VICTORIA PETROLEUM N.L.

Cooper Basin Petroleum Production Operations

Environmental Impact Report

September 2008

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DOCUMENT CONTROL SHEET ENV689 – Victoria Petroleum Production Operations EIR						
Document reference	**Revision No.**	**Revision date**	**Compiled by**	**Checked by**	**Approved by**	**Comment**
689-EIR	A	31Oct06	ZB	SM	SM	Issued to client for review
	B	28 May 07				Incorporation of Client review
	C	18 April '08		CML		Edit to draft stage & sent to PIRSA for review
	0	08Oct08	ZB	SM	ZB	Incorporation of feedback from Regulators. Issued for use

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1 Introduction

Petroleum production operations in South Australia are administered under the *Petroleum Act 2000* by the Department of Primary Industries and Resources (PIRSA).

This document fulfils the requirements of an Environmental Impact Report (EIR) for Victoria Petroleum's production operations and has been prepared in accordance with current legislative requirements, in particular, with Section 97 of the South Australian *Petroleum Act 2000* and Regulation 10 of the Petroleum *Regulations 2000*. The Act and Regulations also require the development and implementation of a Statement of Environmental Objectives (SEO). A draft SEO has been prepared in conjunction with this document.

This EIR addresses Victoria Petroleum's current production operations (including extended production testing) in the South Australian Cooper Basin and has been written to address activities that are likely to occur in the future. The scope of this EIR is discussed in Section 1.2.

1.1 Victoria Petroleum

Victoria Petroleum is an Australian Company based in Perth, Western Australia and listed on the Australian Stock Exchange. A comprehensive review of Victoria Petroleum's activities and operations is available in the annual and quarterly reports, http://www.vicpet.com.au/reports

1.1.1 Cooper Basin Operations

Victoria Petroleum holds a number of Petroleum Exploration Licences (PELs) either in its own right or with Joint Venture partners in the South Australia Cooper/Eromanga Basin. I

Victoria Petroleum has interests in PEL areas PEL 87, 104, 111, 115 and 424 (a consolidation of PEL 86 and PEL 89) Victoria Petroleum operates these PELs on behalf of the companies that make up the Joint Ventures (refer Table 2).

Following the discovery of the Mirage and Ventura Oil Fields in PEL 115 in late 2004, Victoria Petroleum began producing oil at the two wells under extended production testing approvals under PEL 115 in these fields. Subsequently, PPL 213 (Mirage) and PPL 214 (Ventura) were issued. Additional development drilling at Mirage saw Mirage #3 and #4 commence production in 2006.

An extended production test at Growler #1 and #2 wells in PEL 104 commenced in March 2008. PRL 15 has been offered over the Growler field and will be granted in due course.

Figure 1: Location Map-PPL 213 & PPL 214 (excluding PEL 115)

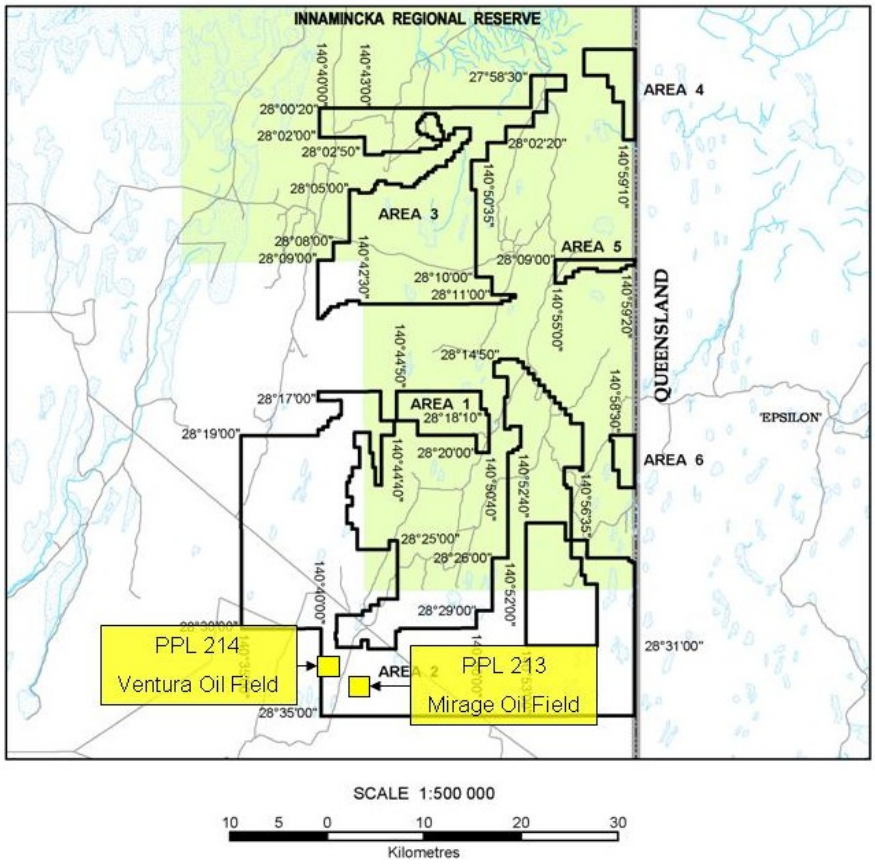


Figure 2: Location Map-PRL 15 (excluding PEL 104)

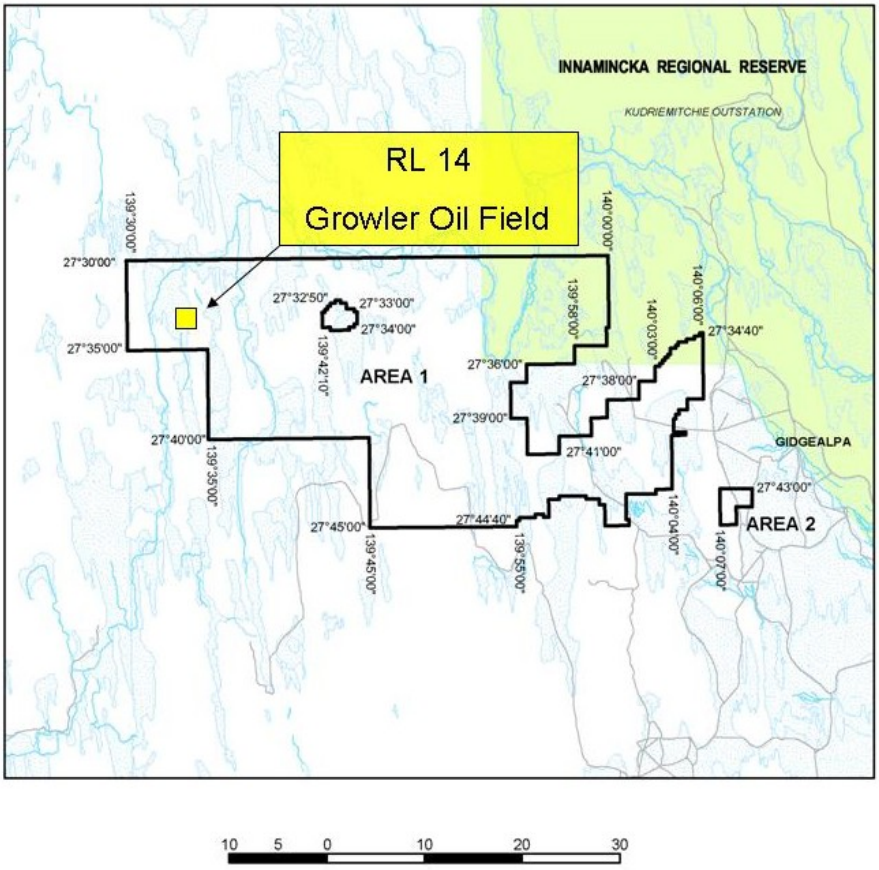


Table 1: Victoria Petroleum Operations as at March 2008

PEL	Total Area	Location	Wells	Production Activities*
87 & 424	9,000 km²	Lie to the north and west of permits PEL 104, PEL 111 in the north-west Cooper Basin.	Nil	None at present
104	1,068 km²	Immediately adjacent and to the west of Tirrawarra Oil Field	Growler-1, 2 (producing) Wirraway-1 (shut-in)	None at present
PRL 15 (pending)	10km^2	Northwest corner of PEL 104	Growler-1, 2 (producing)	EPT of Growler-1 & 2 in progress
111	1,178 km²	Lies to the north of and adjacent to PEL 104.	Ascender-1 (P&A)	None at present
115	1,116 km²	On the south-eastern edge of the Cooper Basin. The permit is comprises six separate areas and surrounds the oil and gas producing fields at Dullingari, Toolachee, Strzelecki, Della and Narcoonowie.	Hornet-1 (C & S) Canberra-1&1A (P & A) Lightning-1 (C & S) Jindivik-1 (P & A) Lancer-1 (P&A)	None at present
PPL 213	10 km²	South of Narcoonowie	Mirage-1, 3, 4 (Producing) Mirage -2 (Shut-in)	Mirage Field *
PPL 214	2 km²	South of Narcoonowie	Ventura-1 (Producing)	Ventura Field *

*Technical details of production operations at these sites are provided in Section 3

Table 2: Joint Venture Partners for PELs 87, 89, 104, 111, 424; PPLs 213 & 214; PRL 14 (as at April 2008) operated by Victoria Petroleum

Licence Holder	Interest
Victoria Oil Exploration (1977) Pty Ltd*	40%
Permian Oil Pty Ltd	20%
Springfield Oil and Gas Pty Ltd	27.5%
Impress (Cooper Basin) Pty Ltd	12.5%

Victoria Petroleum also holds 100% of PEL 115.

Victoria Petroleum also undertakes exploration activities (e.g. seismic, survey, drilling) within the Cooper Basin, which are carried out under separate SEOs.

1.1.2 Environmental Management

Victoria Petroleum is committed to conducting all its operations and activities in an environmentally sound and responsible manner. Victoria Petroleum will conduct its activities to ensure compliance with all applicable laws, regulations and standards and the protection of the environment from pollution and damage.

Victoria Petroleum's commitment is outlined in the Environmental Policy (refer Appendix 1).

Victoria Petroleum's Environmental Management System (EMS) provides the framework within which environmental responsibilities in South Australia are managed. The EMS is based on the standard

ISO 14001[1] and seeks to provide guidance on managing the environmental aspects and consequences of Victoria Petroleum's operations.

Further information on the Victoria Petroleum EMS is provided in Section 6.

1.2 About this Document

This document is an Environmental Impact Report (EIR) as defined under Section 97 of the *Petroleum Act 2000* and Regulation 10 of the *Petroleum Regulations 2000* (refer Section 2.1) and has been prepared in conjunction with the development of Victoria Petroleum's *Cooper Basin Petroleum Production Operations Statement of Environmental Objectives*.

This document is based on a number of existing EIRs, including the *South Australian Cooper Basin Joint Venture Environmental Impact Report: Production and Processing Operations* (Santos 2003), and the Beach Petroleum *Environmental Impact Report for Cooper Basin Petroleum Production Operations* (Beach 2003).

Generic information in this report has been based on the Environmental Impact Report (EIR) developed by Santos Ltd for production and processing operations in the Cooper Basin (Santos 2003). Santos is the predominant organisation in oil and gas exploration and production in the Cooper Basin and Victoria Petroleum's production operations are generally analogous to a small subset of Santos' operation. Consequently, the information on environmental risks and consequences gathered over more than 30 years of operations in the Cooper Basin that is presented in the Santos EIR provides excellent baseline information for this EIR and is not duplicated in this report.

1.2.1 Scope

This EIR addresses potential environmental risks and consequences associated with Victoria Petroleum's production operations in the Cooper and Eromanga Basins. It has been written to address both current and potential future production activities in all land systems in the Cooper Basin, in order to develop a SEO that will address reasonably foreseeable future activities. .

Changes to production operations in the future (e.g. production at new sites) will need to be assessed against this EIR and the SEO to demonstrate that the EIR and SEO are applicable. This assessment would be submitted to PIRSA as a component of the Activity Notification, as required by Regulations 19 and 20 of the *Petroleum Regulations 2000* for operators such as Victoria Petroleum who are classified as high-level official supervision. In some cases it may be necessary to produce a bridging document or brief EIR to supplement this EIR if it does not adequately address risks and consequences associated with the change.

The sites addressed specifically in this EIR are located on pastoral leases and the Innamincka Regional Reserve. While risks and consequences of production operations are not different inside Regional Reserves, any future production operations inside Regional Reserves will require additional approval of the Production Licence from the Minister for Environment and Conservation.

Victoria Petroleum activities that are specifically covered by this EIR include:

- production facility construction, operation, maintenance and abandonment (including extended production testing facilities)
- formation water disposal construction, operation, maintenance and abandonment
- flowline construction, operation, maintenance and abandonment
- road construction, operation, maintenance and abandonment
- oil spill risk, spill site restoration and emergency response
- waste management and land treatment.

[1] AS/NZS ISO 14001:1996 Environmental management systems – Specification with guidance for use.

This EIR and SEO do not apply to exploration activities, drilling activities and sub-surface well/reservoir infrastructure. These activities are covered by:

- *Statement of Environmental Objectives: Geophysical Operations* (Santos 2006).
- *Cooper Basin Operators Drilling and Well Operations SEO* (Santos 2003a).

Consequently the following activities are excluded from this EIR and SEO:

- well site and access track construction
- drilling
- well completion
- pre-wellhead production
- artificial lift (including beam pumps, jet pumps and electronic submersible pumps)
- down hole abandonment
- restoration of well sites and access tracks
- seismic operations.

2 Legislative Framework

This section briefly describes the legislative framework for petroleum licensing in South Australia.

2.1 Petroleum Act 2000

Petroleum production activities are governed by the *Petroleum Act 2000*. The key objectives of the *Petroleum Act 2000* are:

- to protect the natural, cultural, heritage and social aspects of the environment from risks associated with activities governed by the Act
- to provide for constructive consultation with stakeholders, including effective reporting of industry performance to other stakeholders, and
- to provide security of title for petroleum, geothermal energy, and other resources governed by the Act and pipeline licenses.

Environmental Impact Report

As a requirement of the *Petroleum Act 2000* and *Petroleum Regulations 2000*, Victoria Petroleum is required to submit an EIR for South Australian Cooper Basin production operations.

In accordance with Section 97 of the Act, the EIR must:

- take into account cultural, amenity and other values of Aboriginal and other Australians in so far as those values are relevant to the assessment
- take into account risks inherent in the regulated activities to the health and safety of the public, and
- contain sufficient information to make possible an informed assessment of the likely impact of the activities on the environment.

As per Regulation 10 of the Petroleum Regulations 2000 the EIR must include:

- a description of the activities to be carried out under the licence
- a description of the specific site features of the environment that can reasonably be expected to be affected by the activities
- an assessment of the cultural values of Aboriginal and other Australians
- identification and assessment of foreseeable environmental hazards that could potentially be associated with the activities (including events during the construction, operational and abandonment stage as well as atypical events)
- an assessment of the potential consequences of environmental hazards on the environment (extent, duration and proposed mitigation measures)
- an explanation of the basis on which the consequences of hazards have been predicted
- information on consultation undertaken during the preparation of the EIR.

Statement of Environmental Objectives

Part 12 of the Act requires that an approved SEO must be in place before Victoria Petroleum can conduct a regulated activity. A draft SEO has been submitted in accordance with this regulation and has been developed on the basis of information provided in this EIR. The SEO outlines the environmental objectives that the regulated activity is required to achieve and the criteria upon which the objectives are to be assessed.

Assessment and Approval

Once the EIR (and accompanying SEO) is submitted to PIRSA, the agency assesses the document as to whether the activities are to be classified as low, medium or high impact. This in turn determines the level of consultation required prior to final approval of the SEO.

- **Low Impact activities** do not require public consultation, and an SEO may be approved after internal government approval.
- **Medium Impact activities** require a public consultation process for the EIR and proposed SEO, with comment sought for a period of at least 30 business days.

- **High Impact activities** are required to be assessed under the provisions of the *Development Act 1993*.

The level of impact of a particular activity is assessed on the basis of the predictability and manageability of the impacts on the environment. Where the environmental impacts are predictable and readily managed, the impact of the activity is considered low. Where the environmental impacts are less predictable and are difficult to manage, the impact of the activity is potentially high.

Regulated production activities that are carried out in the Innamincka or Strzelecki Regional Reserves must also be formally approved by the Minister for Environment and Conservation.

Once the approval process is complete, all documentation, including the EIR and final SEO, must be entered on an environmental register. This public register resides on the PIRSA internet so that community access is readily available, which will facilitate an openness, transparency and accountability in the decision making process (McDonough, 2000).

2.2 Other Legislation

A number of additional environmental approvals may be required under Commonwealth and South Australian legislation. These are outlined in Table 3.

It must be noted that not all subsequent approvals are mandatory at the development (or construction) stage, as approvals may be required as circumstances arise (for example cultural artefact finds during construction or operation).

Native Title is discussed further in Section 4.4.

Table 3: Additional Environmental Approvals

Agency	Legislation	Issue
Commonwealth		
Department of the Environment, Water, Heritage and the Arts (Approvals and Wildlife Division)	*Environment Protection and Biodiversity Conservation Act 1999*	Assessment and approval required if activities will significantly impact matters of national environmental significance, including: ▪ Natural Heritage Places ▪ wetlands of international importance (Ramsar wetlands) ▪ listed threatened species and communities, and ▪ listed migratory species (for example JAMBA and CAMBA)
Commonwealth	*Native Title Act 1993*	Intersection of registered Native Title claims
South Australia		
Environment Protection Authority (EPA)	*Environment Protection Act 1993*	▪ General environmental duty to avoid causing environmental harm ▪ Establishment of landfill site for waste disposal ▪ Transport of prescribed wastes or substances ▪ Storage or production of large volumes of petroleum (2000m^3 storage or 20 tonnes per hour production)
Department of the Premier and Cabinet (Aboriginal Affairs and Reconciliation Division).	*Aboriginal Heritage Act 1988*	Permission to destroy Aboriginal relic
Department for Environment and Heritage (DEH)	*Heritage Places Act 1993*	Permission to destroy/disturb archaeological relic
DEH	*National Parks & Wildlife Act 1972*	Undertaking regulated activities in Regional Reserves Protection of listed species under Schedule 7-9 of the Act
Department for Water, Land and Biodiversity Conservation (DWLBC)	*Native Vegetation Act 1991*	Removal of native vegetation and achievement of significant environmental benefit (SEB)
DWLBC	*Natural Resources Management Act 2005*	Sourcing water
PIRSA	*Mining Act 1971*	Borrow pits
Attorney-General	*Native Title (South Australia) Act 1994*	Intersection of registered Native Title claims

3 Production Operations

This section provides a technical description of production operations that are currently being or likely to be carried out by Victoria Petroleum in the Cooper Basin.

3.1 Production Facilities

Victoria Petroleum currently has three oil producing facilities in the Cooper Basin, located at Mirage, Ventura and Growler (as indicated in Figure 1,and Figure 2). The Mirage facility is receiving oil from three wells and the Ventura facility is receiving oil from one well. The Growler facility is receiving oil from two wells. With the drilling of additional wells in these fields, additional production infrastructure, including flowlines, may be installed. Additional production facilities may be installed in the future at successful drilling locations.

In the future, oil may also be transported from production facilities by pipelines. The facility would then include oil transfer pumps and piping to load oil into the pipeline. The transmission pipeline itself would require additional approval under the *Petroleum Act 2000* if it traverses land not covered by a production licence (e.g. approval under an Associated Facilities Licence or Pipeline Licence).

A typical oil production facility consists of:

- gathering and manifold system from the oil well(s)
- inlet manifold system
- water separator tank(s)
- skimmer tank
- processed oil storage tanks
- oil transfer pumps
- tanker loading area
- drains and sump
- utilities (instrument air, electric power generation, fuel gas and fuel oil systems) at selected facilities
- office, amenities and accommodation block (at selected facilities)
- telemetry and communications system
- emergency shutdown and control systems
- waste water treatment facilities, including interceptor pits, holding ponds and evaporation ponds
- chemical injection system for corrosion prevention and emulsion breaking
- lined and bunded tanker load-out area
- perimeter fencing.

Electrical power for the facility and the nearby oil fields is provided by electrical generation equipment at the site.

Potable water for the Mirage and Ventura facilities is currently obtained Moomba. Potable water for the Growler facilities is currently obtained from Moomba however in the future it may be obtained from a local pastoral bore. Appropriately licensed water bores may be installed at facilities in the future.

Artificial lift (e.g. rod pumps, jet pumps and electric submersible pumps) may be used on oil wells. Consequently, pumps and high pressure flowlines may be located within the boundary of a production facility. Flowlines are covered by this document, but artificial lift is addressed in the Drilling and Well Operations EIR and SEO (Santos 2003a, b). Figure 1: Location Map-PPL 213 & PPL 214 (excluding PEL 115)Figure 1 shows the location of the Mirage and Ventura facilities. Figure 3, Figure 4 and Figure 5 show schematic layouts of the production facilities. Photos of the facilities and surrounds are provided in Section 4.2.

In the event that additional or new facilities are required, the facilities will be located, where possible on previously disturbed ground. The majority of facilities are usually located on pre-existing drill pads or adjacent to producing wells. This assists in minimising the extent of any additional earthworks and allows existing access tracks to be utilised. However sometimes an additional area may need to be cleared and/or fill imported to provide for facility foundations or bunds.

3.1.1 Processes

The oil produced at Victoria Petroleum's wells is typical of light (API 40-60) Cooper Basin crude.

Oil well site facilities receive fluids from oil producing well(s), separate the gas and water from the oil, and then transfer the processed oil to storage tanks. This oil is currently transported by truck from the facility. Currently, oil from all the fields is transported to Moomba and sold to the South Australian Cooper Basin JV partners.

The water content of fluid produced from an oil well can vary from 0% to 100%. The water content of Victoria's fields typically varies between nil and 70%. Based on Victoria Petroleum's current and expected production rates, the volume of liquid removed at a production facility could potentially range up to 1000 bbls per day.

Management of produced formation water, domestic and other wastes, contaminated soil and temporary product storage pits are discussed in Sections 3.2 and 3.6.

Figure 3: Schematic layout of the Mirage Production Facility

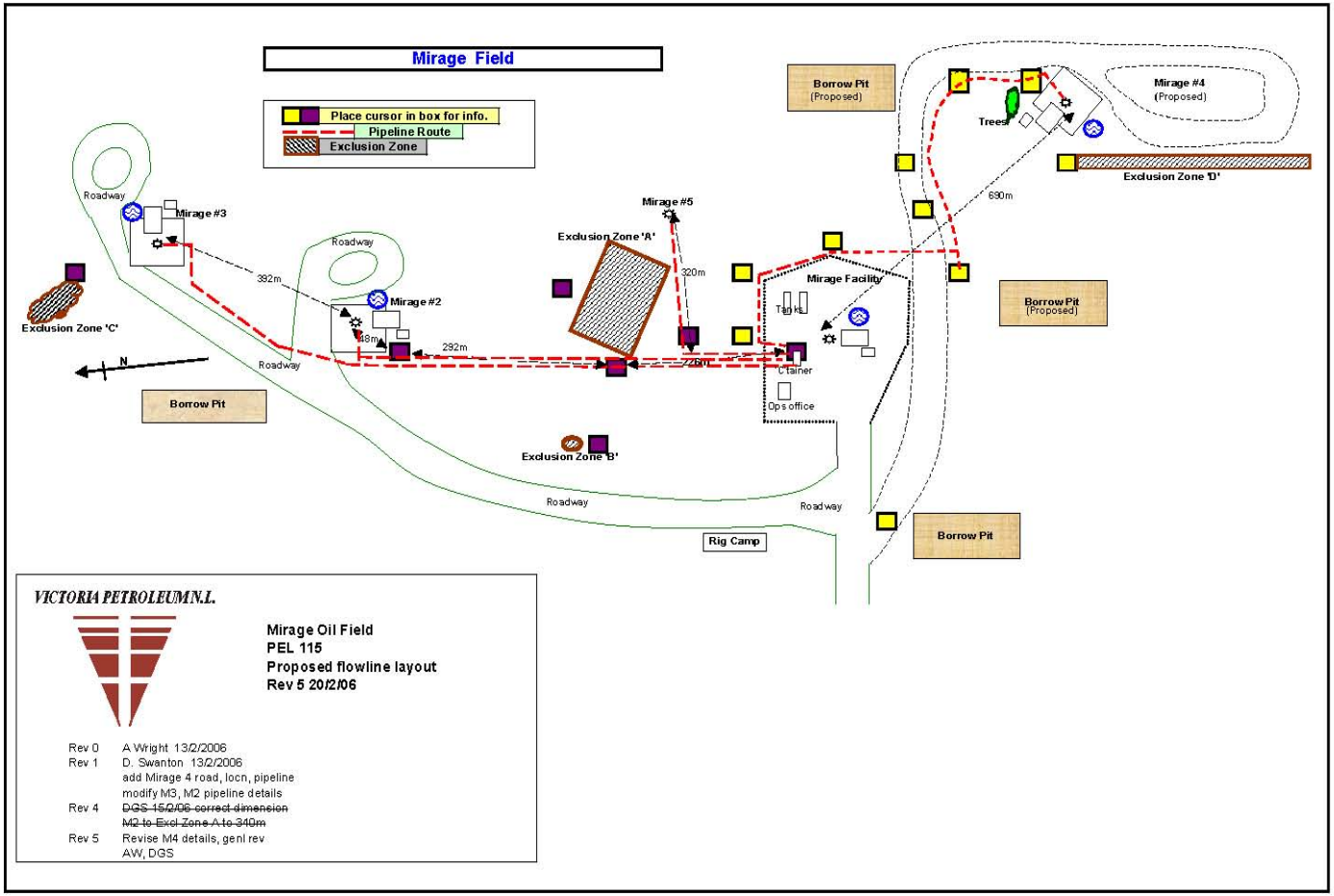


Figure 4: Schematic layout of the Ventura Production Facility

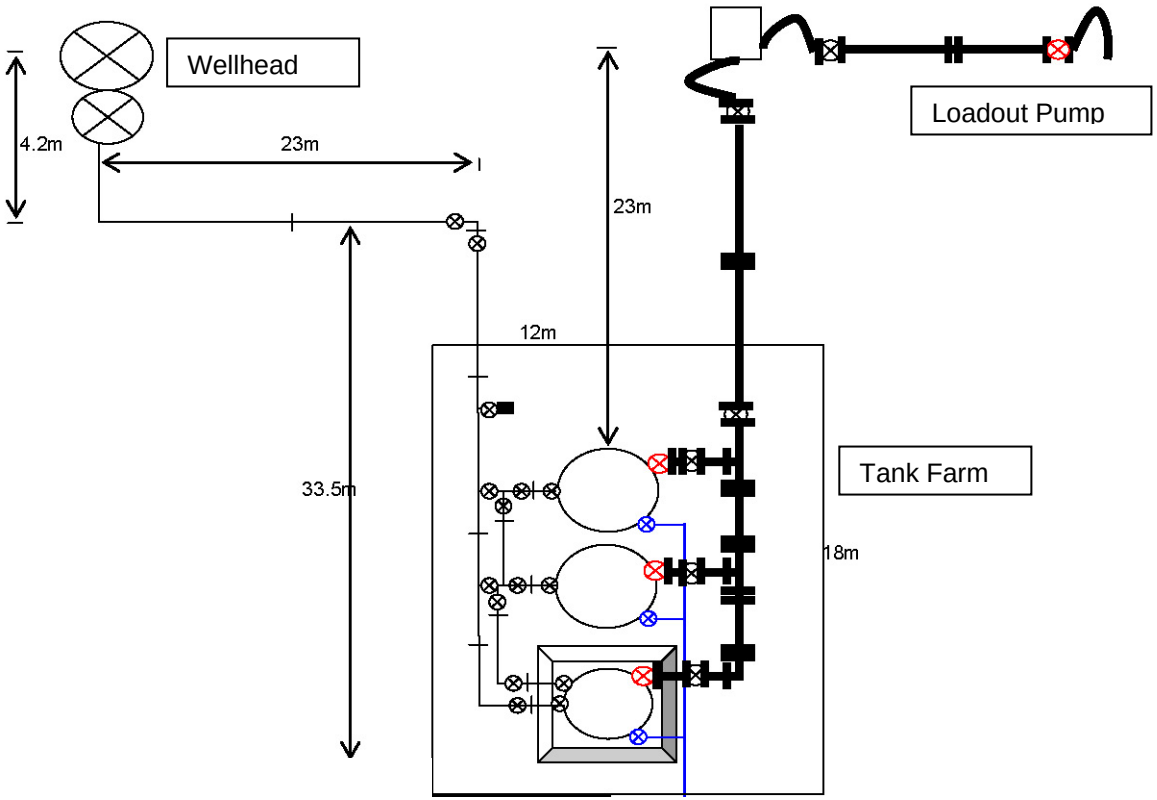
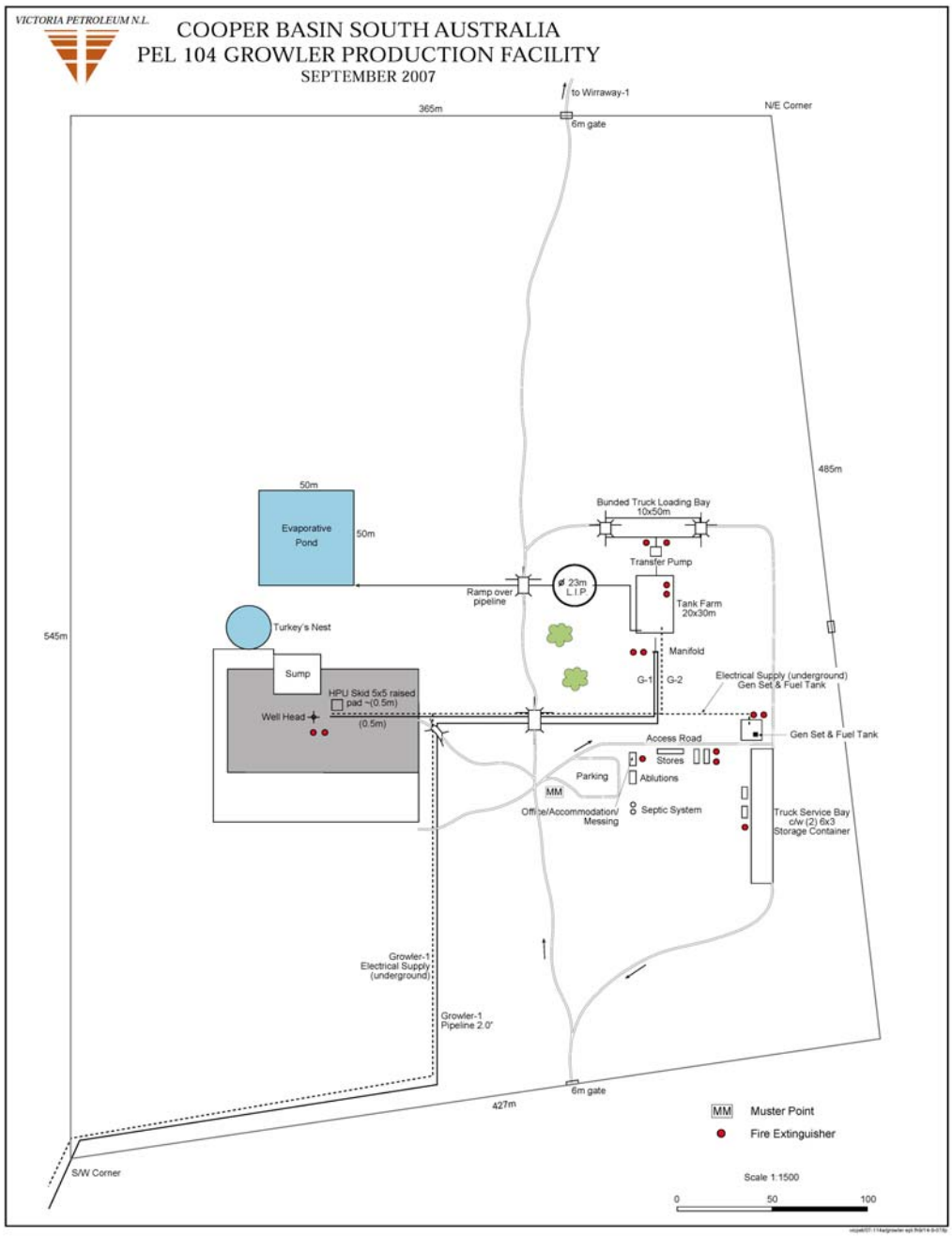


Figure 5: Schematic layout of the Growler Production Facility



3.2 Produced Formation Water

When oil is pumped to the surface it can be accompanied by varying quantities of water. Once the petroleum products have been removed at the facility the remaining water is disposed of. This water is known as produced formation water (PFW).

3.2.1 Water production

Since commencement of production at Ventura and Mirage there has been some water content, which over time and with the addition of additional wells at Mirage, is increasing.

The current volume of water production from the fields are

- Mirage - 43kL/day.
- Ventura - 5 kL/day .
- Growler - 0 kL/day.

3.2.2 Water Treatment and Disposal

Treatment

Produced water is separated from the well streams in separator tanks at each site.

The Separator tanks measure accumulated volumes of water before these volumes are disposed to the turkey's nest, or operated in a continuous draining mode through a piping weir system, on the water outlet. The piping weir maintains a relatively constant water level within the vertical tank. It also prevents any oil from flowing out of the water drain line.

Minor amounts of water may remain in the oil as it flows to the production tank. If significant amounts of water accumulate in the production tank, this water will be recycled back to the vertical tank.

The oil produced from the Mirage and Ventura fields is very light (53°API) and evaporates readily with minimal residue. Oil which may remain on the surface of the interceptor pond will be skimmed.

Disposal

As produced water is a potentially contaminated process by-product, its use for secondary purposes such as road construction, dust stabilisation or livestock watering is strictly controlled. At present Victoria Petroleum has no plans to use produced water for secondary processes and as a result produced water from Mirage and Ventura will be disposed of via evaporation or infiltration.

Water in the Mirage and Ventura fields is currently being disposed of in the "turkey's nest" of each production well. The turkey's nest acts as an interceptor and evaporation pond, is lined with an impermeable liner and has a capacity of approximately 5000 bbls (800 kL).

During extended production testing if water in excess of the capacity of the turkey's nest is produced at a wellsite, it will be transferred from the turkey's nest to the larger unlined drilling sump adjacent to the turkey's nest. The water will be disposed of by evaporation from the turkey's nest and evaporation and infiltration in the drilling sump (if used). The capacity of these two containment areas is considerably in excess of the 480 KL indicated possible water production volume.

If water in excess of the capacity of the turkey's nest and drilling sump is produced, a dedicated interceptor pond and/or additional evaporation ponds may need to be constructed to handle the water.

In this case the typical set-up for interceptor and evaporation ponds is likely to be used.

Interceptor & Evaporation Ponds

An interceptor pond (the first pond in any water disposal system) is lined with an impervious membrane and fenced to prevent stock access. The interceptor pit is used as a buffer to ensure that

any hydrocarbons carried over from primary separation do not enter the unlined ponds. Hydrocarbons entering the system can be manually skimmed or vacuumed from the surface of the interceptor pit.

Water exits the interceptor pit by an underflow pipe to prevent hydrocarbons on the surface moving further into the system. Any water leaving an interceptor pit should have a concentration of not more than 30 mg/L of hydrocarbon.

The most common means of PFW disposal is the use of a pond system to evaporate water. There are many variables in design of evaporation systems. For example they can either be opened, closed, bunded or free form. Whether a system is open or closed depends upon water quality considerations and consultation with pastoral lessees and environmental assessment and approval.

Bunded evaporation systems consist of a series of specially constructed shallow ponds to which PFW is discharged, whilst free form water disposal utilises natural landscape features to form the final evaporation pond in the system as described above.

Free form evaporation systems require at least two specially constructed and bunded ponds following primary separation and the lined interceptor pond through which the PFW passes prior to discharge to the free form evaporation pond. This acts as a safety mechanism in the event of an oil release to the system. Free form evaporation systems most commonly utilise a dune corridor, with bunds constructed at an appropriate distance apart, to form the evaporation pond.

3.3 Flowlines

Flowlines are low pressure pipelines that transport oil from wellheads to production and storage facilities within a production licence area. Higher pressure flowlines (up to 3500 psi) may also be used in association with jet pumps to provide artificial lift (refer Santos 2003b).

Pipelines that are extended beyond the area encompassed by one or more production licences require approval under the *Petroleum Act 2000* under either an Associated Facilities Licence or a Pipeline Licence.

Flowlines are constructed of steel or glass reinforced epoxy (GRE) and typically range in size from 60mm to 90mm external diameter. They can be installed above or below ground. In the Cooper Basin, steel flowlines are usually located on supports above ground, to avoid corrosive soils.

All flowline design and construction is undertaken in accordance with the following Australian Standards:

- AS 4041 – 1998: *Pressure Piping*
- AS 2885 – 1997: *Pipelines - Gas and Liquid Petroleum*
- AS 1978 – 1987: *Pipelines - Gas and Liquid Petroleum - Field Pressure Testing*

Adherence to design standards minimises the risk of flowline failure, which may have serious environmental implications in sensitive locations such as in floodplains or creeklines. Design standards which aim to protect flowline integrity and prevent loss of oil/condensate to the environment include:

- design of the flowline to have an appropriate diameter and wall thickness for the operating pressure requirements
- specification of appropriate mitigation measures (as identified in a risk assessment of the flowline) such as installation of heavier wall thickness pipe where it is buried under rivers, creeks and roadways
- on floodplains and under creeks, it may be necessary to use concrete weighting to counter the buoyancy of the flowline when the soil is saturated with water
- use of high integrity external coating and cathodic protection devices for buried steel pipe to protect against corrosion
- aboveground flowlines must be supported to maintain them clear of corrosive soils
- installation of overpressure protection devices to prevent line rupture:
  - a high pressure shut down valve to isolate the well from the flowline
  - a pressure safety valve (PSV) designed to relieve the pressure above design operating pressure of the flowline

  - liquid flowlines may be equipped with thermal PSVs and check valves to prevent line rupture as a result of temperature induced expansion
- PSVs and flowline bleed points shall be provided with sumps or drums of sufficient capacity to contain discharged fluids
- if required, launching and receiving facilities for pipe cleaning devices (referred to as pigs) shall be constructed to contain minor spills during removal/insertion of pigs and with a sump for draining the receiver/launcher prior to opening. Pigs are typically not used on flowlines.

3.3.1 Route Selection, Survey and Site Preparation

Surveys are undertaken and a preferred route alignment is selected according to evaluation criteria, such as constructability, environmental sensitivity, safety and cost. The centreline is established and engineering aspects of construction finalised.

For buried flowlines the right-of-way (ROW) is cleared with topsoil and vegetation stockpiled separately.

During construction of above ground flowlines the construction easement may be cleared but not graded. Above ground flowlines often require a narrower easement and so result in reduced disturbance to vegetation and topsoil.

3.3.2 Flowline Construction

Construction of a buried flowline involves trenching along the alignment after the construction easement is cleared, typically to a depth of one metre. Trenching to depth of two metres or more may be necessary in locations where lines pass through sand dunes, areas subject to inundation, wash out areas or under roads. Breaks are left in the trench to facilitate fauna movement across and out of the open trench.

Pipe is transported to the flowline easement in sections and typically laid end-to-end adjacent to the trench on raised skids (typically wooden blocks with sandbags placed on top) to protect the pipe coating from damage. This process is known as ‘pipe stringing’. In the case of above ground flowlines, sections of steel pipe are laid out on raised skids adjacent to the eventual flowline supports.

Steel pipes are welded in lengths (of up to one-kilometre or more) in accordance with Australian Standard 2885 – 1995. Each weld is radiographed to test for compliance to specifications. GRE pipes are typically joined by threaded joins with O-ring seals.

The joined pipe sections are lowered into the trench (using side-boom tractors for steel pipe or larger diameter GRE pipe). Sideboom tractors are also used to lower welded steel flowline sections onto pipe supports for above ground flowlines, which are installed so that they are positioned approximately 100mm above the ground surface. Above ground flowlines are buried under roads, on floodplains and at river and channel crossings.

Where necessary, soil and/or padding from approved borrow pits is placed into the trench to protect and stabilise the pipe. The trench is then backfilled and compacted with previously excavated trench spoil material.

3.3.3 Flowline Testing

The integrity of flowlines is verified using hydrostatic testing conducted in accordance with the *SAA Code for Field Pressure Testing of Pipelines* (Australian Standard 1978 - 1987). During hydrostatic testing the flowline is capped with test manifolds, filled with water and pressurised in accordance with the standard.

The use of biocides and chemicals with hydrostatic test water may be required under some circumstances to prevent internal corrosion of the flowline. Hydrostatic test water may be sourced from existing water bores or from creeks or waterholes with sufficient water flows. Produced formation water may also be utilised as a water source provided that it is adequately treated with biocide to remove potential for bacterial contamination of the flowline.

Disposal of hydrostatic test water which contains biocide and other chemicals may be into existing lined and fenced evaporation ponds, or to specifically constructed pits sited to prevent the contamination of surface or near surface waters. Hydrostatic test water that has no biocides or deleterious chemicals added is generally disposed of to the land surface, away from sensitive areas such as creeks.

3.3.4 Site Restoration

The easement is reinstated and restored as soon as possible after pipe laying and backfill. This involves removal of all construction generated refuse, re-contouring of the site, re-establishment of natural drainage lines, bank restoration (if necessary), topsoil respreading and respreading of any cleared vegetation.

3.3.5 Operation

Flowline operation and maintenance provide for continued monitoring and safe operation of the flowline, as outlined in AS 2885. Inspection and monitoring of flowlines are carried out and the operating procedures followed ensure that they are operated within their design capability.

3.4 Road construction and maintenance

The majority of roads throughout the Cooper Basin are constructed and maintained by Santos. Victoria Petroleum currently maintain approximately 70km of access roads to production wells and facilities, some of which are also station tracks.

Where possible, existing roads, station tracks and exploration well access tracks are utilised and maintained where appropriate. However it is expected that a limited amount of road construction or upgrading and realignment may be required for access to future production operations. Within Regional Reserves the creation of new access tracks will be kept to a minimum and where appropriate disused roads will be rehabilitated at the conclusion of activities.

Once surveys are complete and a preferred road alignment is selected, a road is constructed according to the land system(s) it will pass through. In most cases the easement is cleared and graded but under some circumstances the easement may be rolled (e.g. in gibber plains or where the terrain is naturally flat and susceptible to erosion when disturbed). Table 4 provides information on the road construction methods applied to land systems in the Cooper Basin (taken from Santos 2003).

Table 4: Road Construction Methods for Land Systems in the Cooper Basin

Construction Method	Landsystem					
	Wetlands	**Floodplains**	**Gibber Plains**	**Tablelands**	**Dunefields**	**Salt Lakes**
Avoid construction on landsystem						•
Utilise naturally cleared areas	•	•	•	•	•	
Avoid steep slopes			•	•	•	
Weave road between trees and large shrubs	•	•	•	•	•	
Clear and grade easement	•	•			•	
Roll easement			•	•		
Cap road surface with clay or similar borrow material	•	•		•	•	
Culverts or similar devices installed on drainage line crossing	•	•		•	•	

Road construction styles are assessed according to the amount of anticipated use as well as the environmental sensitivity of the area. Roadside borrow pits are used to source material for road fill. Erosion controls are implemented during and after construction and particular attention is given to flood and water flow areas.

Following construction, rehabilitation is undertaken to ensure that surrounding surface drainage is restored and erosion control structures are installed in erosion prone areas.

Supplies of suitable construction material, such as gravel and soil, are usually extracted from sites referred to as borrow pits. Borrow pits are excavated to provide:

- soft earth for trench backfilling
- rubble and earth for upgrading or constructing roads and maintenance of production facilities
- rubble and earth for the construction of above ground flowline infrastructure.

Borrow pits vary considerably in dimension depending upon the quality and quantity of material contained in them, however the typical size of borrow pits is approximately 3, 000 m².

Site selection, environmental management and restoration of borrow pits is undertaken in accordance with the Victoria Petroleum Environmental Management Plan for Drilling and Well Operations (Victoria Petroleum 2004) and the criteria set out in Appendix B of the Victoria Petroleum Cooper Basin Petroleum Production Operations SEO (Victoria Petroleum 2008). Existing borrow pits are used in preference to new ones where appropriate.

In the event that damage occurs to public roads, as a result of Victoria Petroleum's operations, maintenance activities will be undertaken to restore and maintain the road at an acceptable standard (as a minimum to pre-existing standard).

3.5 Oil Transport

Arrangements are presently in place to transport the oil produced from the Mirage and Ventura fields to the Santos facility at Moomba. Once transferred to Moomba control and custody of the oil is transferred to Santos.

Oil is typically transported from the Ventura and Mirage fields via double trailer road train or equivalent (each trailer hauling about 200 bbls (32 kL)) to Moomba for delivery to the Santos road tanker unloading facilities for the Moomba – Port Bonython Pipeline. This involves the tankers travelling on private and public roads.

Access roads in the Cooper Basin may cross creek beds, including the Cooper and Strzelecki Creeks. These creeks are generally dry; the lower Cooper flows once every 2-5 years on average, and flows in the Strzelecki occur even less frequently.

Safe transportation of the oil from the wellsite to the delivery point is the prime responsibility of the transporters, under the *Dangerous Substances Act 1979* and the *Environmental Protection Act 1993*. However, under the *Petroleum Act 2000*, Victoria Petroleum is responsible for minimising the impact of transportation spills of oil produced by the Joint Venturers and the cleanup and remediation of such spills, until the oil is accepted by Santos, or Inland Oil, as the case may be, at the delivery point.

Tanker load out areas at production facilities are lined and bunded to contain any spills.

3.6 Waste Management

Waste management is an important issue and Victoria Petroleum will continue to incorporate appropriate waste management practices into the construction, operation and abandonment phases of its developments. Victoria Petroleum will where possible follow the principles of "Avoid, Reduce, Reuse, Recycle, Recover, Treat, Dispose" and put measures in place to prevent pollution by reducing the use of energy, water, material resources, and recycling waste where possible.

Victoria Petroleum is responsible for the management of all the wastes it generates and for its disposal in accordance with regulatory requirements and industry standards. Waste from operations is generated from two main streams; operation waste and domestic waste (Table 5)..

Table 5: Typical Waste Streams

Waste Type	Disposal
Operation Waste	
Gaseous Waste	Vented – gas, CO_2, H_2S, CO Generator and vehicle emissions
Produced Formation Water	Currently to lined turkey's nest for evaporation. In future may need to construct interceptor pits and then dispose to evaporation ponds/ infiltration basins
Oily Sludge	▪ n/a
Tank Bottom Sludges	▪ n/a
Pig-Receiver/ Slugcatcher Scale	▪ n/a
Contaminated Soil	Treated with fertilisers in situ or trucked to licensed LTU as appropriate (determined in consultation with PIRSA & EPA)
Hydrotest Water	Recycled for each hydrotest section Evaporation pond or to land if no biocides or deleterious chemicals added
Used Chemical Drums	Licensed Waste depot and recycled where possible
Chemical Waste	Licensed Chemical waste depot
Scrap Metal	Recycled where possible or added to licensed landfill
Timber Pallets (Skids)	Recycled where possible
Vehicle Tyres	Waste Depot: ▪ Shredded and added to licensed land fill
Asbestos	▪ n/a

Domestic Waste	
Storm water runoff (camp)	Runoff to vegetation
Sewage	Treated at facility in Septic tank. Treated liquid to infiltration pit
Grey water	Treated at facility in Septic tank. Treated liquid to infiltration pit
Food waste, paper and plastic	Recycle where possible, remainder to licensed landfill
Glass and Cans	Recycle where possible (container deposit items), remainder to licensed landfill
Workshop Waste (rags, filters)	Recycle where possible, remainder to licensed landfill

3.6.1 Landfill – Domestic Waste

Victoria Petroleum does not currently operate landfill sites in South Australia. Any waste disposed to landfill is taken to appropriately licensed landfills (e.g. Moomba).

3.6.2 Sewage Waste Management

Sewage wastes at production facilities will be disposed of to on-site systems that will be managed in accordance with the *Public and Environmental Health (Waste Control) Regulations 1995* and in compliance with the *Standard for the Construction, Installation and Operation of Septic Tank Systems in SA*, or be to the satisfaction of the Department of Health. Consequently Victoria Petroleum will ensure compliance with Clause 11 of the *Environment Protection (Water Quality) Policy 2003*.

3.6.3 Land Treatment / Soil Remediation Areas

Victoria Petroleum's operations currently produce no oily waste.

If a spill did occur it may be treated in situ with fertiliser, however oily sludge or contaminated soil from spills may need to be removed and treated.

Victoria Petroleum do not currently have a land treatment area in South Australia. The main option for treatment and disposal of oily sludge and contaminated soil is removal to the Santos land treatment unit in Moomba.

3.6.4 Temporary Product Storage Pits

Temporary product storage pits are unlikely to be required for Victoria Petroleum production operations.

4 Existing Environment

The Cooper Basin covers a total area of 130,000km^2 of which approximately 50,000km^2 lies within north-eastern South Australia. It is an arid environment, with the climate characterised by hot dry summers, mild dry winters and low and variable rainfall.

The environment of the Cooper Basin has been extensively reviewed in the SACBJV Production and Processing EIR (Santos 2003). This document presents detail on the following aspects of the Cooper Basin environment:

- climate
- soils and landform
- hydrology
- flora and fauna
- geology and hydrogeology
- aquifer use
- Aboriginal and non-Aboriginal heritage
- land use
- socio-economic environment.

The information presented in Santos (2003) is not repeated in this document. This chapter provides site specific detail is on the environment within Victoria Petroleum's exploration leases and production operation areas.

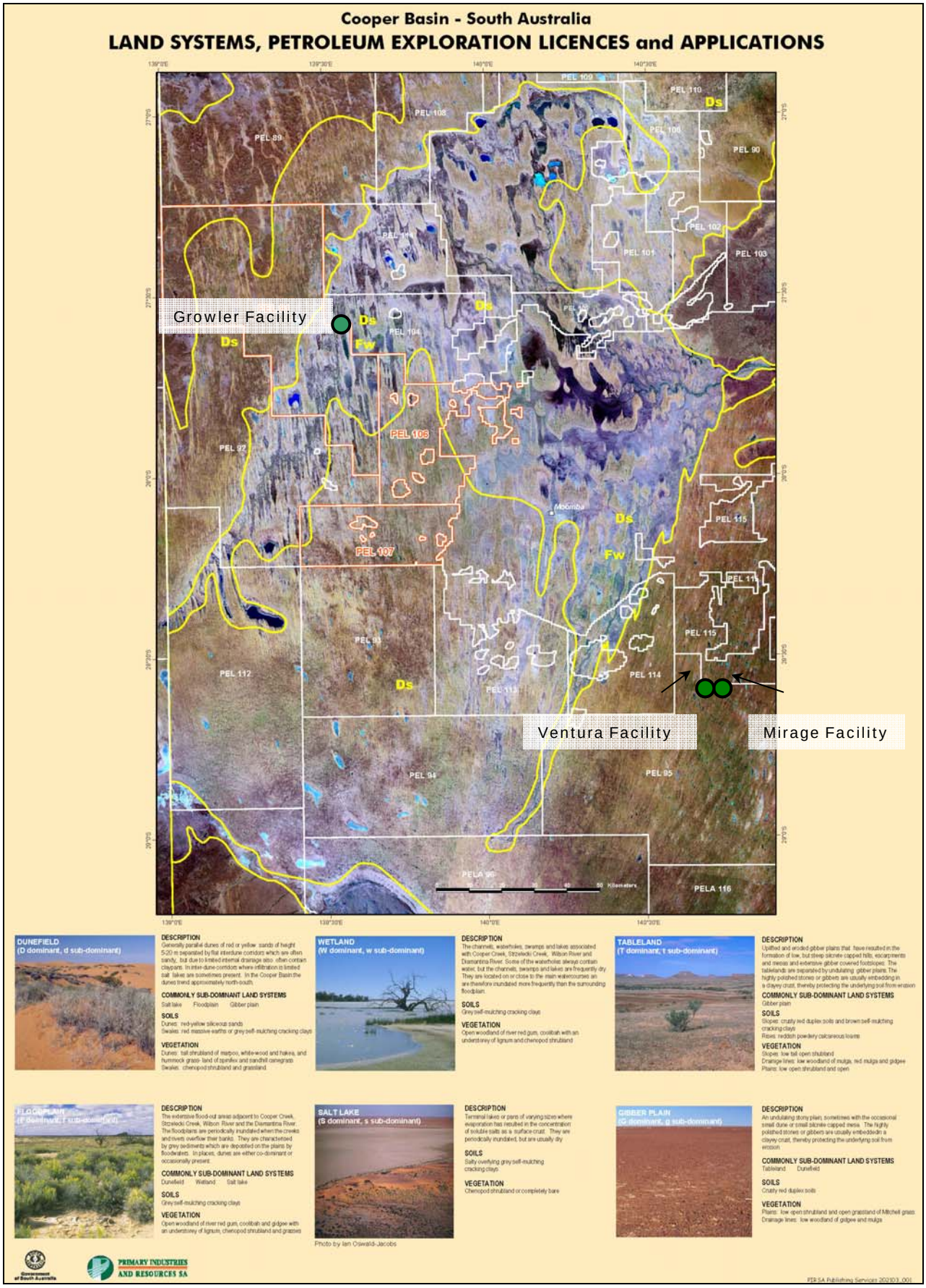
4.1 Land Systems

Victoria Petroleum's PELs contain the six major land systems found in the Cooper Basin. They are:

- dunefields
- floodplains
- wetlands
- salt lakes
- tablelands
- gibber plains.

These land systems are defined by geological, geo-morphological and hydrological influences. The distribution of these land systems across the Cooper Basin is shown in Figure 6.

Figure 6: Land Systems, PELs and Victoria Petroleum Production Facilities in the Cooper Basin



The following paragraphs provide a brief description of the Cooper Basin Land Systems and key environmental issues. Further details are provided in Santos (2003).

Dunefields are widely spread throughout the South Australian Cooper Basin. Dunefields are the dominant land system within Victoria Petroleum PELs. The EPBC Act (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*) listed threatened Dusky Hopping Mouse has been recorded from dunefields near the Strzelecki Creek.

Floodplain – the Cooper Creek floodplain covers the central third of the basin and intersects several Victoria Petroleum PELs. It includes the Coongie Lakes Wetlands System to the north and the Strzelecki Creek floodplain that feeds Lake Blanche in the south. The Cooper Creek floodplain occurs in close association with the dunefields of the basin. Woodlands in floodplain areas constitute important habitat for many bird species, including raptors. Flooding frequencies decrease from annual in the upper Cooper and Coongie Lakes to once every 2-5 years or less frequently in the lower Cooper Creek (refer Santos 2003).

Wetlands – the Cooper Basin contains an array of wetlands, fed by flows from the Cooper Creek. Some of Victoria Petroleum PELs fall within or are adjacent to the Coongie Lakes Wetlands System, which have been included in the directory of nationally important wetlands. The Coongie Lakes Wetland System are also listed under the Ramsar Convention as a wetland of international importance to waterfowl (Morton *et al.* 1995, Blackley *et al.* 1996). Numerous species of migratory birds listed under the EPBC Act utilise these areas.

Salt lakes and salt pans of varying sizes are scattered throughout the basin, and are found within Victoria Petroleum PELs. In these lakes excess evaporation in interior basins leads to the concentration of soluble salts as a surface crust.

Tablelands are dissected residuals or breakaways. They are characterised by a silcrete surface that has been eroded to form low but steep escarpments, mesas, buttes and extensive gibber covered foot slopes (Santos 1997).

Gibber Plain – throughout the Cooper Basin there are vast expanses of flat to gently undulating gibber covered plains and downs such as the Sturt Stony Desert and the Innamincka or Wadi Wadi Dome (Santos 1997). Gibber Plain is found within the more northern Victoria Petroleum PELs (PEL 87 and 89).

The sensitivity of each land system to disturbance depends upon its basic characteristics of geology, landform, soils, hydrology, flora and fauna. The Santos EIR (Santos 2003) discusses each land system in detail with respect to these characteristics.

The environments within the Victoria Petroleum PEL areas are summarised in Table 6.

Table 6: Land Systems and Environmental Features in PELs

PEL	Land System (s)	Significant Environmental Features
87	Dunefield, Gibber plain, Wetland, Floodplain, Saltlake	
104	Dunefield, Salt lake, Floodplain, Wetland	Cooper Creek, Ramsar area Innamincka Regional Reserve
111	Dunefield, Salt lake, Wetland, Floodplain	Cooper Creek, Ramsar area Innamincka Regional Reserve
115	Dunefield, Salt lake	Innamincka Regional Reserve
424 (86&89)	Dunefield, Gibber plain, Wetland, Floodplain, Salt lake	Diamantina River Warburton Creek Goyder Lagoon

A number of Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999*) and State (*National Parks and Wildlife Act 1972*) listed species are also known to occur in the Cooper Basin. The listed species that have been predicted to occur in the region or recorded in the areas in which Victoria Petroleum operates are listed in Table 7.

Table 7: Listed species occurring in PELs

Species	Conservation Status		PEL				
	SA	Cwlth	87	104	111	115	424
Flora							
Needle wattle (*Acacia carnei*)	Vulnerable	Vulnerable		*	*		
Waddy, Birdsville Wattle (*Acacia peuce*)	-	Vulnerable	✓				✓
Pickards Wattle (*Acacia pickardii*)	Rare	Vulnerable	✓				✓ *
Frankenia cupularis (a sea-heath)	Rare	-		*	*		
Slender Fissure-plant (*Maireana pentagona*)	Rare	-	*				*
(*Swainsona dictyocarpa*) (a pea)	Rare	-					*
Fauna							
Desert Rat Kangaroo[2] (*Caloprymnus campestris*)	Endangered	Extinct					*
Kowari (*Dasycercus byrnei*)	Vulnerable	Vulnerable	✓ *		✓		✓ *
Ampurta (*Dasycercus cristicauda hillieri*)	Rare	Endangered					*
Greater Bilby (*Macrotis lagotis*)	Endangered	Vulnerable					✓ *
Lesser Bilby[3] (*Macrotis leucura*)	Endangered	Extinct					*
Fawn Hopping-mouse (*Notomys cervinus*)	Endangered	-	*				*
Dusky Hopping Mouse, Wilkitini (*Notomys fuscus*)	Vulnerable	Vulnerable	✓	✓	✓	✓	✓
Southern Marsupial Mole, Yitjarritjarri (*Notoryctes typhlops*)	Endangered	Endangered					✓
Plains Rat (*Pseudomys australis*)	Vulnerable	Vulnerable					*

[2] Presumed extinct

[3] Presumed extinct

Species	Conservation Status		PEL				
	SA	Cwlth	87	104	111	115	424
Gilbert's Dragon (Amphibolurus gilberti)	Rare	-					*
Grey Grasswren (*Amytornis barbatus*)	Rare	Vulnerable					*
Australian Bustard (*Ardeotis australis*)	Vulnerable	-					*
Australian Painted Snipe[4] (*Rostratula australis*)	Rare	Vulnerable	✓	✓	✓	✓	✓
Grey Falcon (Falco hypoleucos)	Rare	-				*	
Brolga (*Grus rubicunda)*	Vulnerable	-		*			*
Black-breasted Buzzard (*Hamirostra melanosternon*)	Rare	-				*	*
Plains-wanderer (*Pedionomus torquatus*)	Endangered	Vulnerable	✓				✓
Flock Bronzewing (*Phaps histrionica*)	Vulnerable	-					*
Blue-billed Duck (*Oxyura australia*)	Rare	-				*	

Key: ✓ = Predicted to occur in the region (EPBC database), * = Recorded in the region (SA DEH)

Victoria Petroleum is confident that significant impacts to listed threatened species, communities and migratory species that are likely to occur in the Cooper Basin region (refer Santos 2003) can be avoided, due to the nature and limited area of production activities and the management measures that are implemented.

4.2 Environmental Description of Production Facilities

4.2.1 Mirage

The Mirage facility is located on Merty Merty Station in a dunefield land system, approximately 45km east of the Strzelecki Creek and 70km south-east of Moomba.

The dunefields are part of the Strzelecki land system, which extends from east of Lake Blanche to Innamincka, with a tongue extending north of the Cooper Creek into Sturt's Stony Desert (Marree Soil Conservation Board 1997). This large land system (43,161 km^2 total area) contains long parallel sandridges with semi-mobile crests, with sandy and clayey interdunes and numerous claypans and internal soakages.

Soils in this region range from red siliceous sands on the dunes to red sandy clays and loams on the interdune areas and cracking clays on the claypan swamps

[4] Note: Not actually recorded in this region of SA but predicted to occur by EPBC Act database.

The Mirage facility is located in an interdune on a relatively flat surface (refer Plate 1). Soils at the site are red sandy clay and are typical of an interdune. There are no significant drainage lines present at the Mirage facility site and drainage is localised and internal to the interdune. There is no connection to flood flows from the either the Strzelecki or Cooper Creeks.

The facility is 40 km south of the area defined as the Coongie Lakes Wetlands of International Importance under the 1971 Ramsar Convention.

Vegetation on dunes and dune slopes at the site is a very open shrubland / woodland and is dominated by sandhill wattle (*Acacia ligulata*), punty bush (*Senna artemisioides*) and hopbush (*Dodonaea viscosa*), with the occasional mulga (*Acacia aneura*) and groundcover of Spinifex (*Triodia basedowii*), ephemerals and short-lived perennials and grasses.

The interdunes or swales are vegetated by a low grassland/herbland, with scattered shrubs, including needlewood (*Hakea leucoptera*), sandhill wattle (*Acacia ligulata*), dead finish (*A. tetragonaphylla*), plum bush (*Santalum lanceolatum*), bladder saltbush (*Atriplex vesicaria*) and bluebush (*Maireana sp*.) and a groundcover of ephemerals and short-lived perennials including grasses.

Plate 1: Mirage Field production facility at Mirage-1

4.2.2 Ventura

The Ventura facility is also located on Merty Merty Station in a dunefield land system, approximately 40km east of the Strzelecki Creek and 5km west of Mirage-1.

The Ventura site is very similar to the Mirage site and is also located within the Strzelecki land system. Soils in this region also range from red siliceous sands on the dunes to red sandy clays and loams on the interdune areas and cracking clays on the claypan swamps

The Ventura facility is located in a relatively narrow interdune on a gently sloping surface. Soils at the site are a red sandy clay as typically found on an interdune.

The facility is 40 km south of the area defined as the Coongie Lakes Wetlands of International Importance under the Ramsar Convention.

Like Mirage, vegetation on dunes and dune slopes at the site is a very open shrubland / woodland and is dominated by sandhill wattle (*Acacia ligulata*), punty bush (*Senna artemisioides*), hopbush (*Dodonaea viscosa*) and stands of plum bush (*Santalum lanceolatum*), with a groundcover of sandhill canegrass (*Zygochloa paradoxa*) and short-lived perennials.

The sandy inter-dunes at the site are vegetated by a similar mix of the species found growing on the dunes, while the areas with clay swales are vegetated by a low grassland/herbland, with scattered small shrubs and a groundcover of ephemerals and short-lived perennials including grasses.

Plate 2: Ventura production facility

4.2.3 Growler

The Growler oil wells and facility are located on Kanowana station, in a floodplain land system, at the southern edge of Pulcaracuranie Flat within the Cooper Creek floodout area. The site is located approximately 4km south-east of the main channel of Cooper Creek, is approximately 4.9km west of Kanowana Channel and 5.4km south of Mollichuta Waterhole..

The floodplain is part of the Cooper land system which is a large floodplain land system (16,724 km^2 total area) which consists of the waterholes, channels, floodplains and the ephemeral lakes of the Cooper and Strzelecki Creeks, and the field of parallel sandridges with interdune areas connected to and periodically flooded by them.

Soils in the region range from dunes comprised of red siliceous sands to whitish siliceous sands, to pale grey sandy to silty clays (including pale grey self-mulching cracking clays) in the channels and temporary waterholes, to grey self-mulching cracking clay soils with “crabholes” on the flats.

Soils at the Growler site range from pale sandy dunes and sandy clays adjacent to Pulcaracuranie Flat to areas of grey self-mulching cracking clay soils with “crabholes” on the Flat.

The facility lies within the area defined as the Coongie Lakes Wetlands of International Significance under the 1971 Ramsar Convention. This area encompasses the Coongie Lakes proper, the upper Cooper Creek in the north-east and the lower Cooper Creek to the west.

Due to the close proximity of the Cooper Creek and its location within the Cooper food-out area, it is highly likely that the Growler wellsites and possibly the facility would be subject to flooding during major flood events of the Cooper Creek. Flows in this section of the creek occur, on average, once every 2-5 years.

The arrival of flood flows can be predicted months in advance of reaching the Growler vicinity. The site also falls within the area listed on the Register of the National Estate (RNE) as the Cooper Creek floodplain system. This area is listed as it is one of the few unpolluted and unregulated river systems in Australia and is significant as an intact ecosystem where biological/ecological processes that arise out of fluctuations of flooding and desiccation are demonstrated. The floodplain system has a temporal and structural diversity of habitat types. The system also contains large freshwater lakes in an otherwise arid environment, which is a rare phenomenon.

Vegetation at the site is dominated by a lignum shrubland with a sparse cover of perennial grass and short-lived perennial copperburrs on the flat. Vegetation adjacent to the facility, which is located on the toe of a sand dune adjacent to the flat, is comprised of an open Coolibah woodland with an understorey of grasses and herbs.

Plate 3: Growler production facility

4.3 Land Use and Tenure

The major land uses in Victoria Petroleum PELs in the Cooper Basin are pastoralism, oil and gas exploration production, conservation and tourism. Detailed information on land use and land tenure is provided in the Santos Environmental Impact Report: Production and Processing Operations (2003).

Pastoral Properties

The main pastoral enterprise in the region is beef cattle production on native pasture. Pastoral properties and landholders within the Victoria Petroleum operational area are outlined in Table 8.

Table 8: Pastoral Properties within Victoria Petroleum PELs

Station	Landholder / Manager	PEL
Alton Downs	Brook Proprietors	86
Andrewilla (Alton Downs)	Brook Proprietors	86
Pandie Pandie	D&J Morton	86, 87
Beckwith (Pandie Pandie)	D&J Morton	86, 87
Clifton Hills	Weston Managers: T&T Gilbey	86, 89, 111
Goyder Lagoon (Clifton Hills)	Weston Managers: T&T Gilbey	86, 89
Cordillo Downs	Brook Proprietors	87
Kanowana (Clifton Hills)	Weston Managers: T&T Gilbey	89, 104, 111
Innamincka	S. Kidman & Co Managers: G& M Morton	104, 111, 115
Gidgealpa	Santos Ltd Manager: M. Brazel , Gidgealpa Pastoral Co.	104, 115
Merty Merty	P&M Rieck, Merty Merty Pastoral Co	115
Bollards Lagoon	G&G Rieck	115

There are a number of properties in the region that have achieved certification by the National Association for Sustainable Agriculture Australia (NASAA) for organic beef production and there are several producers at the conversion stage. Victoria Petroleum operates or holds PELs on several properties that have either obtained a level of certification or are in the process of conversion to NASAA Organic Beef Exporters (OBE). These include Bollards Lagoon, Merty Merty and Cordillo Downs. The OBE guidelines identify the maximum levels of chemicals allowable in soil, consistent with allowing organic certification for beef exports.

All landholders in Victoria Petroleum's operational regions are also certified under the Cattle Care Quality Assurance system. Cattle Care is an initiative of the Cattle Council of Australia and places emphasis on minimising the risk of chemical contamination, bruising and hide damage and ensuring that herds are effectively managed and improved. In particular, the contamination of property and livestock by organochlorines and other persistent chemicals must be minimised, and contaminated cattle identified. Prevention of bruising and hide damage puts the onus on landholders to manage the property carefully and reduce the risk of damage from foreign bodies.

On these properties any production sites or spill sites will be fenced to exclude stock access and no fertiliser will be added in the site remediation process without permission of the landholder.

Conservation

The main conservation reserves in the region are Innamincka Regional Reserve and Strzelecki Regional Reserve. Regional Reserves are areas proclaimed for the purpose of conserving wildlife, natural or historical features while allowing responsible use of the area's natural resources (including oil and gas production). The Innamincka reserve falls within Victoria Petroleum PELs.

Part of the Cooper Creek system has been proclaimed as the Coongie Lakes Wetland of International Importance under the Ramsar Convention. This Ramsar wetland is defined by Lake Moorayepe to the north, the Queensland border at the crossing of Cooper Creek to the east, and a point south west of Lake Hope. It is estimated that the Coongie Lakes Wetlands Ramsar area covers 30% of the known oil and gas resources within the South Australian portion of the Cooper Basin (DEHAA 1999). The Coongie Lakes and adjacent area, and the Cooper Creek Floodplain are both registered on the National Heritage Register. No petroleum activities are permitted within the Coongie Lakes National Park. Victoria Petroleum's PELs in this area are located west and south-west (and downstream) of the Coongie Lakes and do not fall within the Coongie Lakes proper.

If petroleum resources are discovered by Victoria Petroleum in a Regional Reserve, consultation will be undertaken with DEH, DWLBC and other relevant stakeholders with regards to minimising the identified potential impacts of production operations on the reserve.

Following the completion of production operations the affected areas of the reserve would be rehabilitated to an appropriate standard following consultation with regulators and other relevant stakeholders.

Oil and Gas Production

The actual area of land utilised for gas production is small, but the supporting infrastructure extends throughout much of the central and north eastern portion of the Cooper Basin in South Australia (Marree Soil Conservation Board 1997). Producing oil and gas fields are spread through pastoral lands, regional reserves and the Ramsar wetlands.

The predominant petroleum company in the area is Santos Ltd, operating a large number of oil and gas wells, oil satellites, the Moomba petroleum processing plant and associated infrastructure on behalf of the South Australian Cooper Basin Joint Venture.

4.4 Native Title

There are currently three Native Title Claims in the South Australian Cooper Basin. Details of each claim are presented in Table 9.

Table 9: Native Title Claims in the South Australian Cooper Basin

Title	Location	Native Title Tribunal Status & No.	Representative
Yandruwandha/ Yawarrawarrka Native Title Claim	North east corner of South Australia (SA) extending south to Lake Blanche. Includes PEL 115	Registered SC98/1	Aboriginal Legal Rights Movement Inc.
Dieri Native Title Claim	From Marree in the south to Cameron Corner in the east, to Hadden Corner in the north east, following the Qld border to Lake Teetatobie, south west of Gypsum Cliff, west to Lake Eyre, south to Marree. Includes PELs 104 and 111	Registered SC97/4	Aboriginal Legal Rights Movement Inc.
Wangkangurru / Yarluyandi Native Title Claim	Northern SA and Queensland. Includes PELs 87 and424	Registered SC97/3	Aboriginal Legal Rights Movement Inc., Carpentaria Land Council Aboriginal Corp

Victoria Petroleum has agreements in place with the Native Title claimant groups covering exploration and production.

Before Victoria Petroleum conducts activities within Native Title Claim areas, work area clearances are undertaken with representatives engaged from the relevant group.

5 Environmental Impacts and Mitigation

This section provides an assessment of the environmental impacts associated with Victoria Petroleum's production operations in the Cooper Basin. It includes a description of the hazards, potential consequences and management strategies for Victoria Petroleum's operations and activities in the Cooper Basin. Each assessment table outlines:

- environmental hazards associated with the operation or activity
- the potential consequences of the activity/event
- an outline of key management measures.

5.1 Production Facilities

5.1.1 Facility Operation

There are a number of environmental hazards associated with the operation of oil (or gas) production facilities. They include production of atmospheric emissions (via fugitive, flare and venting sources), loss of containment of oil and storage of chemicals and fuels. These are outlined in Table 10.

Emissions of environmental significance (i.e. known atmospheric pollutants and/or greenhouse gases) are:

- combustion by-products (e.g. oxides of nitrogen, carbon monoxide and sulphur dioxide)
- methane and organic carbon from fugitive sources
- vented gas
- flared hydrocarbons
- vented CO_2, H_2S, and CO.

Quantitative estimates for fugitive emissions and combustion by-products are not available.

There is the potential for accidental spills or leaks of small amounts of process chemicals (e.g. PFW emulsion breakers), cleaning chemicals or fuels during storage or handling and use. Accidental spills/release of oils may also occur as a result of flowline failure or leaks from equipment such as the inlet header, pipeline connection or plant valves. There is also a potential for accidental overflow of oil storage tanks at production facilities.

Leaks, spills and overflows can potentially lead to localised contamination of soil within the plant site and may be a potential ignition source for fire. The risks associated with leak or spill hazards are minimised through appropriate storage and containment and implementation of storage and handling procedures. All chemicals and fuels (including oil storage tanks and waste sump oil pits) are stored on impervious bunded surfaces.

Flooding of production facilities in floodplain areas can lead to contamination of soil and water, particularly if flood levels are high enough to overflow bunded areas. Flooding as a result of seasonal flows of the Strzelecki Creek or the Cooper Creek are not expected the Mirage and Ventura facilities due to their distance from these watercourses and associated floodplains. However the likelihood of a major creek flood is estimated to occur once every 2 to 5 years or longer (Santos 2003) and such floods may impact facilities such as the proposed Growler facility.

Some of the Victoria Petroleum facilities have, or will have, accommodation and offices to house employees working at the facility. The primary hazards associated with these facilities are the storage of domestic waste and sewage. These hazards are dealt with in Section 5.6.

Due to the nature of processing operations there is also an inherent risk of explosion or fire. However this risk is reduced to As Low As Reasonably Practical (ALARP) by implementing various management measures to minimise the risk.

5.1.2 Facility Construction

Environmental hazards associated with facility construction include movement of heavy vehicles, earthworks, vegetation clearance, fire, spills associated with chemical and fuel storage and waste disposal.

Movement of heavy vehicles (e.g. trucks, graders) around the site, borrow pits and access tracks is an environmental hazard as there is a possibility that vehicles may inadvertently damage vegetation, generate dust and / or compact soil if not appropriately managed. Earthworks can result in similar consequences as well as potentially disturbing sites of cultural significance and exposing soils to wind and water erosion.

The type and severity of potential consequences of earthworks is dependent, to a certain extent, on the land system in which the activities are being carried out. Disturbance of soils in some land systems, such as gibber plains and tablelands, can lead to substantial erosion by water while other systems, such as dunefields, are generally more resilient and less likely to suffer any long-term impacts from soil disturbance.

Production facilities are usually located on or adjacent to previously disturbed areas (e.g. drill pads, access tracks) to minimise the need for additional land disturbance and vegetation clearance. Production facilities are also usually located to avoid sensitive land systems or areas of high ecological value (e.g. wetlands, salt lakes). The potential consequences of specific earthwork activities on different landsystems in the Cooper Basin are summarised in Table 12.

Vegetation clearing, can result in loss of vegetation and fauna habitat, siltation of natural drainage lines and watercourses, destabilisation of creek crossings, weed invasion and damage to cultural heritage sites. Vegetation clearance may also impede the movement of fauna around the construction site. Care is taken when planning the location of a facility site to ensure that minimal vegetation is cleared.

A potential source of leaks and/or spills during construction is from chemical and fuel storage areas and refuelling depots associated with construction works. The primary consequence of any leak or spill is localised contamination of soil.

Occurrence of flooding or fire during construction works has a number of potential consequences. For flooding these include significant soil erosion in areas that have been subject to earthworks and possibly loss of vegetation. In the case of a fire, loss of vegetation and fauna habitat and production of particulate air emissions are possible consequences.

Facility construction generates some waste. Materials such as metal off-cuts or wooden pallets can be reused or recycled. All remaining waste materials are removed from the work area and disposed of at an appropriately licensed landfill.

Table 10: Production Facility Impact Assessment

Activity/Event	Potential Consequences	Management Strategy
Earthworks associated with facility construction (e.g. clearing, grading)	▪ Injury or death of fauna/stock in construction area ▪ Introduction and/or spread of weeds ▪ Long term disturbance to natural drainage patterns ▪ Significant damage to third party infrastructure ▪ Soil erosion and siltation of watercourses ▪ Inversion of soil profile ▪ Disturbance to cultural heritage sites ▪ Dust generation ▪ Soil compaction of the easement ▪ Impeded fauna movement through construction area ▪ Damage to native vegetation ▪ Temporary loss of visual amenity ▪ Disruption to land use (e.g. grazing and recreation)	▪ Minimise environmental impact by appropriate sitee selection to minimise or avoid sensitive land systems, vegetation and cultural heritage sites ▪ Use existing disturbed areas where possible ▪ Liaise with landowners regarding notification and management of works and site issues including livestock management ▪ Observe procedures and guidelines for the identification, management and protection of cultural heritage sites, including obtaining heritage clearances by Native Title groups ▪ Minimise vegetation disturbance, and plan construction to avoid vegetated areas ▪ Avoid significant or priority[5] vegetation and ensure proposed site has been scouted for significant vegetation and wildlife habitats by appropriately trained and experienced personnel ▪ Where possible trim vegetation rather than clearing ▪ Undertake vehicle and equipment washdown before entering Cooper Basin or after operating in areas of known weed infestations ▪ Minimise consequences to fauna by leaving excavated areas open for as little time as possible ▪ Utilise fauna ladders (sticks etc.) to facilitate the movement of fauna out of excavations ▪ Regularly inspect excavations for trapped fauna ▪ Reinstate temporary construction areas (e.g. laydown) as soon as possible ▪ Restore borrow pits ▪ Remove waste to minimise visual impact
Explosion or fire at the production facility	▪ Danger to health and safety of employees, contractors and possibly the public ▪ Contamination of soil and/or watercourse ▪ Atmospheric pollution ▪ Burning of vegetation and habitat ▪ Injury to or loss of native fauna	▪ All production facilities are designed and constructed in accordance with relevant standards (e.g. AS3000, AS1940, AS 2885). ▪ Safety, testing, maintenance and inspection procedures are implemented ▪ Establishment of appropriate emergency/spill response procedures for explosion or fire ▪ Erection of fencing and signage to delineate restricted/hazardous areas ▪ Personnel are trained to supervise and instruct individuals entering area to conduct work ▪ Appropriate fire fighting equipment at all production facilities ▪ Safe work permits must be obtained to ensure only individuals with proper clearance can conduct works

[5] Wiltshire and Schmidt (2003). Summarised in PIRSA's *Field guide for the environmental assessment of newly abandoned seismic lines in the Cooper and Eromanga Basins, South Australia.*

Activity/Event	Potential Consequences	Management Strategy
		▪ Safe smoking areas away from equipment or activity ▪ Petrol vehicles to be excluded from restricted areas ▪ Immediate clean up and remediation to minimise contamination to soil/water

Flooding of floodplains / watercourses	▪ Contamination of soil, surface water and/or groundwater
	▪ Damage to infrastructure (e.g. evaporation ponds)
	▪ Access to contaminants by stock and wildlife
	▪ Damage to surrounding vegetation by contaminated water
		▪ Production operations will cease in event of imminent flood inundation. In floodplain land systems, the following steps will be undertaken well in advance of flooding:
		  ▪ Satellite imagery and upstream flood levels used to predict when floodwaters will reach the facility (generally take 2-3 months to reach lower Cooper)
		  ▪ Storage tanks and flowlines drained, purged and filled with water to reduce buoyancy
		  ▪ Interceptor pit (if present) skimmed to remove oil
		  ▪ Fuel tanks drained, engines and all hydrocarbons (e.g. fuel and lubricants) removed off-site
		  ▪ Office/accommodation units tied down
		▪ Previous major floods of the Cooper have inundated oil fields in the Cooper Basin with no significant environmental consequences
		▪ Production facilities will be designed to avoid spread of hydrocarbons during inundation following localised rainfall (eg. appropriately sized/elevated bunds)

Spills or leaks associated with chemical and fuel storage and handling	▪ Contamination of soil and/or watercourse ▪ Access to contaminants by stock and wildlife	▪ Implementation of appropriate chemical and fuel storage and handling procedures (e.g. bunding and signage) in accordance with relevant standards, including AS1940 and the Australian Dangerous Goods Code (ADG) ▪ Regularly educate staff of product, review and monitor chemical and fuel storage, including signage/labelling, proper packing and tie downs ▪ Establishment of appropriate emergency/spill response procedures ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events
Tanker Load-out	▪ Contamination of soil and/or watercourse ▪ Access to contaminants by stock and wildlife	▪ Tanker load-out in lined area, with appropriate bunding to contain spills ▪ Hoses with dry-break couplings ▪ Personnel attendance at all times during tanker filling ▪ *As above*
Fugitive emissions of methane and organic carbon	▪ Release of greenhouse gases contributing to climatic warming	▪ Continual review and improvement of operations ▪ Very low levels of gas associated with current facilities

Activity/Event	Potential Consequences	Management Strategy
Venting of CO_2, H_2S, and CO	▪ Release of greenhouse gases contributing to climatic warming ▪ Atmospheric emissions	▪ Continual review and improvement of operations ▪ Very low levels of gas associated with current facilities
Venting of gas	▪ Release of greenhouse gases contributing to climatic warming ▪ Atmospheric emissions	▪ Very low levels of gas associated with current facilities
Flaring of hydrocarbons	▪ Release of greenhouse gases contributing to climatic warming ▪ Atmospheric pollution	▪ Very low levels of gas associated with current facilities, currently no flaring of gas
Loss of containment of oil outside area designed to contain spills (pipe rupture or leaks from plant equipment)	▪ Danger to health and safety of employees, contractors and possibly the public ▪ Contamination of soil, and/or watercourse ▪ Access to contaminants by stock and wildlife ▪ Loss of vegetation and fauna habitat	▪ All pipelines are designed, constructed and operated in accordance with relevant standards including inspections and maintenance ▪ Construction and operation of filling systems, storage tanks and the tankers in accordance with AS 1940 ▪ Use of steel piping and fittings where possible ▪ Appropriate areas (e.g. separator and storage tanks) bunded and lined to contain spills ▪ Oil storage tanks placed within a bund ▪ Personnel are trained to supervise and instruct individuals entering area to conduct work ▪ Establishment of appropriate emergency/spill response procedures for explosion or fire ▪ PIC supervises and briefs all personnel engaged in works ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness
Access and activity of personnel outside designated facility area / work areas	▪ Damage to vegetation and habitats ▪ Damage to cultural heritage sites	▪ Training and induction of all personnel and visitors includes information on restricted areas and activities ▪ Vehicle access restricted to designated roads and areas ▪ Erection of fencing and signage to delineate restricted areas

5.2 Produced Formation Water

The most significant hazard associated with the operation of petroleum production facilities is the storage and treatment of large volumes of produced formation water (PFW). PFW can be highly saline and contain chemicals (both natural and added), residual hydrocarbons and some naturally occurring heavy metals.

Potential contamination of soil and groundwater may result from leaks in separation tanks, interceptor ponds and bunded or free form evaporation ponds. Subsurface movement can also lead to upwelling of PFW outside of evaporation ponds. However the likelihood of the loss of containment of the storage of PFW is considered rare.

The potential environmental consequences associated with PFW disposal include:

- contamination of soil and near surface aquifers by any carried over hydrocarbon or process chemicals or naturally occurring metals
- contamination of soil and associated vegetation with salts and metals naturally occurring, but concentrated in the PFW
- ingestion of contaminants by native fauna or stock.

There is also potential for birds and other wildlife to come into contact with residual hydrocarbons and other contaminants (such as heavy metals) in interceptor pits. Oiled birds may suffer from restricted movement and distress and often do not survive the effects of ingesting oil and other hydrocarbons.

A research project conducted by Santos indicated that the principal contaminants of concern in the PFW ponds are mercury polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH) and total phenolics (Santos 2003).

Table 11: PFW Storage and Disposal Impact Assessment

Activity/Event	Potential Consequences	Management Strategy
Storage and disposal of PFW at production facilities	▪ Contamination of soil and/or groundwater ▪ Access to contaminants by stock and wildlife ▪ Salinisation of adjacent areas ▪ Death of adjacent vegetation ▪ Injury to or death of wildlife	▪ Site ponds appropriately[6] to minimise potential consequences ▪ Construct ponds using appropriate materials and suitable design criteria for washboard angles, depths etc ▪ Ensure that interceptor pits are appropriately lined ▪ Surface of interceptor pits to be regularly skimmed ▪ Ensure that tanks are well maintained and regularly emptied ▪ Do not overfill evaporation ponds ▪ Monitor ponds for surrounding upwelling of PFW ▪ Monitor and audit evaporation pond sludge and water annually ▪ Periodic review of PFW and implementation of audit recommendations: ▪ Fence off contaminated water sources ▪ Repair any damaged fences or gates ▪ Maintain a register of spills and/or leaks and remediate ▪ Breaker siphon to be installed between interceptor pond and evaporation ponds
Flooding of surrounding floodplain / watercourses	*Refer to Production Facility Impact Assessment (*Table 10*)*	

[6] Appropriately manage means to take into consideration and assess relevant environmental factors (including location of surface water, potential flooding, location of vegetation, etc.) and take measures to reduce the potential impact on these factors through the use of best practice.

5.3 Flowlines

5.3.1 Flowline Construction

Environmental hazards associated with flowline construction include movement of heavy vehicles, earthworks, vegetation clearance, fire, spills associated with chemical and fuel storage and waste disposal. Flooding (of the Strzelecki Creek or the Cooper Creek floodplain and associated watercourses) may also need to be considered to be potential environmental hazard if flowline construction is required in the vicinity of these areas.

Horizontal directional drilling and associated fluids are not considered to be hazards as this method of construction is unlikely to be required for flowline construction activities in the Cooper Basin.

Movement of heavy vehicles (e.g. trucks and side boom tractors) along the construction easement and access tracks is an environmental hazard as there is a possibility that vehicles may inadvertently damage vegetation, generate dust and / or compact soil if not appropriately managed. Earthworks can result in similar consequences as well as potentially disturbing sites of cultural significance and exposing soils to wind and water erosion.

The type and severity of potential consequences of earthworks is dependent, to a certain extent, on the land system in which the activities are being carried out. Disturbance of soils in some land systems, such as gibber plains and tablelands, can lead to substantial erosion by water while other systems, such as dunefields, are generally more resilient and less likely to suffer any long-term impacts from soil disturbance. A study of seismic lines in dunefields in the Cooper Basin indicated that natural rates of erosion on dunes were not accelerated as a result of disturbance to the soil surface (SEA 1999).

Wetlands are avoided under most circumstances when planning flowline routes as they are often of high ecological value and sensitivity. Salt lakes are also avoided as rehabilitation is difficult to undertake and they are therefore likely to be severely scarred by flowline construction activities. The potential consequences of specific earthwork activities on different landsystems in the Cooper Basin are summarised in Table 12.

Other activities along the construction easement, such as vegetation clearing, can result in loss of vegetation and fauna habitat, siltation of natural drainage lines and watercourses, destabilisation of creek crossings, weed invasion and damage to cultural heritage sites. Vegetation clearance may also impede the movement of fauna within the construction zone. Particular care is taken to ensure that minimal vegetation is cleared in Coolibah woodland during easement preparation. The easement is generally minimised to approximately 8m in any heavily wooded areas.

A potential source of leaks and/or spills during construction is from chemical and fuel storage areas and refuelling depots associated with construction works. The primary consequence of any leak or spill is localised contamination of soil. Discharge of hydrostatic test water to ground surface is another potential source of localised soil and groundwater contamination.

The use of biocides and chemicals in hydrostatic test water is required under some circumstances to prevent internal corrosion of the flowline. Disposal of hydrostatic test water which contains biocide or other chemicals may be into existing lined evaporation ponds (i.e. produced formation water facilities) or to specifically constructed pits sited to prevent contamination of surface or near surface waters. Test water that is free of additives may be disposed of to land adjacent to the construction zone.

Occurrence of flooding or fire during construction works has a number of potential consequences. For flooding these include significant soil erosion in areas that have been subject to earthworks and possibly loss of vegetation. In the case of a fire, loss of vegetation and fauna habitat and production of particulate air emissions are possible consequences.

Flowline construction generates very little waste. Many materials such as pipe off cuts, rope spacers and timber skids can be reused or recycled. All remaining waste materials are removed from the work area and disposed of at an appropriately licensed landfill.

Table 12: Consequences Associated with Earthworks in Various Cooper Basin Landsystems

Landsystem	Activity/Event			
	Grading	**Trenching and Backfilling**	**Excavation/Digging (e.g. borrow pits)**	**Soil Stockpiling**
Wetlands	N/A	N/A	N/A	N/A
Floodplains	▪ Soil erosion (wind and water) ▪ Soil compaction ▪ Disturbance of natural drainage systems (construction easement typically restricted to 8m at creek crossings) ▪ Disturbance to cultural heritage sites (generally low density of sites in floodplains)	▪ Disturbance of natural drainage systems (construction easement typically restricted to 8m at creek crossings) ▪ Inversion of the soil profile ▪ Disturbance to cultural heritage sites (generally low density of sites in floodplains) ▪ Impeded fauna movement	▪ Soil erosion (wind and water) ▪ Disturbance of natural drainage systems ▪ Disturbance to cultural heritage sites (generally low density of sites in floodplains)	▪ Disturbance of natural drainage systems (e.g. saltation) ▪ Soil erosion (wind and water)
Gibber Plains	N/A	▪ Soil erosion (particularly susceptible to water erosion e.g. severe gullying) ▪ Disturbance of natural drainage systems (e.g. siltation) ▪ Inversion of the soil profile ▪ Disturbance to cultural heritage sites ▪ Impeded fauna movement	▪ Soil erosion (particularly susceptible to water erosion e.g. severe gullying) ▪ Disturbance of natural drainage systems (e.g. siltation) ▪ Inversion of the soil profile ▪ Disturbance to cultural heritage sites	▪ Soil erosion (wind and water) ▪ Disturbance of natural drainage systems ▪ Inversion of the soil profile
Tablelands	N/A	▪ Soil erosion (particularly susceptible to water erosion eg. severe gullying) ▪ Soil compaction ▪ Disturbance of natural drainage systems (e.g. siltation) ▪ Inversion of the soil profile ▪ Disturbance to cultural heritage sites ▪ Impeded fauna movement	N/A	▪ Soil erosion (wind and water) ▪ Disturbance of natural drainage systems ▪ Inversion of the soil profile

Landsystem	**Activity/Event**			
	Grading	**Trenching and Backfilling**	**Excavation/Digging (e.g. borrow pits)**	**Soil Stockpiling**
Dunefields	▪ Soil erosion (wind and water erosion) ▪ Disturbance to cultural heritage sites (dunefields near waterholes are typically of high cultural significance)	▪ Soil erosion (wind and water erosion) ▪ Disturbance to cultural heritage sites (dunefields near waterholes are typically of high cultural significance) ▪ Inversion of the soil profile ▪ Impeded fauna movement	▪ Soil erosion (wind and water erosion) ▪ Disturbance to cultural heritage sites (dunefields near waterholes are typically of high cultural significance) ▪ Inversion of the soil profile	▪ Soil erosion (wind erosion) ▪ Inversion of the soil profile
Salt Lakes	N/A	N/A	N/A	N/A

N/A – not applicable as the activity is not carried out in this landsystem.

5.3.2 Flowline Operation

The primary hazard associated with the flowline operation is the loss of containment of oil or high pressure natural gas. Accidental spills and leaks may result from flowline failure, which may be caused by:

- heavy vehicle traffic (e.g. collision with an above ground flowline)
- corrosion of the flowline (external or internal)
- natural events which stress the flowline (e.g. flood / earthquake)
- overpressure
- metallurgical or construction faults.

Regular inspection of flowlines and monitoring of the performance of cathodic protection devices on buried steel flowlines is undertaken, to ensure that protection levels are adequate. Major flowlines in the Cooper Basin are also regularly pigged by their operators (e.g. Santos) to remove water and sludge that accumulates at low points within flowlines. Sludge often supports sulphide reducing bacteria that are a significant cause of internal corrosion of flowlines in the Cooper Basin.

Above ground flowlines are regularly inspected to ensure that they do not come into contact with the ground as a result of soil movement or failure of pipe supports. Where contact occurs 'long line corrosion cells' may form and result in rapid pitting of the pipe and possible flowline rupture.

A gas or oil leak from a flowline may result in the release of gas to the atmosphere or contamination of soil or groundwater respectively. The potential exists for oil and condensate to be spilt at any point between an oil well and production facility. Many of the consequences associated with oil spills and leaks, such as vegetation loss, soil disturbance and drainage alteration can be minimised if spills or leaks do occur. However, this largely depends on the land system involved.

In dry environments, such as dunefields and gibber, the consequences associated with an oil spill are mainly localised, as oil is easier to contain and recover in dry conditions. However, the environmental consequences of oil spills in more sensitive wet environments, like the Cooper and Strzelecki Creeks and surrounding floodplains and wetlands, are potentially significant. Of primary concern are flood conditions that can potentially spread oil over large distances and throughout highly sensitive ecosystems. Santos Ltd is undertaking studies to determine consequences of oil spills in both dry and wet conditions and developing appropriate remediation guidelines (Santos 2003).

Fire and explosion are also possible hazards associated with flowline operation. A fire or explosion along a flowline can pose a danger to personnel, contractors and possibly the public and can potentially produce significant amounts of atmospheric emissions. However due to the low volatility and flammability of oil the potential for explosion or fire is considered low, and therefore the potential severity of the consequence minor. The risk is reduced to As Low As Reasonably Practical (ALARP) by management measures.

Table 13: Flowline Construction Impact Assessment

Hazard	Potential Consequences	Management Strategy
Earthworks (e.g. clearing of construction easement, grading, trenching and backfilling)	▪ Injury or death of fauna/stock in construction zone ▪ Introduction and/or spread of weeds ▪ Long term disturbance to natural drainage patterns ▪ Significant damage to third party infrastructure ▪ Soil erosion and siltation of watercourses ▪ Inversion of soil profile ▪ Disturbance to cultural heritage sites ▪ Dust generation ▪ Soil compaction of the easement ▪ Temporary disruption to land use (e.g. grazing and recreation) ▪ Impeded fauna movement through construction zone ▪ Damage to native vegetation ▪ Temporary loss of visual amenity ▪ Disruption to land use (e.g. grazing and recreation)	▪ Minimise environmental impact by appropriate route selection to minimise or avoid sensitive land systems, vegetation and cultural heritage sites ▪ Use existing easements where possible ▪ Liaise with landowners regarding notification and management of works and site issues including livestock management ▪ Observe procedures and guidelines for the identification, management and protection of cultural heritage sites, including obtaining heritage clearances by Native Title groups ▪ Minimise vegetation disturbance, and plan construction to avoid vegetated areas ▪ Avoid significant or priority[7] vegetation and ensure proposed routes have been scouted for significant vegetation and wildlife habitats by appropriately trained and experienced personnel ▪ When establishing line of sight, trim vegetation rather than clearing where possible ▪ Where possible trim vegetation rather than clearing ▪ Undertake vehicle and equipment washdown before entering Cooper Basin or after operating in areas of known weed infestations ▪ Minimise consequences to fauna by leaving trenched areas open for as little time as possible ▪ Utilise trench plugs and fauna ladders (sticks etc.) to facilitate the movement of fauna out of and across trench ▪ Regularly inspect open trenches and excavations for trapped fauna ▪ Where possible conceal line of sight along access tracks to minimise visual impact ▪ Reinstate construction areas including construction easement as soon as possible ▪ Rip areas of compacted soil (except on gibber plains and tableland environments) ▪ Respread topsoil and stockpiled vegetation ▪ Restore borrow pits ▪ Restore natural contours to minimise consequences to natural drainage patterns ▪ Stockpile cleared vegetation and respread following construction to facilitate revegetation ▪ Remove waste to minimise visual impact

[7] Wiltshire and Schmidt (2003). Summarised in PIRSA's *Field guide for the environmental assessment of newly abandoned seismic lines in the Cooper and Eromanga Basins, South Australia.*

Hazard	Potential Consequences	Management Strategy
Movement of heavy machinery and vehicles along construction easement and access tracks	▪ Dust generation ▪ Soil compaction ▪ Soil erosion ▪ Damage to native vegetation ▪ Injury or death of native fauna ▪ Disturbance to cultural heritage sites ▪ Introduction and/or spread of weeds ▪ Damage to third party infrastructure ▪ Disruption to land use (e.g. grazing and recreation) ▪ Increased public access to remote areas	▪ Use existing cleared areas for laydowns and turn-arounds ▪ Liaise with landowners regarding notification and management of works and site issues including livestock management ▪ Undertake vehicle and equipment washdown before entering Cooper Basin or after operating in areas of known weed infestations ▪ Drive only on access tracks and construction easement ▪ Rip areas of compacted soil (not on gibber plains and tablelands)
Spills or leaks associated with chemical and fuel storage and handling	▪ Contamination of soil, and/or watercourse ▪ Access to contaminants by stock and wildlife	▪ Implementation of appropriate chemical and fuel storage and handling procedures (e.g. bunding and signage, use of drip trays and spill kits for refuelling) in accordance with relevant standards, including AS1940 and the Australian Dangerous Goods Code (ADG Code) ▪ Regularly educate personnel of product, review and monitor chemical and fuel storage, including signage/labelling, proper packing and tie downs ▪ Establishment of appropriate emergency/spill response procedures ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events
Ignition of fire along construction easement	▪ Disturbance to cultural heritage sites ▪ Loss of vegetation and fauna habitat ▪ Release of particulate emissions to the atmosphere ▪ Disruption to land use (e.g. grazing and recreation)	▪ Smoking only permitted in a designated safe areas away from equipment or activity ▪ Personnel are trained to supervise and instruct individuals entering area to conduct work ▪ Safe work permits must be obtained to ensure only individuals with proper clearance can conduct works ▪ Appropriate fire fighting equipment on-site ▪ Petrol vehicles to be excluded from construction sites ▪ Emergency response procedures should contain a bushfire scenario ▪ Safety, testing, maintenance and inspection procedures are implemented ▪ Immediate clean up and remediation to minimise contamination to soil/water

Hazard	Potential Consequences	Management Strategy
Disposal of hydrotest water	▪ Contamination of soil and/or watercourse ▪ Loss of or damage to vegetation and fauna habitat as a result of soil or water contamination ▪ Soil erosion / scouring	▪ Use of biocides and toxic chemicals are kept to a minimum and if biocides are necessary UV-degradable biocides (e.g. TPHS) shall be used where practicable ▪ Disposal of hydrostatic test water which contains biocide and other chemicals may be into existing lined and fenced evaporation ponds, or to specifically constructed pits sited to prevent the contamination or surface or near surface waters ▪ Use of aerators / spray bars, geotextile, etc to prevent soil erosion at discharge point where uncontaminated hydrotest water is released to land

Table 14: Flowline Operation Impact Assessment

Hazard	Potential Consequences	Management Strategy
Explosion or fire along a flowline	▪ Contamination of soil, and/or watercourse ▪ Atmospheric pollution ▪ Loss of vegetation and fauna habitat ▪ Disruption to land use (e.g. grazing) ▪ Danger to health and safety of employees, contractors and possibly the public	▪ All flowlines are designed and constructed in accordance with relevant standards including installation of appropriate warning signage ▪ Safety, testing, maintenance and inspection procedures are implemented ▪ Establishment of appropriate emergency/spill response procedures for explosion or fire ▪ Personnel are trained to supervise and instruct individuals entering area to conduct work ▪ PIC supervises and briefs all personnel engaged in works ▪ Safe smoking areas away from equipment or activity
Spill or leak associated with flowline failure to land	▪ Contamination of soil, and/or watercourse ▪ Damage to vegetation and habitat ▪ Disruption to land use (e.g. grazing) ▪ Access to contaminants by stock and wildlife	▪ All flowlines are designed and constructed in accordance with relevant standards including installation of appropriate warning signage Safety, testing, maintenance and inspection procedures are implemented ▪ High pressure flowlines associated with jet pumps have pressure monitoring/shutdown in case of leak ▪ Establishment of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness
Spill associated with flowline failure in a watercourse	▪ Contamination of groundwater, surface water, soil and other riparian systems ▪ Contamination of soil, and/or watercourse ▪ Damage to vegetation and habitat ▪ Access to contaminants by stock and wildlife ▪ Danger to health and safety of employees, contractors and possibly the public	▪ All flowlines are designed, constructed and operated in accordance with relevant standards ▪ Safety, testing, maintenance and inspection procedures are implemented ▪ High pressure flowlines associated with jet pumps not installed across watercourse beds ▪ Establishment of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness

5.4 Road Construction and Maintenance

The major hazards associated with road construction are earthworks, vegetation clearance, chemical and fuel storage and waste disposal. Earthworks and vegetation clearance can potentially result in soil erosion, interruption of natural drainage patterns, disturbance to cultural heritage sites, introduction and spread of weeds and loss of vegetation. Waste disposal and chemical and fuel storage can lead to localised soil or water contamination. As indicated in Section 3.3.1, the type and severity of potential consequences of earthworks is dependent, to a certain extent, on the land system in which the activities are being carried out.

Hazards associated with road maintenance and operation include earthworks (i.e. grading) and introduction of construction material (e.g. fill). Earthworks, including the construction of borrow pits, can potentially disturb natural drainage patterns, lead to soil erosion and result in the alteration of drainage lines or lead to the capture of water which in turn may attract animals and lead to an alteration in grazing patterns. Similarly introduction of fill material can result in alteration of drainage patterns and possibly introduction and/or spread of weeds.

Public roads will be maintained, as appropriate, to minimise consequences on other public road users.

There are few hazards associated with road abandonment. Hazards include earthworks (i.e. ripping) and removal of road construction material (e.g. clay). Ripping can lead to soil erosion and alteration of drainage patterns. Disposal of road construction material may potentially spread weeds or alter drainage patterns and vegetation cover at the disposal site.

Table 15: Road Construction and Maintenance Impact Assessment

Hazard	Potential Consequences	Management Strategy
Earthworks (e.g. clearing of construction easement, grading, trenching and backfilling)	▪ Injury or death of fauna/stock in construction zone ▪ Introduction and/or spread of weeds ▪ Long term disturbance to natural drainage patterns ▪ Significant damage to third party infrastructure ▪ Soil erosion and siltation of watercourses ▪ Inversion of soil profile ▪ Disturbance to cultural heritage sites ▪ Dust generation ▪ Soil compaction of the easement ▪ Temporary disruption to land use (e.g. grazing and recreation) ▪ Impeded fauna movement through construction zone ▪ Damage to native vegetation ▪ Temporary loss of visual amenity ▪ Disruption to land use (e.g. grazing and recreation)	▪ Use existing roads and tracks where possible ▪ Minimise impact on the environment by appropriate route selection to minimise or avoid sensitive land systems, vegetation and cultural heritage sites ▪ Observe procedures and guidelines for the identification, management and protection of cultural heritage sites including heritage clearances by Native Title groups ▪ Design and construct road with drainage features (e.g. culverts and offtakes) that minimise erosion and sedimentation ▪ Liaise with landowners regarding notification and management of works and site issues including livestock management ▪ Minimise vegetation disturbance, and plan construction to avoid vegetated areas ▪ Avoid significant or priority[8] vegetation and ensure proposed routes have been scouted for significant vegetation and wildlife habitats by appropriately trained and experienced personnel ▪ Where possible trim vegetation rather than clearing ▪ Undertake vehicle and equipment washdown before entering Cooper Basin or after operating in areas of known weed infestations ▪ Remove waste to minimise visual impact
Movement of heavy machinery and vehicles along road and access tracks	▪ Dust generation ▪ Soil compaction ▪ Soil erosion ▪ Damage to native vegetation ▪ Injury or death of native fauna ▪ Disturbance to cultural heritage sites ▪ Introduction and/or spread of weeds ▪ Damage to third party infrastructure ▪ Disruption to land use (e.g. grazing and recreation) ▪ Increased public access to remote areas	▪ Use existing cleared areas for laydowns and turn-arounds ▪ Liaise with landowners regarding notification and management of works and site issues including livestock management ▪ Undertake vehicle and equipment washdown before entering Cooper Basin or after operating in areas of known weed infestations ▪ Drive only on access tracks and road formation ▪ Rip areas of compacted soil (not on gibber plains and tablelands)

[8] Wiltshire and Schmidt (1997). Summarised in PIRSA's *Field guide for the environmental assessment of newly abandoned seismic lines in the Cooper and Eromanga Basins, South Australia.*

Hazard	Potential Consequences	Management Strategy
Ignition of fire	▪ Disturbance to cultural heritage sites ▪ Loss of vegetation and fauna habitat ▪ Release of particulate emissions to the atmosphere ▪ Disruption to land use (e.g. grazing and recreation)	▪ Smoking only in safe areas away from equipment or activity ▪ Personnel are trained to supervise and instruct individuals entering area to conduct work ▪ Safe work permits must be obtained to ensure only individuals with proper clearance can conduct works ▪ Petrol vehicles to be excluded from construction sites ▪ Emergency response procedures should contain a bushfire scenario ▪ Safety, testing, maintenance and inspection procedures are implemented ▪ Immediate clean up and remediation to minimise contamination to soil/water
Spills or leaks associated with chemical and fuel storage and handling	▪ Contamination of soil, and/or watercourse ▪ Access to contaminants by stock and wildlife	▪ Implementation of appropriate chemical and fuel storage and handling procedures (e.g. bunding and signage, spill kits) in accordance with relevant standards, including AS1940 and the Australian Dangerous Goods Code (ADG) ▪ Regularly educate staff of product, review and monitor chemical and fuel storage, including signage/labelling, proper packing and tie downs ▪ Establishment of appropriate emergency/spill response procedures ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness ▪ Immediate clean up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events
Presence of borrow pits	▪ Injury or death of stock and wildlife ▪ Dispersal of watering points and redistribution of stock/wildlife movements resulting in inadvertent damage to vegetation and habitats ▪ Soil erosion	▪ Procedures for operation and restoration of borrow pits are followed (refer VP Drilling EMP) ▪ Existing unrestored borrow pits are used in preference to establishing new pits, and planning is undertaken to rationalise borrow pit establishment ▪ Reworking of pits, or construction of new pits occurs a minimum of 75m from existing facilities, including stock yards ▪ Pits are not to be established in locations which pose an unacceptable hazard to stock or wildlife ▪ Borrow pits are restored as soon as practicable after material extraction is complete, to a standard consistent with the surrounding land use, to achieve a +2, +1 or 0 Goal Attainment Scaling score (refer to SEO Appendix B) ▪ Restored pits have topsoil / overburden replaced and pit reprofiled where necessary to prevent erosion and minimise the capture of water
Movement of road construction material	▪ Introduction and/or spread of weeds	▪ Inspect / monitor for weeds during standard inspections of facilities and infrastructure ▪ Undertake control measures for weed outbreaks ▪ Do not import material from areas of weed/disease infestation ▪ Washdown of equipment bought in from high risk areas for weed infestation

Hazard	Potential Consequences	Management Strategy
Use of roads	▪ Dust generation ▪ Introduction and/or spread of weeds ▪ Injury or death of stock and wildlife ▪ Increased public access to remote areas	▪ Training, speed restrictions and appropriate signage to reduce speed and increase awareness of hazards ▪ Inspect / monitor for weeds during standard inspections ▪ Signage to prevent unauthorised access

5.5 Transport

The major hazard associated with the transport of oil on road networks is a leak or spill of oil or fuel (e.g. as a result of a collision, truck rollover). Many of the consequences associated with oil spills and leaks, such as vegetation loss, soil disturbance and drainage alteration, can be minimised by effective emergency response and remediation. However, this largely depends on the land system involved.

Transport personnel will comply with road rules and drive to road conditions to minimise impact on other road users.

In dry environments, such as dunefields and gibber, the consequences associated with an oil spill are mainly localised, as oil is easier to contain and recover in dry conditions. However, the environmental consequences of oil spills in more sensitive wet environments, like the Cooper and Strzelecki Creeks and surrounding floodplains and wetlands, are potentially significant. Flood conditions that can potentially spread oil over large distances and throughout highly sensitive ecosystems are of primary concern and management measures need to minimise the environmental risk in these conditions.

Other hazards associated with oil transport include encountering stock or fauna on the roads. Consequences, such as stock or fauna death and vehicle damage or accidents, can be minimised by reducing the occurrence of nigh travelling and speed restrictions.

Table 16: Transport Impact Assessment

Hazard	Consequence	Management Strategy
Use of roads	▪ Dust generation ▪ Introduction and/or spread of weeds ▪ Injury or death of stock and wildlife	▪ Training, speed restrictions and appropriate signage to reduce speed and increase awareness of hazards ▪ Restrictions on night driving ▪ Inspect / monitor for weeds during standard inspections ▪ Signage to prevent unauthorised access
Spill associated with transport of oil/condensate (via truck) to land	▪ Contamination of groundwater, surface water and soil ▪ Damage to vegetation and habitats ▪ Access to contaminants by stock and wildlife	▪ Transportation of chemicals, fuels and oils in accordance with ADG Code ▪ Ensure roads and causeways are designed to minimise risk of vehicle accident ▪ Regularly educate staff of product, review and monitor chemical and fuel transportation, including signage/labelling, proper packing and tie downs ▪ Training and speed restrictions to reduce speed and increase awareness of hazards ▪ Vehicles are maintained and serviced in accordance with manufacturer's specifications ▪ No transportation movements in wet conditions ▪ Transport movements at night typically avoided ▪ Appropriate communication between trucks and facilities to plan safe transport movements ▪ Appropriate signage installed (e.g. at access to public roads) ▪ Establishment of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness ▪ Immediate clean-up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to stock or wildlife ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events
Spill associated with transport of oil/condensate (via truck) to watercourse/wetland	▪ Contamination of groundwater, surface water and soil ▪ Damage to vegetation and habitats ▪ Access to contaminants by stock and wildlife	As above, plus: ▪ Install signage at creek crossings where appropriate ▪ No fording of flowing streams, transportation movements in wet conditions ▪ Removal of contaminated soil from spills in watercourses as appropriate

5.6 Waste Management

Domestic waste at Victoria Petroleum production facilities is currently transported to a licensed waste disposal facility (Moomba). Sewage and grey water is treated septic treatment systems on site. There is a potential for localised contamination of soil and groundwater as a result of leaks from the sewage treatment system. Quantities of sewage generated at facilities are not currently measured.

Victoria Petroleum does not currently operate landfill sites for disposal of domestic waste in South Australia. If landfill sites were required to be developed in the future, they would be sited in a suitable, stable area, distant from watercourses or floodplain areas and approved and operated in accordance with EPA requirements, as discussed in Section 0.

Victoria Petroleum's operations currently produce minimal oily waste or contaminated soil and Victoria Petroleum does not currently have a land treatment area for treating oily waste or contaminated soil in South Australia. Any such waste generated would be removed off site to an appropriate facility (e.g. Santos Land Treatment Unit at Moomba). It is possible that Victoria Petroleum may establish a land treatment site for soil remediation at some stage, subject to necessary PIRSA and EPA approvals. A land treatment site would treat oily waste by mixing with existing soil, with the aim of breaking down oil by evaporation, photochemical processes and biological action of naturally occurring soil micro-organisms. Once hydrocarbons are broken down, soil would be analysed and uncontaminated soil transported by truck to appropriate disposal location.

Chemical wastes are not currently generated, but would be removed off-site to an appropriately licensed disposal facility.

Potential consequences of these waste management practices include contamination of soil or groundwater and the introduction and/or spread of weeds. In the case of a landfill site consequences also include outbreaks of pests and scavenging by wildlife.

Table 17: Waste Management Impact Assessment

Hazard	Potential Consequences	Management Strategy
Storage of domestic waste at camps, burning and transport to landfill	▪ Scavenging by native and pest species ▪ Pest outbreaks ▪ Localised contamination of soil and/or groundwater ▪ Loss of visual amenity ▪ Air pollution associated with burning ▪ Odorous emissions	▪ Minimise generation of waste where practicable ▪ Provide suitable covered bins for the collection and storage of wastes ▪ All waste are collected in one area at each camp site ▪ Cover all loads of rubbish leaving camps to ensure no spillage ▪ Reduce, reuse and recycle ▪ No burning of waste within Innamincka Regional Reserve
Spills or leaks associated with disposal and treatment of sewage	▪ Localised contamination of soil and/or groundwater ▪ Access to contaminants by stock and wildlife	▪ Containment of all sewage wastes within septic tank ▪ Fence off contaminated areas ▪ Repair any damaged fences or gates ▪ Backfill of all pits upon completion of production and processing operations
Domestic waste disposal facility*	▪ Contamination of soil and/or groundwater ▪ Loss of visual amenity ▪ Scavenging by native animals and pest species ▪ Pest outbreaks	▪ Sited in a suitable, stable area, distant from watercourses or floodplain areas ▪ Design and operation in accordance with EPA approval requirements ▪ Undertake soil and groundwater monitoring ▪ Cover and fence site with an appropriate material to prevent the spread of rubbish from the site by wind and prevent access by stock and wildlife ▪ Bury rubbish immediately to facilitate degradation and reduce offensive odours and aesthetic consequences ▪ Fill in waste pits if flood inundation is imminent
Storage and disposal of contaminated soil*	▪ Contamination of soil and/or groundwater ▪ Access to contaminants by stock and wildlife	▪ Appropriate siting of land treatment site in a suitable, stable area, distant from watercourses or floodplain areas ▪ Appropriate disposal of oil sludge to land treatment area ▪ Monitoring of surrounding soil and groundwater for contaminants annually ▪ Fence off contaminated areas ▪ Repair any damaged fences or gates ▪ Development of remediation plans for the sludge pits and land treatment area
Temporary storage of product in pits	▪ Contamination of soil and/or groundwater ▪ Fire or explosion ▪ Danger to health and safety of employees, contractors and possibly the public ▪ Access to contaminants by stock and wildlife	▪ Temporary storage of product in pits avoided unless no feasible alternative ▪ Product stored for shortest time possible ▪ Pit lined to contain product ▪ On completion of use of pit, contaminated soil removed for remediation and pit backfilled ▪ Safe smoking areas away from storage pit ▪ Erection of fencing and signage to delineate restricted/hazardous areas ▪ Fencing of pit to prevent access by stock or wildlife ▪ Establishment of appropriate procedures for temporary storage of product ▪ Consider weather and flood likelihood when planning pit use

Hazard	Potential Consequences	Management Strategy
		▪ Remove oil from pit before flooding occurs ▪ Periodic review and exercise of response equipment and procedures to ensure preparedness ▪ *Refer also to* Table 10 *for production facility management*

6 Environmental Management Framework

The Victoria Petroleum Environmental Management System (EMS) provides the framework within which environmental responsibilities in South Australia are managed.

Victoria Petroleum's environmental management system will continue to evolve in response to management reviews, changing technology, industry practices, regulatory requirements, research, monitoring, and community expectations.

6.1 Environmental Management System

The EMS is a key tool in managing Victoria Petroleum's environmental responsibilities, issues and risks.

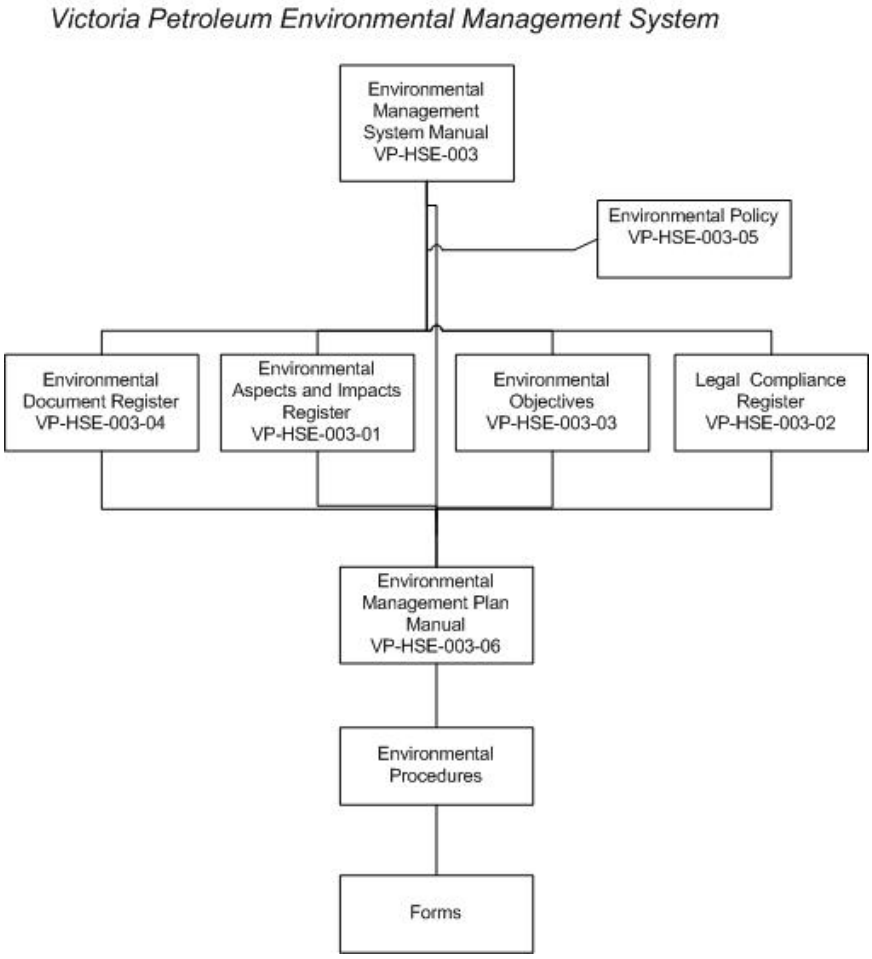
The EMS is based on Australian Standard/New Zealand Standard *ISO14001:1996 Environmental Management Systems – Specification with guidance for use.*

The EMS is comprised of a number of levels of documentation (including plans and procedures) that form the framework for the management of the environment in which Victoria Petroleum operates (refer to Figure 7).

The EMS covers all activities undertaken by Victoria Petroleum in Australia including:

- Petroleum exploration
- Drilling and well operations
- Petroleum production.

Figure 7: Framework of Victoria Petroleum's EMS



6.2 Environmental Policy

Victoria Petroleum is committed to conducting its business operations in an environmentally responsible manner.

Victoria Petroleum has an Environmental Policy which outlines how Victoria Petroleum will achieve its environmental objectives.

6.3 Environmental Management Plans

A major component of the EMS are Environmental Management Plans (EMPs). Victoria Petroleum has either developed or adopted a number of EMPs to provide guideline and procedures on the environmental management of activities. EMPs currently in use by Victoria Petroleum are:

- Environmental Management Plan for Drilling and Well Operations in the Cooper and Eromanga Basins, SA (Victoria Petroleum 2004)
- Environmental Management Plan for Seismic Operations in the Cooper and Eromanga Basins, SA (PIRSA 2003)

6.4 Environmental Induction

Victoria Petroleum shall hold a formal induction and risk assessment with all field operations personnel prior to the start of production operations to ensure they understand their role in protecting the environment. The induction shall include notification of environmental objectives and environmental requirements.

6.5 Roles & Responsibilities

Environmental roles and responsibilities of Victoria Petroleum personnel and contractors are summarised below.

Safety considerations shall be assessed and managed in accordance with Victoria Petroleum's and contractors' health and safety procedures and are not discussed here. For further information refer to the Victoria Petroleum Safety Management Plan and contractor health and safety documentation.

Victoria Petroleum

- Licence-holder with overall responsibility for environmental compliance.
- Responsible for planning of production operations and approval by PIRSA.
- Undertake early and on-going contact with land owners/occupiers.
- Report serious or reportable incidents to PIRSA and other government agencies / stakeholders if required.

Site Operators/Contractors

- Responsible for ensuring compliance with Victoria Petroleum Environmental Policy, Environmental Procedures, Production Operations Manual and emergency response plan/procedures
- Undertaking appropriate training and inductions
- Responsible for complying with regulatory requirements, including any specific approval conditions
- Report all incidents
- Maintain ongoing liaison with Victoria Petroleum.

6.6 Environmental Procedures

Victoria Petroleum have adopted a number of Environmental Codes of Practice and environmental procedures to assist in the management of environmental consequences of their activities. These procedures include:

- Environmental Procedures – Seismic Operations. Environmental Procedures for Seismic Exploration in the Cooper Basin, South Australia and Queensland (Santos 1999)
- Environmental Procedures for Borrow Pit Management (Santos 1997)
- Stock Proof Fencing Standard (Santos March 2000)
- Environmental Procedures for the Management of Aboriginal Heritage Sites (Santos 1998)
- Code of Environmental Practice – Production and Processing (Santos 1999)
- Code of Environmental Practice – Drilling and Workover Operations (Santos 1998)
- Code of Environmental Practice – Seismic Operations (Santos 1999)
- Field Guide to the Common Plants of the Cooper Basin, South Australia and Queensland (Santos 2003)
- Australian Pipeline Industry Code of Environmental Practice (APIA 2005)

In addition, the environmental assessments carried out for each of Victoria Petroleum's activities contain site specific procedures / requirements which must be followed.

6.7 Production Operations Manual

A Product ion Operations Manual has been complied and is under review by PIRSA for ultimate approval.

6.8 Oil Spill Management and Restoration

A review of oil spill management in the Cooper Basin was conducted by Santos Ltd to determine appropriate criteria for the assessment of oil spill remediation in their operations area and to define when management and monitoring activities of a particular spill site can justifiably cease.

The Santos review recommended the following spill response, which Victoria Petroleum will implement:

- contain the spill
- report the spill
- recover as much spilt material as possible
- fence stock out of the area affected by the spill
- rake the spill area to facilitate the natural biological remediation of the site
- monitor the remediation progress as per monitoring program
- ongoing spill site monitoring and sampling.

Soil samples should be collected from the spill site to determine residual contamination levels and sampling is likely to focus on TPH, BTEX and heavy metals.

Santos are currently developing a Soil Health Index for remediation of oil spills, in consultation with EPA and PIRSA (Santos 2003). It is expected that this will become the industry standard form managing oil spill remediation.

6.9 Abandonment

Victoria Petroleum will progressively rehabilitate facilities that are no longer required (e.g. disused roads, pipeline routes and borrow pits). The rehabilitation of these sites will include:

- removal of all infrastructure and rubbish
- testing for contamination of soil and groundwater and remediation to the relevant regulatory standard
- re-contouring of the land surface to reinstate natural contours and drainage lines, and
- ripping of compacted areas (except in gibber systems) to alleviate compaction and encourage revegetation.

Site specific procedures apply to some facilities. For example, oil flowlines are pigged to remove residual hydrocarbons or sludge and, for buried flowlines, above ground points are cut off and blinded below the surface. Rehabilitation requirements will be determined by the relevant regulatory agency or agencies at the time of abandonment.

Major facilities such as evaporation ponds will also be rehabilitated when they are no longer required. The above process generally applies to abandonment of all facilities, but specific procedures will apply for some facilities.

7 Consultation

The Cooper Basin is a sparsely populated and remote arid region. The local community broadly includes pastoral leaseholders, Innamincka township members, the National Parks and Wildlife Service (NPWS), tourists, petroleum and geothermal explorers and producers and associated contractors.

It is a requirement under the *Petroleum Regulations 2000* that information on consultation with relevant landowners, Aboriginal groups or representatives, government departments or agencies, or any other interested person or parties be outlined in an EIR.

Stakeholders in the Cooper Basin region include regulatory agencies, local tourism and community, industry groups and environmental organisations.

Extensive consultation with stakeholders was undertaken by Santos and PIRSA during production and review of the SACBJV Production and Processing Operations EIR and SEO in 2002/03 (Santos 2003). Consequently, key stakeholders are aware of and understand the relevant issues associated with petroleum production operations in the Cooper Basin.

An overview of each stakeholder group consulted by Santos and issues raised through consultation in the past is provided in Table 18.

Table 18: Key Stakeholder Issues Identified in Previous Consultation by Santos Ltd

Stakeholder	Key Issues
Government Agencies	
Department of the Environment, Water, Heritage and the Arts (Approvals and Wildlife Division) (formerly Environment Australia)	▪ *EPBC Act 1999* requirements
Environment Protection Authority	▪ Licensing and reporting requirements ▪ Monitoring and reporting of particulate emissions ▪ Water quality monitoring in evaporation ponds ▪ Environmental incident reporting (significant environmental incidents) ▪ Waste licensing
Greenhouse Challenge Office	▪ National Pollution Inventory (NPI) reporting
NPWS (Dept. for Environment & Heritage)	▪ Production activities in designated conservation reserves/areas (e.g. Innamincka Regional Reserve, Strzelecki Regional Reserve)
Pastoral Board	▪ Stocking rates ▪ Access to water ▪ Access roads and fences maintenance
PIRSA	▪ Licensing and reporting requirements ▪ Action plans and KPI targets ▪ Oil spill remediation ▪ Produced formation water monitoring and management ▪ Environmental incident reporting (significant environmental incidents)
Tourism SA	▪ Third party use of lease areas ▪ Maintenance of roads ▪ Third party safety
Dept. for Transport, Energy & Infrastructure (formerly Transport SA)	▪ Construction and maintenance of road infrastructure in the Cooper Basin region

Stakeholder	Key Issues
Industry Groups	
APPEA	▪ Yearly greenhouse gas emissions inventory report ▪ Greenhouse gas challenge program
Business Chamber of Australia	▪ Petroleum production and development
Petroleum contractors	▪ Petroleum production and development
Petroleum developers	▪ Petroleum production and development
Pipeline operators	▪ Petroleum production and development
Community/Environmental Groups	
Representatives of Aboriginal groups	▪ Native Title agreements ▪ Heritage clearance of well sites and access tracks ▪ Identification and preservation of Aboriginal cultural heritage sites
Arid Areas Catchment Water Management Board (this role is now fulfilled by the SA Arid Lands Natural Resources Management Board)	▪ Cooper Creek Catchment management
Australian Conservation Foundation	▪ Issue by issue (e.g. operational activities in designated RAMSAR areas)
Conservation Council of South Australia	▪ Issue by issue (e.g. operational activities in designated RAMSAR areas)
Cooper Creek Catchment Committee	▪ Cooper Creek catchment management
Farmers Federation	▪ NASAA organic beef certification requirements ▪ Water access ▪ Pest control
Great Artesian Basin Consultative Council	▪ GAB water extraction
Lake Eyre Basin Coordinating Group	▪ Cooper Creek catchment management ▪ Multiple landuse strategies for the Cooper Basin
Marree Soil Conservation Board (this role is now fulfilled by the SA Arid Lands Natural Resources Management Board)	▪ Issue by issue (e.g. pest control, provision of information)
Nature Conservation Society	▪ Issue by issue (e.g. operational activities in designated RAMSAR areas)
Pastoral leaseholders	▪ Land access ▪ Lease arrangements ▪ NASAA organic beef certification requirements ▪ Cattle Care Quality Assurance System

As Victoria Petroleum's operations are very similar in nature to production activities outlined in the Santos EIR (although at a much smaller scale) it was not considered necessary to undertake another round of extensive consultation with all stakeholders. However several government agencies were consulted during the development of this EIR.

Victoria Petroleum aims to continue to engage stakeholders for the duration of its production activities to ensure that all potential concerns are identified and appropriately addressed.

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9 Abbreviations

ADG Code	Australian Dangerous Goods Code
ALARP	As Low as Reasonably Practical
APPEA	Australian Petroleum Production & Exploration Association
bbls	Barrels (1 barrel = 159 litres)
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
CAMBA	China-Australia Migratory Bird Agreement
CO	Carbon monoxide
CO_2	Carbon dioxide
DEH	Department for Environment and Heritage, South Australia
DEH (Cwlth)	Department of the Environment and Heritage
DWLBC	Department of Water, Land and Biodiversity Conservation
EIR	Environmental Impact Report prepared in accordance with Section 97 of the Petroleum Act 2000 and Regulation 10
EMS	Environmental Management System
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
GAB	Great Artesian Basin
GRE	Glass Reinforced Epoxy
ha	Hectare
H_2S	Hydrogen Sulphide
ISO	International Standards Organisation
JAMBA	Japan-Australia Migratory Bird Agreement
kboe	Thousand barrels of oil equivalent
km	Kilometre
km^2	Square kilometres
KPI	Key performance indicators
L	Litre
LTU	Land Treatment Unit
m	Metre
m^2	Square metre
mg/L	Milligrams per litre
mm	Millimetre
NASAA	National Association for Sustainable Agriculture Australia
NPI	National Pollutant Inventory
NPWS	National Parks and Wildlife Service
OBE	Organic Beef Exporters
PAH	Polycyclic Aromatic Hydrocarbon
PEL	Petroleum Exploration Licence
PFW	Produced Formation Water
PIRSA	Primary Industries and Resources, South Australia

PEL	Petroleum Exploration Licence
PPL	Petroleum Production Licence
psi	Pounds per square inch
PSV	Pressure Safety Valve
ROW	Right-of-Way
SA	South Australia
SACBJV	South Australian Cooper Basin Joint Venture
Santos	Santos Ltd
SEO	Statement of Environmental Objectives prepared in accordance with the Petroleum Act 2000
TPH	Total Petroleum Hydrocarbons

Appendix 1: Victoria Petroleum Environmental Policy

VICTORIA PETROLEUM N.L.

ENVIRONMENTAL POLICY

Victoria Petroleum NL is committed to conducting all its operations and activities in an environmentally sound and responsible manner.

The company plans and manages its activities in order to minimise disturbance to the environment in which it operates by utilising environmental standards consistent with development in technology, industry, codes of practice and all relevant statutory requirements.

Victoria Petroleum NL requires its employees and contractors to undertake their work in an environmentally sound manner and to consider environmental protection, and the protection of native flora and fauna in its operations as one of their responsibilities.

The code of Environmental Practice of the Australian Petroleum Production and Exploration Association Ltd (APPEA) has been accepted by Victoria Petroleum NL as providing the most appropriate basis for its environmental management programme. The basic principals adopted require the company to:

- comply with applicable Commonwealth and State Government's statutory requirements for the protection of the environment
- in the absence of specific regulatory prescription or guidelines adopt the best practicable means available to minimise and ameliorate adverse environment impacts
- consult with appropriate government agencies and other parties so as to meet all statutory requirements and to facilitate effective liaison with government and non government bodies
- ensure timely and effective consultation with landholders (owners or lessees) and where land is held or managed by Aboriginal communities ensure liaison is with relevant and authorised representatives
- assess the regional and local environmental sensitivity and adopt strategies to avoid or protect such areas
- plan to locate, design, operate and decommission all facilities and associated infrastructure so as to avoid or mitigate adverse environmental impact
- monitor environmental effects and audit environmental performance at all stages of exploration, development and production.
- provide adequate training to enable employees to recognise the potential implications of their activities and be equipped and motivated to act in an environmentally responsible manner.

John Kopcheff

Managing Director

Appendix 2: Significant Environmental Benefit Criteria

Preliminary Calculations for Native Vegetation Act 'Significant Environmental Benefit'

The South Australian *Native Vegetation Act 1991* and the *Native Vegetation Regulations 2003* apply to vegetation clearance for petroleum pipeline construction. Under Regulation 5(1)(zd), operations authorised under the *Petroleum Act 2000* are permitted to clear native vegetation, provided that either:

- the clearance is undertaken in accordance with a Statement of Environmental Objectives (SEO) and the Native Vegetation Council has signified that, as a result of work undertaken in accordance with the SEO, there will be a 'significant environmental benefit' (SEB) at the site of the operations or within the same region of the State, or
- the project makes a payment into the Native Vegetation Fund of an amount considered by the Native Vegetation Council to be sufficient to achieve a 'significant environmental benefit'.

This appendix sets out the method of calculation that will be used to determine the size of the 'significant environmental benefit' (SEB) required under the *Native Vegetation Act 1991* for Victoria Petroleum's production operations.

This document also provides estimates of likely vegetation clearance and of the resulting SEB requirement. However, the actual clearance and actual SEB requirement can only be confirmed following pipeline construction, when the actual width of the construction area and the extent of areas where it is narrowed can be assessed. Consequently, it is proposed that the calculations for vegetation removal and SEB requirement will be finalised after the completion of construction.

Area of Vegetation Impacted

Based on a construction width of 30 m and a length of 91.5 km in South Australia, approximately 280 ha will be subject to temporary disturbance for construction of the pipeline, camp and other work sites.

It is noted that this is likely to overestimate the area where native vegetation is actually removed, for the following reasons:

- the vegetation present is sparse in many areas. Although essentially all the area cleared are vegetated with 'native vegetation', there are many bare areas, and the total cover in many other areas is very low, particularly if annual and ephemeral species (which are likely to be minimally impacted by pipeline construction) are excluded.
- significant vegetation (e.g. large trees) can be left standing within the area that is 'cleared' for facilities and flowlines.

The majority of the disturbance involved in pipeline construction is temporary. The construction right-of-way will be rehabilitated following construction. Good regeneration of native vegetation on the right-of-way is expected[9] because soil disturbance is short term, topsoil and any seedstock it contains will be replaced, the right-of-way is narrow and seed sources are available adjacent to it to allow recolonisation, and weed levels are low so competition from weeds will be low.

Type and Significance of Vegetation Present

Vegetation on the routes is predominantly low open shrubland, open lignum or Acacia shrubland and open coolibah woodland.

[9] Although there are no data available on regeneration on a pipeline right-of-way in the region, evidence from studies of historic seismic lines in the region (which used outdated practices involving significant soil disturbance) has shown that good regeneration of native vegetation occurs unless poor soil management has resulted in erosion.

All of the vegetation types recorded are very common and widespread throughout the region. No plant species with a conservation rating at State or National level were found during the field inspection.

Vegetation communities identified along the pipeline are discussed in Section 5.4,

No rare or threatened plant species were observed during the survey. Whilst the occurrence of such flora species cannot be completely ruled out, it is considered that if any are present, they would be in very low numbers.

Calculation of SEB Requirement

The Native Vegetation Act or Regulations do not explicitly define SEB or prescribe the extent of SEB. Guidelines[10] have been developed for the minerals and petroleum industry to provide a flexible framework for determining the level and method of SEB.

The Guidelines provide a method for calculation of 'set-aside' area, based on the area cleared multiplied by the 'SEB ratio'. The SEB ratios vary from 2:1 to 10:1, depending on vegetation condition. The Guidelines suggest a reduction of the SEB ratio by 50% if on-site re-vegetation (ecological restoration) is carried out following completion of activities.

The guidelines focus mainly on longer term disturbance (e.g. mine sites and petroleum production sites). In the absence of any guidelines more specific to pipelines, Beach proposes to use the Guidelines to determine the SEB requirement for this project.

SEB Ratio

The project area has been subject to historic and ongoing grazing pressure from sheep, cattle, rabbits and other introduced herbivores. The vegetation structure has consequently been altered by selective grazing of various strata, but there are few weeds and most seed sources are likely to be available to regenerate the original structure. Vegetation in the region has not been actively cleared except where required for development of infrastructure.

Consequently, it is considered that the vegetation condition for the pipeline route falls under the Guidelines' category of: *Native vegetation with some disturbance*. The Initial SEB assessment ratio for *Native vegetation with some disturbance*, based on Table 1 of the Guidelines is 6:1 (area).

If the Guidelines are used to calculate the SEB requirement, they indicate that the SEB ratio should be reduced by 50% because on-site restoration will be undertaken i.e. the ratio becomes 3:1.

Proposed SEB

As discussed above, it is proposed that the SEB requirement be discussed with PIRSA and the Native Vegetation Council to determine an appropriate requirement.

Victoria Petroleum will undertake work to achieve a SEB based on the actual area of disturbance and the SEB ratios outlined above. This work is proposed to be undertaken as a component of a broader programme to achieve a SEB for vegetation clearance resulting from Victoria Petroleum's current and future activities in the region.

Discussions are ongoing with the SAAL NRM Board and other organisations regarding potential SEB projects. Victoria Petroleum will continue to engage with PIRSA and the Native Vegetation Council / DWLBC to ensure that an appropriate SEB is achieved.

[10] Dept. of Water, Land & Biodiversity Conservation (2005) *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetation associated with the minerals and petroleum industry*. Prepared for the Native Vegetation Council, September 2005.