

South Australia Cooper Basin



Addendum to the Environmental Impact Report: Production and Processing Operations

Five Year Review of the Statement of Environmental Objectives

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DOCUMENT CONTROL SHEET						
Summary of Updates to Cooper Basin Production and Processing Operations EIR (2003) and SEO (2010)						
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Addendum to P&P EIR	0	24 Oct 2008	S. Milne	BW	PN (Santos)	Santos internal review comments included. Issued to PIRSA
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1 Introduction

The *South Australia Cooper Basin Joint Venture Statement of Environmental Objectives: Production and Processing Operations, October 2003* (SEO) (Santos 2003b) was prepared by Santos and, following an extensive consultation process, was approved under the *Petroleum Act 2000* in October 2003.

Under Regulation 14 of the *Petroleum and Geothermal Regulations 2000* (the Regulations), an approved SEO must be reviewed at least once in every five years. As such, Santos, as author of the SEO, has undertaken a review of the SEO. This document provides a summary of the review process and the proposed updates to the SEO.

The original SEO was produced on the basis of an Environmental Impact Report (EIR) (Santos 2003a). This document builds on the information provided in the EIR and has therefore been formulated as an *Addendum to the EIR*.

1.1 Scope and Methodology

The scope of the SEO review was based on the requirements of Sections 99 and 100 of the South Australian *Petroleum and Geothermal Energy Act 2000* (the Act), and regulation 14(2) of the Regulations, which states that a review must take into account, or address:

- (a) changes in information or knowledge in relevant areas
- (b) community expectations in relation to relevant environmental issues
- (c) changes in the use of land
- (d) changes in operational practices
- (e) other matters determined to be relevant by the Minister.

The following steps were undertaken in the review:

- a brief review of the information provided in the *South Australia Cooper Basin Joint Venture Environmental Impact Report: Production and Processing Operations, February 2003* (EIR) was undertaken, with particular reference to items (a), (c) and (d) above
- discussions were held with key groups within Santos to identify any issues with the SEO
- potential revisions to the SEO previously drafted by Santos (some of which had been previously discussed with PIRSA) were reviewed
- discussions were held with PIRSA regarding the review process and any key issues with the SEO
- recent SEOs and comments made during their approval were reviewed to capture changes in approach or expectations
- the information in the SEO was reviewed to assess whether it was current, relevant and adequate
- the SEO was updated where appropriate based on the above information
- following internal Santos review, the revised SEO was submitted to PIRSA.

It is important to note that the SEO is in continual use, and is reflected throughout other documentation (e.g. in the Santos Environment Health and Safety Management System (EHSMS)). For this reason, all revisions were vetted to ensure that they were clearly necessary or beneficial, rather than representing slightly different wording that would achieve the same end result.

2 Information in the EIR

As discussed above, a brief review of the Environmental Impact Report was undertaken to determine whether there were any areas of relevance to the SEO where information required updating, with particular reference to the matters listed in Section 1.1.

In general, the information in the EIR was considered to provide an adequate basis for the preparation of the revised SEO and a full revision of the EIR was not undertaken. Rather, updates to information of specific relevance to the review of the SEO are discussed in Section 2.1. Additional information required to support proposed changes to the SEO is provided in Section 2.2.

2.1 Updates

Operational practices, hazards and risks

There have been no major changes in the operational practices in the Cooper Basin, although improvements are continually being implemented. As such, the description of operations and hazards and risks provided in the EIR are appropriate for current operations.

Since the preparation of the EIR, the drilling of new wells and the maturing of the Cooper Basin operations has resulted in natural variation from the statistics for some aspects of the operations (e.g. total number of wells, total length of pipelines and annual production figures). However, the level of variation is not considered material to the setting of objectives and assessment criteria in the SEO. Consequently, an update of statistics regarding the production and processing operations is not provided in this document.

Since 2003, there has been more extensive use of Glass-fibre Reinforced Epoxy (GRE) material for constructing low pressure oil flowlines. This is not a material change to construction processes or risk factors, but does mean the associated trench may be left open for longer periods of time to allow for pressure testing. As such more stringent fauna management measures have been introduced at Objective 7 of the SEO.

Production Licences and Pipeline Licences

There have been minor changes to the South Australia Cooper Basin parties' (SACBP¹) production licences in the Cooper Basin since the preparation of the EIR, and at the time of writing this document, Santos and the SACB parties held Production Licences (PPLs) 6 to 167 inclusive (but excluding PPLs 21 and 62); PPLs 169 to 201 inclusive; and PPL 206. However, licence areas can be frequently added or removed and it is recommended that the relevant (Act) licence register (<http://www.pir.sa.gov.au/petroleum/licensing/register>) should be checked if a current listing of licences is required.

The SACBP's Cooper Basin pipelines that operate under Pipeline Licences (PLs) have also been explicitly included in the scope of the SEO (excluding the sales gas pipelines and the liquids pipeline to Port Bonython). As noted in Section 3.3, while similar to numerous other unlicensed pipelines that were explicitly covered by the SEO, the following pipelines are licensed (predominantly because they cross the SA/Qld border):

- PL 5 – Ballera (Qld) to Moomba pipeline
- PL 9 – Stokes (Qld) to Mettika trunkline
- PL15 – Moon (Qld) to Kerna trunkline
- PL 17 – Jackson (Qld) to Moomba pipeline.

Pipeline Licence 17 was granted in the five years since the gazettal of the initial SEO (Santos, June 2003a).

Description of Existing Environment

Some changes have occurred to the information provided in Section 5 of the EIR. Of particular note are:

- Proclamation of the Coongie Lakes National Park in 2005 (in which oil and gas exploration is excluded) and establishment of three adjacent management zones (which supersede the

¹ The SACB parties are the parties to joint ventures in the Cooper Basin operated by Santos

previous Coongie Lakes Control Zone): the “No-mining Zone”, the “Walk-in Mining Zone” and the ‘Controlled Access Mining Zone”

- Ongoing changes to the conservation status of numerous species that occur in the region under state and Commonwealth legislation
- Changes to the state’s natural resources management framework, with the introduction of the South Australian Arid Lands Natural Resources Management Board
- Change over time in the statistics quoted (e.g. tourist visitation, value of pastoral production).

While these changes need to be considered by the SACBP when planning and undertaking operations, they are not considered to make a significant difference to the evaluation of hazards, risks and management measures in the EIR.

Native Vegetation Legislation

The *Native Vegetation Regulations 2003* came into force subsequent to the development of the SEO. These regulations mean that the *Native Vegetation Act 1991* now applies to vegetation clearance for petroleum operations. Under Regulation 5(1)(zd), petroleum operations are permitted to clear native vegetation, provided that either:

- the clearance is undertaken in accordance with a 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’.

A ‘significant environmental benefit’ is typically achieved by undertaking works to establish, regenerate, preserve or maintain native vegetation.

As indicated in Section 3.4, the revised SEO incorporates the requirement to achieve a SEB for vegetation clearance related to production and processing activities that has occurred since the *Native Vegetation Regulations 2003* came into force, in accordance with Regulation 5(1) (zd).

Petroleum exploration does not require a SEB, under Native Vegetation Regulation 5(1)(zc).

Management of Environmental Risks

Section 8.2 of the EIR provides an overview of the EHSMS. While the EHSMS has undergone some evolution since the drafting of the EIR, the principles and practices outlined are still relevant. A brief update on the EHSMS is provided below.

The EHSMS forms the structure of Santos’ approach to managing risks to the environment. Based on AS4801 and AS/NZS ISO 14001, the EHSMS provides rigor and consistency to its performance, and additional surety that Santos is complying with all regulatory obligations.

Santos has a multi-layered approach to managing environmental risks, including:

- vision and policies
- environment committees at Board and management levels
- specialist environmental staff and advisors
- specific standards that employees and contractors must follow as part of their day-to-day responsibilities
- regular internal and external environmental audits.

The EHSMS and the way it is implemented is continually being reviewed and improved. Areas deserving special attention are identified along with other initiatives to foster responsible environmental attitudes and behaviour amongst Santos employees and contractors.

2.2 New or Additional Information

2.2.1 Abandonment & Rehabilitation

Abandonment and rehabilitation of pipelines and facilities was previously covered by the EIR and SEO. The proposed revisions to the SEO provide additional clarification of the abandonment and rehabilitation process and requirements.

The key steps in abandonment and rehabilitation are:

- remove above-ground infrastructure
- assess the site for potential contamination and undertake treatment / remediation if necessary
- restore the site to approximate pre-existing contours (or as otherwise agreed with the regulator and stakeholders), restore natural drainage and relieve compaction (e.g. by ripping) where appropriate

Plans for abandonment and rehabilitation will be developed in consultation with PIRSA and relevant stakeholders. Further details are provided in the SEO.

A risk assessment for abandonment and rehabilitation of pipelines and facilities is provided in Appendix 5.1, as this has been identified as a gap in the EIR.

2.2.2 Cooper Creek water extraction

The extraction of water from Cooper Creek has been added to the SEO as a contingency, to provide a source of water where conventional forms (PFW or bore) are limited and where strict flow and volumetric criteria are met. This water would be used for routine petroleum exploration and production activities, and volumes extracted reported to PIRSA through annual reporting.

Approval to conduct surfacewater extraction from Cooper Creek is subject to the following conditions:

- An approvals request for any proposed extraction is raised internally. This request will include estimated total volume required
- The above request must demonstrate that PFW and Borewater of an acceptable quality cannot be sourced within an economically viable haulage distance (maximum 2 hour return journey)
- Any approved extraction occurs where water flow at Callamurra is $\geq 2.15\text{m}$ ($\geq 0.1\text{m}$ flow at Innamincka Causeway) and rising, and never at permanent water refuges (e.g Callamurra). Accompanying maps in Appendix 5.2 specify locations of approved extraction points at Innamincka, and Kudrieke and Mitchie Crossings. Extraction will only occur at these points, and will not involve permanent pumping stations
- Cumulative extraction volume to be capped at 15 ML per year²
- Cumulative extraction volumes to be recorded in monitoring database and included in annual PIRSA reporting
- Non-conformance with the above is a reportable incident - see Section 3 "Reporting" for incident definitions.

A risk assessment for Cooper Creek water extraction is provided in Appendix 5.1.

² Note if this entire annual allocation was extracted in one day (extremely unlikely) when minimum flow conditions were satisfied this would constitute 0.75% of daily flow at Callamurra gauging station (2,000 ML).

2.2.3 Flowline Fauna Management

Revised fauna management procedures are under development and are included in the SEO. The emphasis is to minimise the duration of time trenches are left open combined with an increased provision of exit structures, permitting fauna self-egress. This strategy will apply to below ground GRE and steel flowlines.

2.2.4 PFW Waterflood

Produced Formation Water waterflood for enhanced oil recovery has been included in the SEO. Extensive information on this process is provided in the EIR for the Jena waterflood pilot project (Santos 2003c) and is not repeated here.

3 Changes to the SEO

It was generally agreed during the review process that the SEO has been effective in establishing appropriate and workable environmental objectives and measurement criteria. Consequently, extensive revisions to the SEO objectives and measurement criteria were not considered to be required and the review exercise can be considered to be a 'fine tuning' of the existing SEO.

The proposed changes to the SEO are described in the following sections.

3.1 Minor Changes and Updates

Details such as abbreviations, names of government departments, statutory bodies, legislation and other SEOs have been updated and a number of corrections to minor errors have been made throughout the document. These have not been individually delineated.

Other minor changes include fonts and paragraph formats (which have been changed to a universally available font and clearly legible paragraph spacing), page numbering and table numbering (which have been simplified) and the map of the Cooper Basin (which has been updated).

3.2 Document Structure

A number of changes to the SEO's structure have been made to 'streamline' the SEO and make it as simple, clear and usable as possible. These changes have included removing material that is not essential to the operation of the SEO or required by the Act.

The key changes to the structure are:

- The columns in the table of environmental objectives and assessment criteria (formerly Table 2-1) have been re-ordered to a more readable structure that has been used in recent SEOs (e.g. the geophysical operations SEO (Santos 2006))
- Consultation information (Section 4 and Appendix 8) has been deleted. This information is of historical value, and is still on record in the original SEO and EIR however it is not required in an SEO by the Act and adds little to the day-to-day use of the SEO
- Appendix 1 (Environmental Hazards and Potential Consequences) has been deleted. This information is contained in the EIR and it is not required in an SEO by the Act
- Appendices 2 to 7 (the Goal Attainment Scaling Criteria) have been re-organised. Three of these tables have been removed (with the majority of their contents incorporated directly into the main body of the SEO), and the contents of the remaining GAS tables have also been modified slightly. A new GAS table to cover rehabilitation of abandoned production facilities has been added. See section 3.4 of this report for further discussion.

3.3 Scope

The broad scope of the SEO remains unchanged and covers the SACBP production and processing operations in the Cooper Basin. However, the following relatively minor modifications to the scope have been made:

- the title of the SEO has been modified to refer to the South Australia Cooper Basin parties (SACBP), rather than the South Australia Cooper Basin Joint Venture. The SACB parties are the parties to joint ventures in the Cooper Basin operated by Santos
- licensed pipelines in the Cooper Basin have been explicitly included in the scope of the SEO (currently this includes PLs 5, 9, 15 and 17). This does not represent a major change to the SEO as it previously covered pipelines under 'gathering systems' and information for several of these licensed pipelines was included in the EIR. The pipelines are individually licensed (and PL 5, 9 and 15 were operating under separate SEOs) predominantly because they cross the SA/Qld border, rather than there being any significant difference in their contents and operation to the unlicensed pipelines that were covered by the SEO. PL 17 (the recently constructed Jackson-Moomba pipeline) was approved under the Production and Processing SEO
- a contingency for extraction of water from Cooper Creek has been added, to provide an alternative source of water when specific flow criteria exist and conventional water sources are unviable
- Produced Formation Waterflood has been added by consolidating information from the Jena Waterflood Pilot Project SEO (Santos 2003d).

Additional detail regarding abandonment is included in the SEO. This is not considered a significant scope change, as the stated scope of the 2003 SEO included abandonment.

3.4 Objectives and Assessment Criteria

The Environmental Objectives and Assessment Criteria (along with the incident definitions discussed in Section 3.5 of this report) are the sections of the SEO most integral to its use. As discussed above, the contents of these have been changed only where the review identified a genuine need for update, clarification or improvement.

The key changes to the Objectives and Assessment Criteria are:

- All objectives:
 - References to GAS criteria in the *Assessment Criteria* column reworded to match the reorganised GAS tables and to ensure that all appropriate entries in the GAS tables are referenced under the correct objective
 - Some redundant information in the *Comments* column has been deleted.
- Objective 1
 - 'Safety' added to the objective wording for clarity i.e. "Minimise any safety risk to the public and other third parties"
 - Reference to 'health risks' added to assessment criteria
 - Additional measures added to *Guide to How Objectives Can Be Achieved* column.
- Objective 2:
 - Reference to wetlands land systems in the *Assessment Criteria* column for well lease and access track construction has been removed as it is not relevant to the objective (which deals with soil) and is inconsistent with the wording in the EIR. Additional reference to wetlands has been added under Objectives 4 (water) and 7 (flora and fauna). Reference to steep tableland land systems has been changed to "steep tableland slopes" to more accurately reflect the EIR
 - Changes made in the *Assessment Criteria* column to remove the reference to disposal criteria for PFW contaminant levels (covered by the GAS criteria in Appendix 2) and

- added requirement “No increase in contamination at LTU’s designated treatment area”.
- Several criteria added that were previously in the GAS tables in Appendix 2, 3 and 6
- Reference to PFW Environmental Management Plan made in *Guide to How Objectives Can Be Achieved* column. EMP follows from extensive risk assessment in 2009, and will incorporate improvement objectives informed by this process
 - Reference to the approved Soil Health Index (SHI) included in the *Comments* column
 - Measures added / edited in *Guide to How Objectives Can Be Achieved* column.
- Objective 3: Assessment criteria modified (“spread” added) to better reflect objective wording and reference to weed management plans added.
 - Objective 4:
 - Assessment criteria “No spills or leaks outside of areas designed to contain them” deleted (the criteria “No water (surface or groundwater) contamination as a result of fuel or chemical storage and handling” adequately reflects the objective)
 - Several criteria and measures that were previously in the GAS tables in Appendix 6 added to *Assessment Criteria* and *Guide to How Objectives Can Be Achieved* columns
 - Assessment criteria, *Guide to How Objectives Can Be Achieved* and comments added for PFW waterflood (taken from the Jena waterflood SEO (Santos 2003d)). Reference to SHI included in *Comments* column
 - Assessment criteria, *Guide to How Objectives Can Be Achieved* and comments added for Cooper Creek water extraction
 - Waste Disposal assessment criteria deleted and cross-referenced to Objective 2
 - Additional measures added to *Guide to How Objectives Can Be Achieved* column.
 - Objective 5:
 - “Known” deleted from objective’s wording
 - Additional measures added to *Guide to How Objectives Can Be Achieved* column.
 - Objective 6:
 - Assessment criteria, *Guide to How Objectives Can Be Achieved* and relevant comments added for PFW waterflood (taken from the Jena waterflood SEO (Santos 2003d))
 - Inclusion of specific well abandonment criteria and objectives removed from SEO (out of scope of Production and Processing SEO), as thoroughly covered in the 2009 Drilling and Well Operations SEO (reference to Objective 6 of this SEO included in Comments section).
 - Objective 7:
 - Assessment criteria, *Guide to How Objectives Can Be Achieved* and comments added for Native Vegetation Act ‘significant environmental benefit’ and fauna management. Several assessment criteria added that were previously in the GAS tables in Appendix 2 and 3
 - Additional measures added to *Guide to How Objectives Can Be Achieved* column including additional reference to wetlands
 - Additional measures added to *Guide to How Objectives Can Be Achieved* to improve fauna management associated with flowline installation.
 - Objectives 8 and 9: No changes (other than updates to names etc).
 - Objective 10: Assessment criteria, *Guide to How Objectives Can Be Achieved* and comments added for Cooper Creek water extraction. Several criteria added that were previously in the GAS tables in Appendix 2 and 3 added to *Guide to How Objectives Can Be Achieved*.
 - Objective 11:
 - Reworded objective to clarify drivers for optimisation.
 - Assessment criteria added – “No increase in contamination at LTU’s designated treatment area”.

- Reference to requirements of the *Public and Environmental Health (Waste Control) Regulations 1995* regarding sewage management added to reflect legislative requirements
- Additional measures added to *Guide to How Objectives Can Be Achieved* column.
- Objective 12:
 - Assessment criteria added to reflect SHI process
 - Assessment criteria “No unresolved reasonable stakeholder complaints” deleted – already covered under Objective 10
 - Assessment criteria, *Guide to How Objectives Can Be Achieved* and comments added for production facility abandonment and pipeline abandonment.
- Objective 13: Additional measures added to *Guide to How Objectives Can Be Achieved* column.
- GAS tables:
 - Following discussions with PIRSA, GAS tables in Appendix 2 and 3 were removed and the criteria they contained were incorporated into the table of environmental objectives and assessment criteria in the SEO. GAS was originally developed to deal with the subjectiveness of visual assessments, but most of the criteria did not have a subjective aspect and could be covered by a single measure. GAS was therefore not considered necessary or appropriate for these. The criteria have been added to the SEO (where not already covered) as either Assessment Criteria or in the *Guide How Objectives Can Be Achieved* column
 - PFW tables (previously Appendix 5 and 6 and part of Appendix 1) were re-organised to split out field audit criteria. Desktop audit criteria and criteria relevant to the SHI process were removed from the appendices following discussions with PIRSA and incorporated into the table of environmental objectives in the SEO where appropriate
 - New GAS table (Appendix 4) has been added to cover rehabilitation of abandoned production facilities. This table is based on the PIRSA (2009) *Field Guide for the Environmental Assessment of Abandoned Petroleum Well Sites in the Cooper Basin, South Australia*.

3.5 Reporting

The key changes are:

- Incident definitions modified to match PIRSA’s standardised incident definitions for operation activities (released in September 2009)
- Non conforming extraction of Cooper Creek surfacewater included as a *Reportable Incident*
- Added reference to requirements to report incidents causing or threatening serious environmental harm to EPA where applicable
- Inclusion of proposed “Rectification Period” to improve SEO compliance in the event of a serious incident.

4 References

DWLBC (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. Department of Water, Land & Biodiversity Conservation

PIRSA (2009). *Field Guide for the Environmental Assessment of Abandoned Petroleum Well Sites in the Cooper Basin, South Australia*. Prepared by the Petroleum and Geothermal Group, Division of Minerals and Energy Resources, Primary Industries and Resources South Australia

Santos (2003a). *South Australia Cooper Basin Joint Venture Environmental Impact Report: Production and Processing Operations*. Santos Ltd, Adelaide

Santos (2003b). *South Australia Cooper Basin Joint Venture Statement of Environmental Objectives: Production and Processing Operations*. Santos Ltd, Adelaide

Santos (2003c). *South Australia Cooper Basin Joint Venture Environmental Impact Report: Waterflood Pilot Project*. Santos Ltd, Adelaide

Santos (2003d). *South Australia Cooper Basin Joint Venture Statement of Environmental Objectives: Jena Waterflood Pilot Project*. Santos Ltd, Adelaide

Santos (2006). *South Australian Cooper Basin Operators Statement of Environmental Objectives: Geophysical Operations*. Santos Ltd, Adelaide

Santos (2009). *South Australia Cooper Basin Statement of Environmental Objectives: Drilling and Well Operations*. Santos Ltd, Adelaide.

5 Appendix

5.1 Appendix 1: Additional Environmental Risk Assessment Summaries

5.1.1 Introduction

This appendix provides summaries of qualitative risk assessments that have been undertaken for aspects of production and processing operations that were not covered in detail in the EIR (Santos 2003a) or have been added to the scope of the SEO. These include:

- Pipeline decommissioning and abandonment
- Production facilities abandonment
- Cooper Creek water extraction.

As indicated in the main body of the Addendum to the EIR, production facilities abandonment and pipeline decommissioning and abandonment were included in the scope of the SEO, however additional detail has been provided here to support the information that has been added to the SEO regarding these activities. Cooper Creek water extraction has been added to the SEO.

Produced formation water waterflood has also been added to the SEO, however detailed risk assessments are provided in the Waterflood Pilot Project EIR (Santos 2003c) and are not repeated here.

5.1.2 Risk Assessment Process

Environmental risk is the chance of something happening that will result in impact to an aspect of the environment. Risk is measured in terms of the consequences of an event and their likelihood.

Section 8 of the EIR (Santos 2003a) provides a description of the risk assessment process. The same process has been used in this assessment, however the tables used to define the various levels of consequence, likelihood and risk have been updated to match the current Santos EHSMS standard for risk assessment (EHSMS09). These tables are provided below.

Consequence Matrix - Natural Environment (from Table 3 in EHSMS09 Appendix A)

Consequence		
Critical	V	Destruction of sensitive environmental features. Severe impact on ecosystem. Regulatory & high level Government intervention/action.
Major	IV	Long term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action
Moderate	III	Short term impact on sensitive environmental features (e.g. gibber plain). Triggers regulatory investigation.
Minor	II	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Requires immediate regulator notification
Negligible	I	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Incident reporting according to routine protocols

Likelihood Descriptors (Table 4 in EHSMS09 Appendix A)

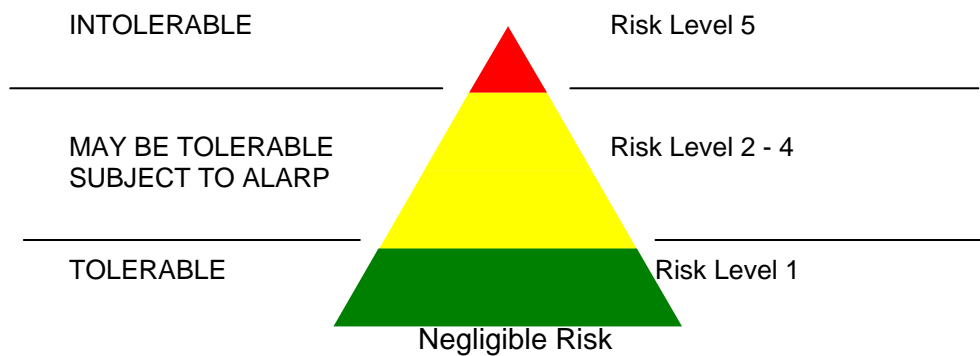
Likelihood	Descriptor
Almost Certain	Will happen often at the location (e.g. Dust causing irritation to the eye during very windy conditions, Release of gas to atmosphere when venting equipment prior to maintenance)
Likely	Could occur at the location or more frequently in Santos (e.g. Eye injury from metal shard, not causing blindness; Spill of oil onto ground requiring cleanup; Back strain requiring time off work);
Possible	Could occur in Santos (e.g. Eye injury causing blindness in one eye; Spill of oil requiring significant cleanup; Back injury resulting in permanent disability)
Unlikely	Incident could occur in the worldwide oil and gas industry (e.g. Complete blindness from chemical burns; Oil spill causing major environmental damage and international adverse publicity; Fatality resulting from toppling heavy equipment while attempting to lift manually)
Remote	Incident not expected to occur in the worldwide oil and gas industry (e.g. Eye injury resulting in death due to infection; Internationally significant environmental effect resulting in destruction of ecosystem; Heart attack of vehicle driver resulting in vehicle impacting plant causing gas release and major plant fire.)

Risk Matrix (Table 5 in EHSMS09 Appendix A)

		Consequence				
		Negligible	Minor	Moderate	Major	Critical
		I	II	III	IV	V
Likelihood	Almost Certain	2	3	4	5	5
	Likely	1	3	3	4	5
	Possible	1	2	3	3	4
	Unlikely	1	1	2	2	3
	Remote	1	1	1	1	2

The level of risk (1-5) is interpreted using the tolerance criteria defined by the following diagram.

EHS and Process Safety Risk Tolerance Levels (Figure 1 in EHSMS09)



5.1.3 Risk Assessments

The following tables summarise the results of the risk assessments for environmental hazards associated with pipeline decommissioning and abandonment, production facilities abandonment and Cooper Creek water extraction.

The results indicate that all of the risk levels are assessed as Level 1 (in the Tolerable region) or Level 2 (the lowest risk level ALARP (As Low As Reasonably Practical) region).

Table A1-1: Pipeline decommissioning and abandonment

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
Movement of machinery and vehicles along ROW and access tracks during rehabilitation	<ul style="list-style-type: none"> ▪ 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 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Vehicle washdown prior to commencing work to prevent the spread of weeds ▪ Driving only on access tracks and pipeline easement ▪ Rip areas of compacted soil (not on gibber plains and tablelands) 	Negligible	Possible	1
Spill or leak associated with pipeline failure / pigging during decommissioning	<ul style="list-style-type: none"> ▪ Contamination of soil and/or watercourse ▪ Disruption to land use (e.g. grazing) ▪ Danger to health and safety of employees, contractors and possibly the public ▪ Atmospheric pollution (gas) ▪ Access to contaminants by stock and wildlife 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ All pipelines are designed, constructed and operated in accordance with the Santos Pipeline Management System including pipeline inspections and maintenance ▪ Pipeline decommissioning programs planned to take into account pipeline condition and location and minimise risk of rupture or leak ▪ Establishment of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Annual review and exercise of response equipment and procedures ▪ Immediate clean-up and remediation to minimise contamination to soil/water ▪ Fencing of contaminated areas if threat is posed to 	Major	Unlikely	2

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
		stock or wildlife <ul style="list-style-type: none"> ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events 			
Spills and leaks associated with chemical and fuel storage and handling	<ul style="list-style-type: none"> ▪ Contamination of soil, groundwater and/or watercourses ▪ Access to contaminants by stock and wildlife 	Appropriate procedures and guidelines include: <ul style="list-style-type: none"> ▪ Implementation of appropriate fuel and chemical storage and handling procedures (e.g. bunding and shut-off valves) in accordance with relevant standards, including AS 1940 and the Australian Dangerous Goods (ADG) Code ▪ Implementation of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Annual 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 ▪ Regularly educate staff of product, review and monitor chemical and fuel storage, including signage/labelling, proper packing and tie downs ▪ Maintain a register of spills and/or leaks and implement corrective actions based on analysis of spill events 	Minor	Possible	2
Earthworks e.g. grading, ripping and backfilling	<ul style="list-style-type: none"> ▪ Injury or death of fauna in a construction zone ▪ Loss of visual amenity ▪ Damage to native vegetation ▪ Introduction and/or spread of weeds ▪ Disturbance to natural drainage patterns ▪ Damage to third party infrastructure ▪ Soil erosion and siltation of watercourses ▪ Inversion of soil profile ▪ Dust generation ▪ Soil compaction 	Appropriate procedures and guidelines include: <ul style="list-style-type: none"> ▪ Minimise impact by restricting earthworks to the minimum area necessary (typically occur on existing, disturbed infrastructure sites) ▪ Time trenchlines remain open to be minimised, with a corresponding increase in the frequency of fauna exit structures ▪ Observation of procedures for location of services and infrastructure ▪ Obtain excavation permits where required ▪ Observation of procedures and guidelines for the identification, management and protection of cultural heritage sites 	Minor	Possible	2

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
	<ul style="list-style-type: none"> ▪ Disturbance to cultural heritage sites 	<ul style="list-style-type: none"> ▪ Rip areas of compacted soil (except on gibber plains and tableland environments) ▪ Respread topsoil and stockpiled vegetation ▪ Restore natural contours to minimise impacts to natural drainage patterns ▪ Minimise vegetation disturbance, and plan works to avoid vegetated areas and significant or “priority” vegetation ▪ Stockpile any cleared vegetation and respread following works to facilitate revegetation. ▪ Minimise impacts to fauna by leaving excavations open for as little time as possible ▪ Vehicle and equipment washdown when operations have been undertaken in areas of known weed infestations ▪ Removal of waste to minimise visual impact ▪ Liaison with landowners regarding notification and management of works and site issues including livestock management 			
Ignition of fire along ROW	<ul style="list-style-type: none"> ▪ 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) 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Operation under fire permit requirements ▪ No smoking or safe smoking 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 sites ▪ Emergency response procedures should contain a bushfire scenario ▪ Safety, testing, maintenance and inspection procedures are implemented 	Moderate	Unlikely	2
Disposal of hydrotest water or water used for flushing pipelines	<ul style="list-style-type: none"> ▪ Contamination of soil and/or watercourse ▪ Loss of vegetation and fauna habitat as a result of soil or water contamination 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Use of biocides and toxic chemicals are kept to a minimum and where practicable biocides which degrade rapidly when exposed to UV shall be used ▪ Disposal of water which contains biocide, other chemicals or hydrocarbons may be into existing lined 	Negligible	Unlikely	1

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
		and fenced evaporation ponds, or to specifically constructed lined pits sited to prevent the contamination of surface or near surface waters			

Table A1-2: Production facilities abandonment

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
Explosion or fire at the satellite	<ul style="list-style-type: none"> ▪ Danger to health and safety of employees, contractors and possibly the public ▪ Contamination of soil and/or watercourse ▪ Atmospheric pollution (gas) 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Abandonment programs planned to avoid or minimise hazardous situations, with controls in place to address risks ▪ No smoking or safe smoking 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 ▪ Immediate clean-up and remediation to minimise contamination to soil/water ▪ Petrol vehicles to be excluded from gas well/pipeline sites ▪ Implementation of appropriate emergency/spill response procedures for explosion or fire ▪ Safety, testing, maintenance and inspection procedures are implemented 	Major	Unlikely	2
Storage of waste and disposal to landfill (e.g. Moomba waste facility)	<ul style="list-style-type: none"> ▪ Scavenging by native and pest species ▪ Pest outbreaks ▪ Contamination of soil and/or groundwater 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Minimise generation of waste where practicable ▪ Recycle and re-use material where possible ▪ Provide suitable covered bins for the collection and storage of wastes ▪ All waste are collected in designated area(s) ▪ Cover all loads of rubbish leaving camps to ensure no spillage 	Minor	Possible	2
Spills and leaks associated with chemical and fuel storage	<ul style="list-style-type: none"> ▪ Contamination of soil, groundwater and/or watercourses ▪ Access to contaminants by stock and wildlife 	Refer to Table A1-1	Minor	Possible	2
Earthworks e.g. grading, ripping and backfilling	<ul style="list-style-type: none"> ▪ Injury or death of fauna in a construction zone ▪ Loss of visual amenity ▪ Damage to native vegetation ▪ Introduction and/or spread of weeds ▪ Disturbance to natural drainage 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Minimise impact by restricting earthworks to the minimum area necessary (typically occur on existing, disturbed infrastructure sites) ▪ Observation of procedures for location of services and infrastructure 	Minor	Possible	2

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
	<p>patterns</p> <ul style="list-style-type: none"> ▪ Damage to third party infrastructure ▪ Soil erosion and siltation of watercourses ▪ Inversion of soil profile ▪ Dust generation ▪ Soil compaction ▪ Disturbance to cultural heritage sites 	<ul style="list-style-type: none"> ▪ Obtain excavation permits where required ▪ Observation of procedures and guidelines for the identification, management and protection of cultural heritage sites ▪ Rip areas of compacted soil (except on gibber plains and tableland environments) ▪ Respread topsoil and stockpiled vegetation ▪ Restore natural contours to minimise impacts to natural drainage patterns ▪ Minimise vegetation disturbance, and plan works to avoid vegetated areas ▪ Avoid significant or "priority" vegetation ▪ Stockpile any cleared vegetation and respread following works to facilitate revegetation ▪ Minimise impacts to fauna by leaving excavations open for as little time as possible ▪ Vehicle and equipment washdown when operations have been undertaken in areas of known weed infestations ▪ Removal of waste to minimise visual impact ▪ Liaison with landowners regarding notification and management of works and site issues including livestock management 			
<p>Movement of machinery and vehicles along ROW and access tracks during rehabilitation</p>	<ul style="list-style-type: none"> ▪ 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 	<p>Refer to Table A1-1</p>	<p>Negligible</p>	<p>Possible</p>	<p>1</p>
<p>Disposal of hydrotest water</p>	<ul style="list-style-type: none"> ▪ Contamination of soil and/or watercourse ▪ Loss of vegetation and fauna habitat as a result of soil or water 	<p>Refer to Table A1-1</p>	<p>Negligible</p>	<p>Unlikely</p>	<p>1</p>

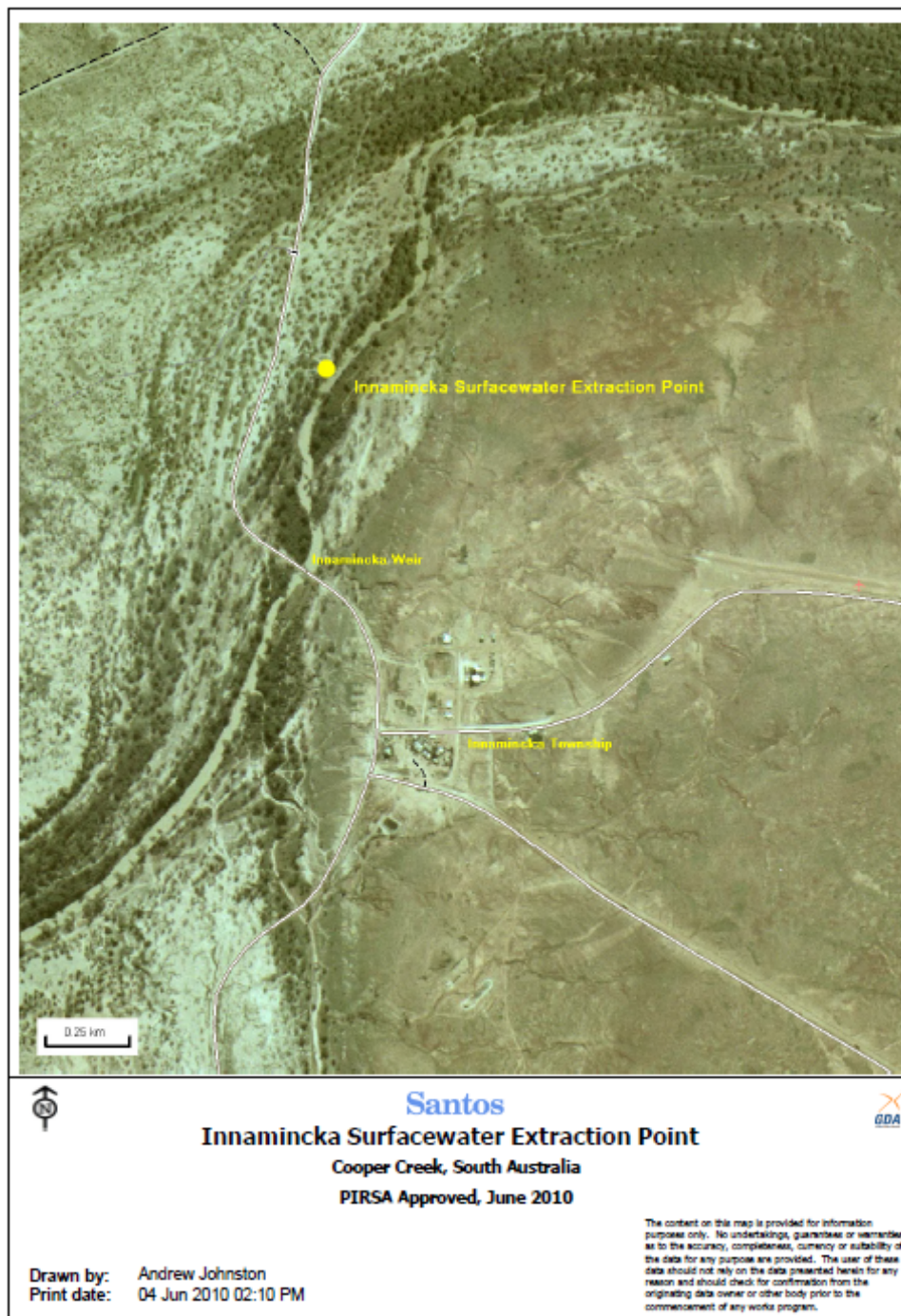
Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
	contamination				
Loss of containment of gas or oil (pipeline rupture or leaks from satellite equipment)	<ul style="list-style-type: none"> ▪ Contamination of soil and/or watercourse ▪ Atmospheric pollution ▪ Danger to health and safety of employees, contractors and possibly the public ▪ Access to contaminants by stock and wildlife ▪ Loss of vegetation and fauna habitat 	<p>Appropriate procedures and guidelines include:</p> <ul style="list-style-type: none"> ▪ Abandonment programs planned to avoid or minimise hazardous situations, with controls in place to address risks ▪ Implementation of appropriate emergency/spill response procedures for spills or leaks to soil and water ▪ Annual review and exercise of response equipment and procedures ▪ 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 	Major	Unlikely	2

Table A1-3: Cooper Creek water extraction

Hazard	Consequence	Management Strategies	Severity of Consequence	Likelihood	Level of Risk
<p>Unsustainable extraction of water from Cooper Creek</p>	<ul style="list-style-type: none"> ▪ Loss of visual amenity ▪ Damage to native vegetation ▪ Introduction and/or spread of weeds ▪ Disturbance to natural drainage patterns ▪ Disturbance to cultural heritage sites ▪ Disruption to land use (e.g. grazing and recreation) ▪ Localised contamination of soil and/or watercourses 	<p>Approved management strategy:</p> <ul style="list-style-type: none"> ▪ An approvals request for any proposed extraction is raised internally. This request will include estimated total volume required ▪ The above request must demonstrate that PFW and Borewater of an acceptable quality cannot be sourced within an economically viable haulage distance (maximum 2 hour return journey) ▪ Any approved extraction occurs where water flow at Callamurra is $\geq 2.15\text{m}$ ($\geq 0.1\text{m}$ flow at Innamincka Causeway) and rising, and never at permanent water refuges (e.g Callamurra). Accompanying maps in Appendix 5.2 specify locations of approved extraction points at Innamincka, and Kudrieke and Mitchie Crossings. Extraction will only occur at these points, and will not involve permanent pumping stations ▪ Cumulative extraction volume to be capped at 15 ML per year ▪ Cumulative extraction volumes to be recorded in monitoring database and included in annual PIRSA reporting ▪ Non-conformance with the above is a reportable incident - see Section 3 "Reporting" for incident definitions. 	<p>Negligible</p>	<p>Possible</p>	<p>1</p>

5.2 Appendix 2: Cooper Creek Surface Water Extraction Points

5.2.1 Innamincka Surfacewater Extraction Point



5.2.2 Mitchie and Kudrieke Crossing Surfacewater Extraction Points

