulations under the *Occupational Health, Safety and Welfare Act, 1986*.

The size of the charge used and the depth at which it is placed should be determined so that no surface impact results from detonation. The final safe distances should be determined with due consideration given to charge size, depth of hole, shooting conditions and techniques employed.

Explosives should not be used down hole within 100 metres of any building, pipeline, wellhead, and water bore or pastoral fixture unless such an activity has been specifically addressed in the Statement of Environmental Objectives for the activity and has the agreement of the facility owner.

Unused explosives should be returned to the storage magazine each day.

The accepted minimum distance of “upholes” (using a down hole geophone and a weight drop at the surface as a source) is 20 metres from any building, pipeline, wellhead, water bore or pastoral fixture.

SHOTHOLE/UPHOLE RESTORATION

Measures to restore shot holes and up-holes and the cave-ins or damage caused by any explosives used to as near as possible to the original state include:

- plugging with unsaturated, unconsolidated fill;
- using a "Tiger Paw" or similar plug inserted about 2 metres from the surface before completing the back filling and tamping of the shot hole – paying particular attention to areas frequented by livestock;

- spreading any drilling muds and drill cuttings not used for backfilling on the adjacent seismic line or track; and
- removing all litter such as pegs, detonator wire and firing line from the site.

AQUIFER CONTAMINATION PREVENTATIVE PROCEDURES

The proper containment of any aquifer intercepted by drilling is an essential element of good oilfield practice.

Any queries regarding aquifer intersection, broaching or plugging can be made to the Department of Water Resources Drilling Inspector, Adelaide Office Phone (08) 8463 3174. In any case, any instance of artesian water interception should be reported to the landowner/occupier and PIRSA.

Measures to protect aquifers, include the setting of a down hole cement plug sufficient to prevent any flow from a broached aquifer or contamination of it from another aquifer. The plug should be placed immediately after the hole is logged.

CAMPSITES

The following requirements are applicable to all campsites. All activities should be planned with the objective of causing minimal disturbance to the environment particularly with regard to the prevention of pollution and protection of fauna and flora.

SELECTION

Measures to achieve the objective of causing minimal disturbance include locating campsites:

- as near as practical to existing access tracks or roads, to avoid the need for the clearance of native vegetation and subsequent disturbance to animal habitats;
- wherever possible on previously disturbed areas;
- on well drained ground away from all major water courses, creeks, wells and pastoral property infrastructure (such as bores, dams and homesteads); and
- not near sites of known natural, scientific, Aboriginal or non-Aboriginal heritage significance.

PREPARATION

Land clearance for campsites is not permitted in the Cooper or Eromanga Basins.

Earth drains for the disposal of liquid waste from the ablution or kitchen facilities should only be required for campsites, which are intended to occupy a site for an extended period of time.

It is preferable to remove liquid waste from ablution and kitchen facilities by way of canvas hoses to a flagged off area down slope from the campsite.

If earth drains and pits are required they should be constructed in such a manner as to:

- allow for rapid infiltration;
- prevent discharge of waste waters to creeks and surface waters; and

- be of an adequate size to ensure that water is directed away from areas frequented by camp personnel and vehicles.

If pits are required for the disposal of sewage and biodegradable domestic waste, they should all be of a size sufficient to contain all waste and allow for burial to a minimum depth of one metre. Pits should only be used when it is impracticable to remove waste to an approved public refuse pit.

OPERATION

The overarching objective is that all waste should be disposed of in a safe, efficient and environmentally conscious manner.

Waste water from drains leading from the kitchen and ablution vans should be emptied to earth pits dug specifically for this purpose.

All non-biodegradable waste such as litter, rubbish, industrial oils, cooking fats and oil, chemicals and fuel should be removed from the campsite.

Areas should be set aside for the specific purposes of vehicle parking, engine and vehicle maintenance so that any spillage of oil, grease and fuel is spatially confined for ease of site restoration. All waste sump oil should be retained for proper disposal and not discharged on the ground.

Adequate and properly maintained fire-fighting equipment should be present at the campsite and all fires and ignition sources should be controlled.

RESTORATION

Measures to enable the area to be returned to its prior condition include:

- ripping areas of ground which have been compacted or where accidental oil spillage has occurred. (If campsites are located in gibber areas, ripping will only be warranted in exceptional circumstances); and
- removing all rubbish.

FIRE PREVENTION

Seismic crews should be fully aware of the potential for fire that may apply to the area in which work is being performed. Fire-fighting equipment, training and procedures should be the responsibility of the Operator.

Measures to aid the prevention of fires include the:

- provision of appropriate fire-fighting equipment at all work sites;
- training of personnel in fire fighting procedures;
- fitting of all vehicles and other machinery with fire extinguishers, which comply with the relevant Australian standards.
- fitting of all vehicles with an efficient exhaust system free from leaks and, where appropriate, spark arresters; and
- regular inspection of the underneath of vehicles and the removal of any collected flammable material.

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Appendix A

ENCLOSURE 1

HANDOUT SHEETS

Summaries of some environmental responsibilities

**SUMMARY OF SOME OF THE OPERATOR'S TECHNICAL
REPRESENTATIVE'S (BIRD DOG)
ENVIRONMENTAL RESPONSIBILITIES**

- Maintain ongoing liaison with permit person.
- Ensure that prior to commencing work in the survey area, all field personnel receive a formal induction which includes notification of the environmental objectives.
- Ensure that contractors and their employees are adequately supervised so that the operator's environmental objectives are achieved.
- Ensure that regulatory requirements, including any specific conditions contained in the approval of the survey, are complied with.
- Ensure that no pets, firearms, traps and nets are kept by seismic contractors and their employees whilst in the operator's exploration licence area.
- Ensure that contractors' vehicles have been thoroughly cleaned (preferably with steam) to prevent the introduction of weeds to the survey area.

SUMMARY OF SOME OF THE PERMIT PERSON'S ENVIRONMENTAL RESPONSIBILITIES

- Undertake early and on-going contact with the land owners/occupier to identify matters of local concern including:
 - access through fence lines
 - any quarantine restrictions (for example on properties holding organic beef production certification)
 - sources of water
 - condition of existing tracks
 - ensuring that the post-operational clean up meets the standards agreed to with land owners/occupier.
- Inform the land owners/occupier of any delays to the start of the survey, and confirm that there has not been any alteration to the conditions existing at the time of the first meeting.
- Maintain ongoing liaison with company bird dog.
- Use existing gates wherever possible and leave them as found.
- Discourage the use of seismic lines and access tracks by unauthorised personnel.
- Liaise with appropriate Aboriginal people and communities to ensure that sites and objects according to Aboriginal tradition are afforded protection.
- Notify PIRSA, Aboriginal traditional owners and the Division of State Aboriginal Affairs if any cultural objects or remains are located.
- Ensure that the requirements under any native title agreement are adhered to.
- Do not keep firearms, traps, nets and pets whilst on a seismic survey.

SUMMARY OF SOME OF THE SURVEYORS' ENVIRONMENTAL RESPONSIBILITIES

- Leave all gates as you find them (ie either open or shut).
- Be aware of any fire restrictions and wildfire dangers that may apply in the area where the survey is taking place.
- Ensure that your vehicle is fitted with appropriate fire fighting equipment.
- Use Biodegradable paper flagging in preference to plastic flagging tape.
- Retrieve all pin flags and survey pegs - other than permanent survey marks - at the end of the survey.
- Notify the supervisor, bird dog or permit person if any Aboriginal sites cultural objects or remains are located.
- Prepare chainage diagrams (maps), which clearly show any sensitive areas to be avoided by the recording crew.
- Ensure all deviations and detours are clearly signposted.
- Do not keep firearms, traps, nets and pets whilst on a seismic survey.

**SUMMARY OF SOME OF THE LINE PREPARATION
EQUIPMENT OPERATORS'
ENVIRONMENTAL RESPONSIBILITIES**

- Ensure that you have been trained in the techniques necessary to prepare seismic lines with the least possible environmental impact.
- Ensure that you know and use the different line preparation techniques required in sand dune, floodplain, wetland, salt lake, gibber plain and table land areas.
- Notify the supervisor, bird dog or permit person if any Aboriginal cultural or heritage sites, objects or remains are located.
- “Walk” your dozer to mark the line and only drop your blade if necessary to create access for seismic vehicles across obstacles such as sand dunes, drainage channels and crabholes in floodplain areas.
- Wherever possible, rootstock is to be left in place and seed-bearing topsoil is not to be removed from the seismic line.
- Remove perennial vegetation only when absolutely necessary.
- Avoid clearing vegetation in areas of extensive stands of perennial shrubs or trees.
- Use techniques such as weaving around shrubs and offsetting sand dune crossings reduce the linearity and visual impact of seismic lines.
- Do not prepare seismic lines wider than 5 metres (ie a single bulldozer blade width).
- Do not restrict, divert or block the flow of water in creeks, rivers or water holes.
- Place doglegs at seismic line/road intersections (to discourage use by tourist’s etc).
- Do not keep firearms, traps, nets and pets whilst on a seismic survey.
- Be aware of any fire restrictions and fire dangers that may apply in the area where the survey is taking place.

**SUMMARY OF SOME OF THE EXPLOSIVE HANDLERS'
(UPHOLE AND SHOTHOLE) ENVIRONMENTAL
RESPONSIBILITIES**

- Ensure that you are aware and comply with legislation such as the *Explosives Act 1936-1982*, International Association of Geophysical Contractors (IAGC) Safety Manual and Occupational Health and Safety regulations.
- Be aware of any fire restrictions and fire dangers that may apply in the area where the survey is taking place.
- Ensure that final safety distances are determined by considering charge size, depth of hole and shooting conditions.
- Do not use explosives within 100 metres of any building, pipeline, well head or pastoral fixture.
- Ensure that the charge size and the depth of the charge in the hole are determined so that no surface impact results when the charge is detonated.
- Ensure that shotholes are located to the side of the seismic line and after the charge is fired are backfilled and suitably plugged with dry unconsolidated fill and the disturbed area restored as near as possible to its original state.
- Ensure electric fences are turned off before handling explosives in their vicinity.
- Remove all rubbish and work associated debris such as wooden pegs, rags, flagging tape and detonator wires prior to abandonment.
- Do not keep firearms, traps, nets and pets whilst on a seismic survey.

**SUMMARY OF SOME OF THE RECORDING CREW'S
ENVIRONMENTAL RESPONSIBILITIES**

- Do not operate vibrators and other surface energy sources within 20 metres of any gas or oil pipeline or building.
- Do not use explosives within 100 metres of any building, pipeline, well head or pastoral fixture.
- Notify the supervisor if any Aboriginal heritage or cultural sites, objects or remains are located.
- Where cables are laid across a public road, place warning signs advising vehicles to slow down.
- Line operations in wet weather are not allowed.
- All rubbish and work associated debris is to be picked up and disposed of in containers carried by the crew for this purpose.
- Keep offline activity to an absolute minimum and keep all vehicles within the confines of the prepared line.
- Use existing gates wherever possible and leave them as they are found (ie. either open or closed).
- Report any damaged fences or gates to the bird dog.
- Ensure that vehicles carry adequate fire fighting equipment (including a fire extinguisher).
- Do not to keep firearms, traps, nets and pets whilst on a seismic survey.

**SUMMARY OF SOME OF THE DRILLING CREW'S
(UPHOLE AND SHOTHOLE)
ENVIRONMENTAL RESPONSIBILITIES**

- If explosives are intended to be used as the energy source, ensure that drillholes are not drilled within 100 metres of any building, pipeline, wellhead or pastoral fixture.
- Ensure that upholes intended to be used for a downhole geophone and weight drop as an energy source are drilled no closer than 20 metres from any pipeline or well.
- If during drilling operations, artesian water is intercepted, the landowner/occupiers and PIRSA are to be notified immediately. After logging the hole, insert a cement plug sufficient to prevent water flow from the breached aquifer.
- Ensure that vehicles carry adequate fire fighting equipment (including a fire extinguisher).
- Keep off-line activity to a minimum (NO SHORT CUTS!). All line deviations are to be followed. Leave all gates, as they are found (ie either open or shut).
- Ensure there is adequate clearance by drilling rigs, when operating near electrical distribution lines or other services.
- Only use water from a source, which has the approval of the land owners/occupier. If in doubt, check with the permit person or bird dog.
- Do not keep firearms, traps, nets and pets whilst on a seismic survey.

SUMMARY OF SOME OF THE REHABILITATION CREW'S ENVIRONMENTAL RESPONSIBILITIES

- Remove all rubbish and work-associated debris, including wooden pegs and pin flags, fuel and oil drums, used grease cartridges, rags, flagging tape, and detonator wires.
- Discourage third party use of seismic lines by reforming the roadside verge and tine-ripping each side of the road for a distance of at least 100 metres to disguise seismic line intersections with roads and tourist access routes.
NB – No ripping in Gibber Areas.
- Spread any vegetation removed during line preparation across the line.
- Remove any windrows or rills (in areas other than sand dune crossings) from the edge of the line and spread the material over the line.
- Plug shot holes and upholes with dry unconsolidated fill and a “Tiger Paw©” or similar plug inserted at about 2 metres from the surface before completing the back filling and tamping of the hole.
- Widely disperse any drill cuttings or drilling mud residue remaining after the hole is backfilled and tamped to the surface.
- Totally remove the residue of drilling muds, which contain non-organic chemicals, from properties that are certified to produce organic beef.
- If any artesian water is flowing from the drillhole, PIRSA is to be notified immediately and a downhole cement plug inserted that is sufficient to prevent water flow from the breached aquifer.
- Remove all rubbish from campsites.
- Rip compacted areas and areas where oil spills have occurred to a depth of at least 500 mm. (Campsites located in gibber areas are not to be ripped).