Eden Energy

Statement of Environmental Objectives:

Geothermal Exploration Drilling

January 2006

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1 Introduction

1.1 Purpose

This Statement of Environmental Objectives (SEO) has been prepared to meet the requirements of sections 99 and 100 of the South Australian *Petroleum Act 2000* (the Act) and regulations 12 and 13 of the *Petroleum Regulations 2000*.

The intent of this SEO is to outline the environmental objectives that Eden Energy are required to achieve during geothermal drilling operations, and the criteria upon which these objectives are to be assessed. Environmental objectives have been developed on the basis of information provided in the Environmental Impact Report (EIR) for the Witchelina Geothermal Energy Project: Proposed Hole WWD1 Re-Entry Programme.

The objectives in this SEO are derived from the *South Australia Cooper Basin Operators Statement of Environmental Objectives: Drilling and Well Operations* (Santos 2003) with minor changes in emphasis reflecting the differences of scale and site and location inside the boundary of Lake Torrens National Park. Although this SEO is directed at exploratory drilling for hot rock information rather than full-scale drilling at the scale of a conventional oil rig, the objectives that have been taken from the Cooper Basin drilling SEO are still generally relevant to the proposed activities. Differences lie in the level of implementation needed to achieve the environmental objectives, given the smaller scale and the simpler engineering concerned, and differences in the specific Lake Torrens margin landscape.

1.2 Scope

This SEO has been developed to apply to the drilling / re-entry of the existing mineral exploration drill hole WWD1, inside the boundary of Lake Torrens National Park. However, it is likely that this SEO (and/or the existing Cooper Basin drilling SEO) may be used to cover future geothermal exploration by Eden Energy. In this case an assessment of these SEOs against proposed activities will be carried out to ensure the SEO(s) cover the activities.

The operations that are covered by this SEO are:

- drilling site and access track construction;
- drilling site and access track abandonment;
- drilling;
- well / drill hole completions and downhole testing; and,
- well / drill hole abandonment.

These operations are described in the EIR.

The Petroleum Act broadly defines the environment to include natural, social, cultural and economic aspect. The environmental objectives outlined in this SEO incorporate all of these elements.

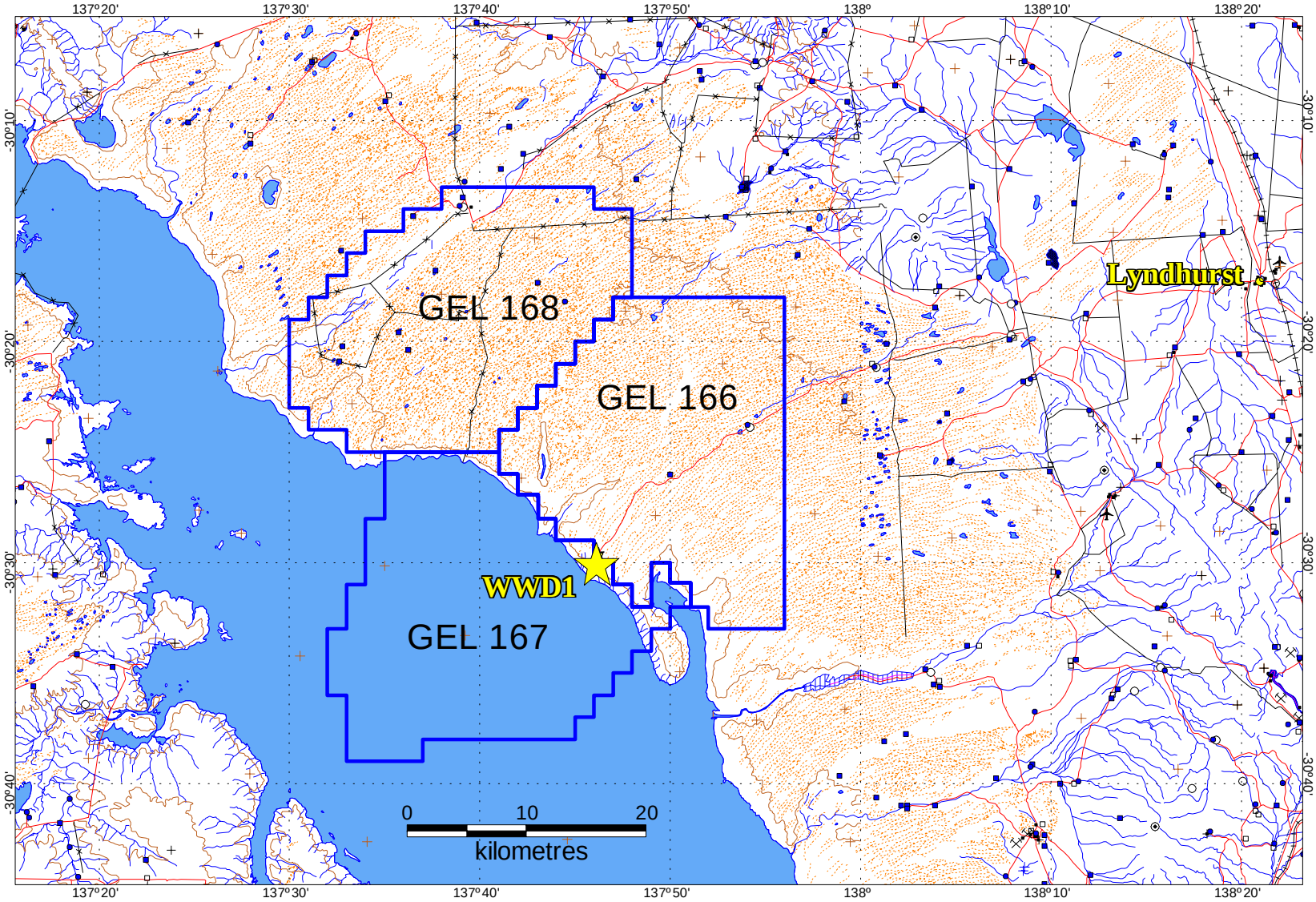

Figure 1-1: Location Map Showing Eden Energy GELs and Drill Hole WWD1

2 Environmental Objectives

2.1 Objectives

The objectives of the Petroleum Act include:

- to minimise environmental damage from activities involved in exploration for, or the recovery or commercial utilisation of, petroleum and other resources to which the Act applies

- to protect the public from risks inherent in regulated activities.

Eden Energy is committed to achieving a range of environmental objectives (listed in Table 1) with respect to the potential environmental risks associated with the proposed geothermal exploration operations that are identified in the EIR. These objectives are in keeping with the objectives of the Petroleum Act.

2.2 Assessment Criteria

The criteria for measuring the achievement of the environmental objectives are detailed in Table 1 and take one of the following forms:

- **Defined conditions -** In some cases, the achievement of an objective can be assessed through ensuring defined conditions are met or carried out. Such conditions include:

    - prohibitions to undertake a specific action (for example, to achieve the objective 'Minimise impacts to soil' during well site and access track construction, the assessment criteria may be to prevent the removal of the gibber mantle in gibber plan areas).

    - Requirements to carry out certain actions in accordance with approved procedures or industry accepted standards (for example, the storage and handling of fuel, oils and chemicals should be undertaken in accordance with Australian Standard AS 1940).

- **Goal Attainment Scaling (GAS) criteria** – Environmental objectives requiring visual assessment are likely to be prone to uncertainties of subjective judgement. To minimise this occurring, GAS is used to measure such objectives against a series of criteria described by a written description and/or photographically. GAS is applicable to measuring objectives related to minimisation of disturbances to natural vegetation, soil and rehabilitation of well sites and access tracks. GAS criteria are referenced where applicable and presented in Appendices 1 to 4.

- **Scientific studies/monitoring** - In some cases the assessment of the environmental objectives may not be possible in the shorter term and may require longer term monitoring and scientific evaluation. In such cases, the assessment criteria may be in the form of longer term data and information gathering (for example, the objective to 'Minimise loss of aquifer pressures and avoid aquifer contamination' may require ongoing monitoring of well bore pressures).

Each objective will be assessed using a selection of the assessment options outlined above. This will enable Eden Energy and others to determine whether the objectives are being achieved. Comments on any variances will be recorded and reported where required (refer section 3 of this report).

Table 1: Environmental Objectives and Assessment Criteria

Environmental Objective	Assessment Criteria
1. Minimise the risk to public and other third parties.	Reasonable measures implemented to ensure no injuries to the public or third parties. Fires only permitted as per the *Fires and Emergency Services Act 2005*.
2. Minimise disturbance and avoid contamination to soil.	Ground water and associated drilling mud/fluids contained within designated sumps <u>Well Site and Access Track Construction</u> 0, +1 or +2 GAS criteria are attained for "Minimise impacts on soil" objective as listed in Appendix 1 for well site location and construction and "Minimise visual impacts of abandoned well sites and access tracks" objectives as listed in Appendix 3 for well site and access track restoration. No unauthorised off-road driving or creation of shortcuts. No construction activities are carried out on salt lakes, steep tableland land systems or wetlands land systems (as defined in Cooper Basin Drilling EIR). <u>Borrow pit construction and restoration</u> 0, +1 or +2 GAS criteria are attained for "Minimise Visual Impacts for constructing borrow pits" objective as listed in Appendix 2, and "Minimise visual impacts" and "Minimise impact on soil" objectives as listed in Appendix 4. <u>Fuel and Chemical Storage and Handling</u> No spills/leaks outside of areas designed to contain them. <u>Waste Management</u> All domestic wastes are disposed of in accordance with EPA licensing requirements. Attainment of GAS criteria for "Site left in clean, tidy and safe condition after final clean-up" objective during well site restoration (refer Appendix 3) No spills or leaks from sewage treatment process and sludge pits.
3. Avoid the introduction or spread of pest plants and animals and implement control measures as necessary.	No weeds or feral animals are introduced to operational areas.

Environmental Objective	Assessment Criteria
4. Minimise disturbance to drainage patterns and avoid contamination of surface waters and shallow ground water resources.	Well Lease and Access Track Construction Well leases and access tracks are located and constructed to maintain pre-existing water flows (i.e. channel contours are maintained on floodplains and at creek crossings). Drilling Mud Sumps No overflow of drill cuttings, muds and drilling fluids from mud sumps. No waste material disposal to sumps. Fuel/Chemical Storage and Handling No leaks/spills outside of areas designed to contain them.
5. Avoid disturbance to sites of cultural and heritage significance.	Proposed well sites and access tracks have been surveyed and any sites of Aboriginal and non-Aboriginal heritage identified. Any identified cultural and heritage sites have been avoided.
6. Minimise loss of aquifer pressures and avoid aquifer contamination.	Drilling & Completion Activities There is no uncontrolled flow to surface (Blow out). Sufficient barriers exist in casing annulus to prevent crossflow between separate aquifers or hydrocarbon reservoirs. Relevant government approval obtained for abandonment of any radioactive tool left downhole. Producing, Injection, Inactive and Abandoned Wells No cross-flow behind casing between aquifers, and between aquifers and hydrocarbon reservoirs unless approved by DWLBC.

Environmental Objective	Assessment Criteria
7. Minimise disturbance to native vegetation and native fauna.	No unnecessary disturbance of native species. No unnecessary disturbance of dead plant material. <u>Well Lease and Access Track Construction and Restoration</u> Any sites with rare, vulnerable and endangered flora and fauna have been identified and avoided. 0, +1 or +2 GAS criteria are attained for "Minimise impacts on vegetation" objective as listed in Appendix 1, during well lease and access track site selection and construction and for "Re-establish natural vegetation on abandoned well sites and access track" objective in Appendix 3. <u>Borrow Pits Construction and Restoration</u> 0, +1 or +2 GAS criteria are attained for "Minimise impacts on vegetation" objective as listed in Appendix 2 during borrow pit site selection and construction, and "Minimise Impact on Vegetation" objective in Appendix 4 for borrow pit restoration. <u>Waste Management</u> Refer to assessment criteria for Objective 11. <u>Fuel and Chemical Storage and Management</u> Refer to assessment criteria for Objectives 2 and 4.
8. Minimise air pollution and greenhouse gas emissions.	Compliance with EPA requirements.
9. Maintain and enhance partnerships with the regional community.	No unresolved reasonable complaints from the community.
10. Avoid or minimise disturbance to stakeholders and/or associated infrastructure	No reasonable stakeholder complaints left unresolved.
11. Optimise waste reduction and recovery	With the exception of drilling fluids, drill cuttings and other fluids disposed during well clean-up, and sewage wastes, all wastes to be disposed of at an EPA licensed facility in accordance with EPA Licence conditions. Attainment of GAS criteria for "Site left in clean, tidy and safe condition after final clean-up" objective during well site restoration (refer Appendix 3). Attainment of GAS criteria for "Site left in clean, tidy and safe condition" objective during borrow pit restoration (refer Appendix 4).

Environmental Objective	Assessment Criteria
12. Remediate and rehabilitate operational areas to agreed standards.	No unresolved reasonable stakeholder complaints. Contaminated Site Remediation Contaminated sites are remediated in accordance with criteria developed with the principles of the National Environment Protection Measure for Contaminated sites and in consultation with the EPA. Well Site and Access Track Restoration The attainment of 0, +1 or +2 GAS criteria for (refer Appendix 3): "minimise visual impact of abandoned well sites", "minimise visual impact of abandoned access tracks" and "re-establish natural vegetation on abandoned well sites and access tracks" Abandoned wells are secured flush to the surface. Borrow Pit Restoration The attainment of 0, +1 or +2 GAS criteria for (refer Appendix 5): "minimise impact on vegetation", "minimise impact on soil" and "minimise visual impacts". *Note:* Well abandonment issues addressed under objective 6.
13. Minimise the impact to the values of the Lake Torrens National Park	No significant adverse impact on environmental values of the Lake Torrens National Park. Compliance with the *National Parks and Wildlife Act 1972* and Regulations pertaining to correct conduct in a reserve. Induction of personnel includes familiarisation with the *National Parks and Wildlife Act 1972* and Regulations. The District Ranger is notified of the commencement date of activities at least ten days prior to work commencing (Mr Ken Anderson, District Ranger, Wilpena Pound, telephone 8648 0049, facsimile 8648 0031, email anderson.ken@saugov.sa.gov.au). No firewood or kindling collected from within Lake Torrens National Park. No pets or firearms brought into Lake Torrens National Park.

3 Reporting

Petroleum Regulation 12 (2) requires an SEO to identify events that could cause a serious incident or a reportable incident within the meaning of Section 85 of the *Petroleum Act, 2000*.

3.1 Serious Incidents

Section 85 of the Act defines a serious incident as an incident arising from activities conducted under a licence in which any of the following occur:

(a) a person is seriously injured or killed

(b) an imminent risk to public health or safety arises

(c) serious environmental damage occurs or an imminent risk of serious environmental damage arises

(d) security of natural gas supply is prejudiced or an imminent risk of prejudice to security of natural gas supply arises.

Pursuant to Regulation 12 (2), the incidents listed below are considered to be serious incidents that may arise from the proposed geothermal exploration operations:

- any spill of fuel, oil or hazardous material that encroaches on land outside a drilling site or into groundwater supplies
- any disturbance to sites of Aboriginal or non-Aboriginal heritage significance
- removal (and destruction) of rare, vulnerable or endangered flora and fauna species (without appropriate permits and approvals)
- explosion or fire at any facility or pipeline (i.e. well site)
- well incident that poses an imminent safety or environmental risk
- identification of cross flows in aquifers, or uncontrolled flows to the surface.

3.2 Reportable Incidents

Reportable incidents are incidents (other than a serious incident) arising from activities conducted under a licence.

Pursuant to Regulation 12(2), the incidents listed below are considered to be reportable incidents that may arise from the proposed geothermal exploration operations:

- any spill or leak of fuel/chemical outside areas designed to contain such spills
- demonstrated presence of cross flow or flows to surface from the well bore
- a complaint from a stakeholder as a result of operations
- any introduction of weed species
- detected unauthorised third party access to facilities.

4 References

Eden Energy (2005). *Environmental Impact Report Witchelina Geothermal Energy Project: Proposed Hole WWD1 Re-Entry Programme*. Eden Energy, Perth.

Malavazos, M. & Dobrzinski, I. 1995. *Goal Attainment Scaling Applied to Assessing Environmental Impact of Petroleum Operations in the Cooper Basin*, May, SA DME Report DME 16/90.

PIRSA (1998). *Field Guide for the Environmental Assessment of Abandoned Petroleum Well Sites in the Cooper Basin, South Australia*, Prepared by the Petroleum Group, Dept of Primary Industries and Resources SA.

Santos Ltd (2003). *South Australia Cooper Basin Operators Environmental Impact Report: Drilling and Well Operations.* Santos Ltd, Adelaide.

Santos Ltd (2003). *South Australia Cooper Basin Operators Environmental Impact Report: Drilling and Well Operations.* Santos Ltd, Adelaide.

Social and Ecological Assessment Pty Ltd. (1997). *Field Guide to the Common Plants of the Cooper Basin (South Australia and Queensland)*. Santos Ltd, Adelaide.

Appendix 1: Criteria for Assessing Well Site Location and Construction

Objective	**Minimise impacts on soil**		**Minimise impact on vegetation**	**Reduce disturbance to drainage patterns**
	Roll gibber	***Topsoil stockpiling***	***Minimise perennial vegetation clearance***	***No obstruction of water flows***
-2	Blading has occurred in gibber and tableland environments.	No stockpiled topsoil evident.	Trees of priority 1 in Field Guide[1] (or equivalent species[2]) removed in area where could have been avoided.	Water flows obstructed as a result of earthworks.
-1			Vegetation of priority 2 or 3 in Field Guide[1] (or equivalent species[2]) removed in area where could have been avoided.	Minor channels only obstructed during well lease and access track construction.
0	Gibber rolled.	Topsoil and any cleared vegetation stockpiled at well lease and campsite.	Trees and vegetation removed in area where could not have been avoided.	No obstruction of water flows, or flows diverted around the well lease if required.
+1			No trees removed, only vegetation of priority 4 in Field Guide[1] (or equivalent species[2]) cleared. No trees or vegetation removed.	
+2				No obstruction of channels of any dimension.

[1] Field Guide refers to the *Field Guide to the Common Plants of the Cooper Basin – South Australia and Queensland* (SEA Pty Ltd 1997)

[2] "Equivalent species" means a plant species of similar size, longevity, conservation status and ecological niche in the region where the activities are being carried out.

Appendix 2: Criteria for Assessing the Siting and Construction of Borrow Pits

Objective	Minimise impacts on vegetation	Protect unknown sites of natural, scientific, or heritage significance	Minimise visual impacts
	Perennial vegetation clearance minimised	***Avoid sites***	***Site pit appropriately***
-2	Trees of priority 1 in Field Guide[3] (or equivalent species[4]) removed in area where could have been avoided.	Sites disturbed.	Borrow pit less than 20m from road.
-1	Trees of priority 2 or 3 in Field Guide[1] (or equivalent species[4)] removed in area where could have been avoided.		Borrow pit less than 50m from road.
0	Trees and vegetation removed in area where could not have been avoided.	Sites identified, flagged and avoided.	Borrow pit more than 50m from road. Visible from road due to lack of screening vegetation.
+1	No trees removed, only vegetation of priority 4 in Field Guide[1] (or equivalent species[4)]) cleared.		Borrow pit shielded from road by utilising screening vegetation or landform.
+2	No trees or vegetation removed.	Sites identified, flagged and avoided by 100m.	Borrow pit not visible from road.

[3] Field Guide refers to the *Field Guide to the Common Plants of the Cooper Basin – South Australia and Queensland* (SEA Pty Ltd 1997)

[4] "Equivalent species" means a plant species of similar size, longevity, conservation status and ecological niche in the region where the activities are being carried out.

Appendix 3: Criteria for Assessing Well Site Restoration

Objective	Minimise visual impact of abandoned well sites[5]		Minimise visual impact of abandoned access tracks[1]	Re-establish natural vegetation on abandoned well sites and access tracks[1]		Site to be left in a clean, tidy and safe condition	
	Interdune and floodplain well sites	***Well sites located on dunes***	***Access tracks assessed from the main track***	***For well sites where it has been less than 5 years since restoration***	***For well sites where it has been more than 5 years since restoration***	***Well marked and cellar backfilled***	***Rubbish removed***
-2	The site remains as a prominent consolidated surface with a distinct edge.	Extensive gully erosion down the face of the dune and/or a steep site edge is prominent.	The track is prominent because of a scraped surface, windrows along its edges or gully erosion.	The site remains as a consolidated surface.	No revegetation evident.	Cellar not backfilled completely.	Large items of litter present across site, eg. drums, pieces of casing and cables etc.
-1	The site surface and edge have been contoured into the surrounding landscape, but the colour of foreign material contrasts with the surroundings.	The edge of the site has been restored into the natural contour of the dune, but the colour of foreign material contrasts with the surroundings.	The track surface has been contoured into the surrounding landscape, but the colour of foreign material contrasts with the surroundings.	The colour of foreign material contrasts with the surroundings.	The revegetation mostly consists of annuals and biennials. In contrast to the surroundings, there are few perennials.	Cellar backfilled but no marker erected.	Small items of litter spread over more than 50% of the site, eg. tin cans, nuts and bolts, rags, small pieces of cable and wood etc.
0	The site contours and colour blend with the surroundings; but earthwork disturbance (eg ripping or respreading of original material) is still prominent.	The edge and colour of the site blend with the surroundings. The site contours are visible only when viewed from the top of the dune. They cannot be seen from the base. Erosion gullies are present down the face of the dune but they are not extensive or prominent.	The track contours and colour blend with the surroundings, but the earthwork disturbance (eg. ripping, rolling or respreading of original material) is still prominent.	The site surface has been appropriately restored to facilitate revegetation (eg. ripping or respreading of original material).	The revegetation consists of annuals, biennials and perennials, but there are some bare patches which are inconsistent with the surroundings.	Cellar backfilled and marker erected.	No evidence of litter on site.
+1	The earthwork disturbance is beginning to blend into the surroundings.	The edge and colour of the site blend with the surroundings. The site contours are visible only when viewed from the top of the dune. They cannot be seen from the base. There are no erosion gullies down the face of the dune.	The track contours and colour blend with the surroundings and the earthwork disturbance is beginning to blend also.	The revegetation is extensive and consists of annuals and biennials. In contrast to the surroundings, there are no perennials.	The revegetation, mostly perennials, is consistent with the surroundings, but there is contrast in maturity between them.		
+2	The site contours and colour blend with the surroundings and the earthwork disturbance is indistinguishable from the surroundings.	The edge and colour of the site blend with the surroundings. The site contours are indistinguishable, whether viewed from the top or base of the dune.	The track contours and colour blend with the surroundings and the earthwork disturbance is indistinguishable.	The revegetation is extensive and mostly consists of annuals and biennials. Perennials which are consistent with the surroundings are beginning to establish.	The revegetation type, density and maturity is indistinguishable from the surroundings.		

[5] See PIRSA guidelines (PIRSA 1998) for photographic examples of these outcomes

Appendix 4: Criteria for Assessing the Restoration of Borrow Pits

Objective	**Minimise impact on vegetation**	**Minimise impact on soil**	**Minimise visual impacts**	**Site to be left in a clean and tidy condition**
	Acceptable revegetation after rainfall	***Minimise erosion***	***Borrow pit effectively recontoured and ripped***	***Rubbish removed***
-2	No revegetation evident.	Severe erosion evident.	No recontouring of pit has occurred – pit sides are very steep. Topsoil and vegetation not respread.	Litter present on site.
-1	Revegetation localised on the base of the pit but none or very little on the sides of the pit.	Moderate erosion.	Pit sides battered but not ripped.	
0	Perennial grasses and shrubs revegetated and type consistent with surroundings. Some bare patches still present. Vegetation cover is uniform over base and sides of pit.	Minor erosion along the sides of the pit.	Pit sides battered and ripped along the contour, but are still highly visible. Topsoil and vegetation respread over disturbed area.	No litter present on site.
+1			Pit contours blend well into surrounding landscape, although still evident.	
+2	Vegetation type and density indistinguishable from surrounding landscape.	No erosion anywhere on the pit.	Pit contours indistinguishable from surrounding landscape. Access ripped.	