

APPENDIX 6

Aboriginal Cultural Heritage Assessment



VIEW OF THE MODIFICATION AREA IN ITS NORTHERN PORTIONS.

ABORIGINAL CULTURAL HERITAGE ASSESSMENT

MODIFICATION TO THE BULGA OPTIMISATION PROJECT EASTERN EMPLACEMENT AREA: DISTURBANCE BOUNDARY MODIFICATION

SINGLETON LOCAL GOVERNMENT AREA

JUNE 2016

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FOR UMWELT (AUSTRALIA) PTY LTD
ON BEHALF OF
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Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environmental & Heritage Management (OzArk) has been engaged by Umwelt (Australia) (the Client), on behalf of Bulga Coal Management (BCM; the Proponent) to complete an Aboriginal cultural heritage assessment of the Eastern Emplacement Area (EEA) Disturbance Boundary Modification as part of a Modification to the Bulga Optimisation Project (BOP) within the Singleton Local Government Area.

Approval for the BOP, which related to ongoing operation of the Bulga Surface Operations to 31 December 2035, was granted by the Planning Assessment Commission (under delegation from the Minister for Planning) on 1 December 2014 (SSD-4960; BOP Consent).

BCM proposes a change to the design of the EEA approved in the BOP Consent to a more efficient design, reducing the need for some currently approved infrastructure construction (Modification Area). It is intended that a Modification of the BOP Consent will be sought under section 96(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to obtain approval for the proposed modified development.

The entirety of the Modification Area was assessed during the BOP field survey in December 2011. This survey was undertaken with the assistance of BOP Registered Aboriginal Parties (RAPs). The BOP assessment identified two sites within the Modification Area: BOP OS-2 (AHIMS #37-6-2836) and the northern portions of BOP SC-3 (AHIMS #37-6-2847). The southern portions of BOP SC-3 are in the area of approved disturbance and were salvaged during the BOP salvage program in 2015.

On Friday 12 February 2012 OzArk Principal Archaeologist Ben Churcher, together with Aboriginal community representatives Leanne Kirkman (Hunter Valley Aboriginal Corporation) and Adam Sweeny (Tocomwall Pty Ltd), conducted a pedestrian survey of the Modification Area. One Aboriginal site, BOP IF-8, was recorded as a result of the current assessment and attempts were made to locate previously recorded sites #37-6-2836 and the northern portions of BOP #37-6-2847. Site #37-6-2836 was not able to be located during the survey, while artefacts were recorded at site #37-6-2847.

Due to the nature of the proposed work across the entirety of the Modification Area, newly recorded Aboriginal site, BOP IF-8, and previously recorded sites #37-6-2836 and #37-6-2847 would be totally destroyed should the Modification be approved. The most appropriate measure of management for the sites would entail archaeological salvage which equates to a recorded surface collection of all artefacts (as per 'Category 3' management in the *Bulga Coal Complex Aboriginal Cultural Heritage Management Plan* [ACHMP; BUL SD PLN 0046]).

Recommendations concerning the Modification Area are as follows:

1. As BOP IF-8, BOP OS-2 and BOP SC-3 are unavoidable by the proposed work, all surface artefacts should be collected for safe-keeping. The collection process should be undertaken under a revised Bulga Coal Complex ACHMP and follow the requirements of the 'Category 3' salvage process listed in **Section 6.2** and as described by OzArk (OzArk 2012: 465).
2. At BOP OS-2 no surface artefacts were visible at the time of the 2016 inspection. Salvage of this site should be undertaken, although it may be necessary to use shovels/trowels to remove accumulated silts from the road to fully determine if the recorded artefacts remain within the site boundary.
3. Outside of BOP IF-8, BOP OS-2 and BOP SC-3 there are no constraints to the proposed work, however, the following precautions should be made:
 - a. The proposed works should stay within the assessed area. If the works are required to deviate from the assessed area then further archaeological assessments may be required; and
 - b. Should any items be noted during the proposed work that are suspected to be of Aboriginal origin, then work in the area should cease and the advice from a suitably qualified archaeologist sought to assess the nature of the find and to suggest an appropriate path forward. Protocols contained in the Bulga Coal Complex ACHMP should be followed.

CONTENTS

Executive Summary	iii
1 Introduction	1
1.1 Brief Description of the Modification	1
1.2 Background	1
1.3 Proposed Modification and Associated Work	5
1.4 Modification Area	7
1.5 Relevant Legislation	8
1.5.1 State Legislation	8
1.5.2 Commonwealth Legislation	9
1.5.3 Applicability to the Modification	9
1.6 Assessment Approach	9
2 The Archaeological Assessment	10
2.1 Purpose and Objectives	10
2.1.1 Aboriginal Archaeological Assessment Objectives	10
2.2 Date of Archaeological Assessment	10
2.3 Aboriginal Community Involvement	10
2.3.1 RAP comments on this report	11
2.4 OzArk Involvement	15
2.4.1 Field Assessment	15
2.4.2 Reporting	15
3 Landscape Context	16
3.1 Topography and Hydrology	16
3.2 Geology and Soils	16
3.3 Vegetation	17
3.4 Climate	17
3.5 Land–Use History and Existing Levels of Disturbance	18
3.6 Conclusion	18
4 Aboriginal Archaeology Background	20
4.1 Local Archaeological Context	20

4.1.1	Desktop Database Searches Conducted	20
4.2	Predictive Model for Site Location.....	21
5	Results of Aboriginal Archaeological Assessment.....	25
5.1	Sampling Strategy and Field Methods.....	25
5.2	Effective Survey Coverage.....	26
5.3	Aboriginal Sites Recorded.....	27
BOP-IF8.....		27
5.4	Previously Recorded Aboriginal Sites Located.....	29
5.5	Aboriginal Community Consultation	31
5.6	Discussion	31
5.7	Assessment of Significance	32
5.7.1	Introduction.....	32
5.7.2	Assessed Significance of the Recorded Sites	33
5.8	Likely Impacts to Aboriginal Heritage from The Modification	34
5.8.1	Ecological Sustainable Development Principles.....	35
5.8.2	Cumulative Harm	35
6	Management and Mitigation: Aboriginal Heritage	38
6.1	General Principles for the Management of Aboriginal Sites.....	38
6.2	Management and Mitigation of Recorded Aboriginal Sites	38
7	Recommendations	40
	References	41
	Plates.....	42
	Appendix 1: Aboriginal Community Consultation Log.....	44
	Appendix 2: Survey Methodology (abridged).....	50
	Appendix 3: RAP Comments to this Report.....	60

FIGURES

Figure 1-1: Design of the BOP Disturbance Area from the original EIS	2
Figure 1-2: Design of the BOP Disturbance Area from the revised EIS	3
Figure 1-3: Modification Area showing previous assessment results	4
Figure 1-4: Proposed BOP modification for the revised EEA design (source: Umwelt2016).....	6
Figure 1-5: Aerial showing the Modification Area.	7
Figure 3-1: Landforms of the Modification Area.....	17
Figure 4-1: BOP SC-3 showing extent and numbers of artefacts salvaged in 2015.....	21
Figure 5-1: Survey of the Modification Area.	25
Figure 5-2: Location of BOP IF-8 in relation to the Modification Area.	28
Figure 5-3: View of location of BOP IF-8 and BOP IF-8 artefact.....	28
Figure 5-4: Environment of BOP OS-2.	29
Figure 5-5: Environment of BOP SC-3 in 2016.....	30
Figure 5-6: Selection of artefacts recorded at BOP SC-3 in 2016.....	30
Figure 5-7: Potential impact to heritage items reference matrix.....	36

TABLES

Table 1-1. Changes to the existing approved BOP development.	5
Table 3-1: Landforms within the Modification Area.....	16
Table 4-1: Aboriginal heritage: desktop-database search results.	20
Table 5-1: Survey coverage data.	27
Table 5-2: Landform summary—sampled areas.....	27
Table 5-3: Survey results.	28
Table 5-4: BOP SC-3: locations of exposure one and exposure two.	30
Table 5-5: Significance assessment of BOP IF-8.	34
Table 5-6: BOP OS-2 and BOP SC-3: scientific significance assessment.....	34
Table 5-7: Impact assessment.	35
Table 5-8: Value of heritage impact on heritage items.....	37

PLATES

Plate 1: View of the ridge landform looking towards the Mushroom Composters.....	42
Plate 2: View from upper slope overlooking the Modification Area. Note no GSV.....	42
Plate 3: View of mid-slope landform surveyed by Transect 1.	43
Plate 4: View of tributary to the northeast drainage showing gully erosion and incision.....	43

1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE MODIFICATION

OzArk Environmental & Heritage Management (OzArk) has been engaged by Umwelt (Australia) (the Client), on behalf of Bulga Coal Management (BCM; the Proponent) to complete an Aboriginal cultural heritage assessment of the Eastern Emplacement Area (EEA) Disturbance Boundary Modification (the Modification Area) within the Singleton Local Government Area (LGA).

BCM propose a change to the design of the EEA approved as part of the Bulga Optimisation Project (BOP) to a more efficient design, reducing the need for some currently approved infrastructure. It is intended that a Modification of SSD-4960 will be sought under section 96(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to obtain approval for the proposed modified development.

1.2 BACKGROUND

Approval for the BOP, which related to ongoing operation of the Bulga Surface Operations to 31 December 2035, was granted by the Planning Assessment Commission (under delegation from the Minister for Planning) on 1 December 2014 (SSD-4960; BOP Consent).

The Environmental Impact Statement submitted for the BOP (EIS; Umwelt 2013) assessed the environmental impacts of the original BOP design which included the EEA; an out-of-pit emplacement area located to the north of the Bulga Coal Complex (BCC) Infrastructure Area (**Figure 1–1**). This included part of an area of land owned by Mushroom Composters Pty Ltd (Mushroom Composters). The Response to Submissions and Revised and Amended Project Application Assessment Report prepared for the BOP (Revised Project Report) assessed an amended EEA design which did not involve emplacement on the land owned by Mushroom Composters (**Figure 1–2**). The amended EEA design is approved under the BOP Consent.

Ongoing consultation with the Mushroom Composters has identified an opportunity for an amended design for the EEA which would meet the needs of both companies. The amended design occupies some of the Mushroom Composters land but does not directly impact on the Stage 1 Composting Facility. A Modification to the BOP Consent is proposed to obtain approval for this amended design.

The entirety of the Modification Area was assessed during the BOP field survey in December 2011. This survey was undertaken with the assistance of BOP Registered Aboriginal Parties (RAPs). **Figure 1–3** shows the survey transects undertaken in 2011 and the survey results for the BOP within the Modification Area. This figure shows the survey track of one archaeologist whereas there were up to 12 RAPs present for the survey giving a greater survey coverage than is shown in this figure.

Figure 1-2: Design of the BOP Disturbance Area from the revised EIS (source: Umwelt 2013b).

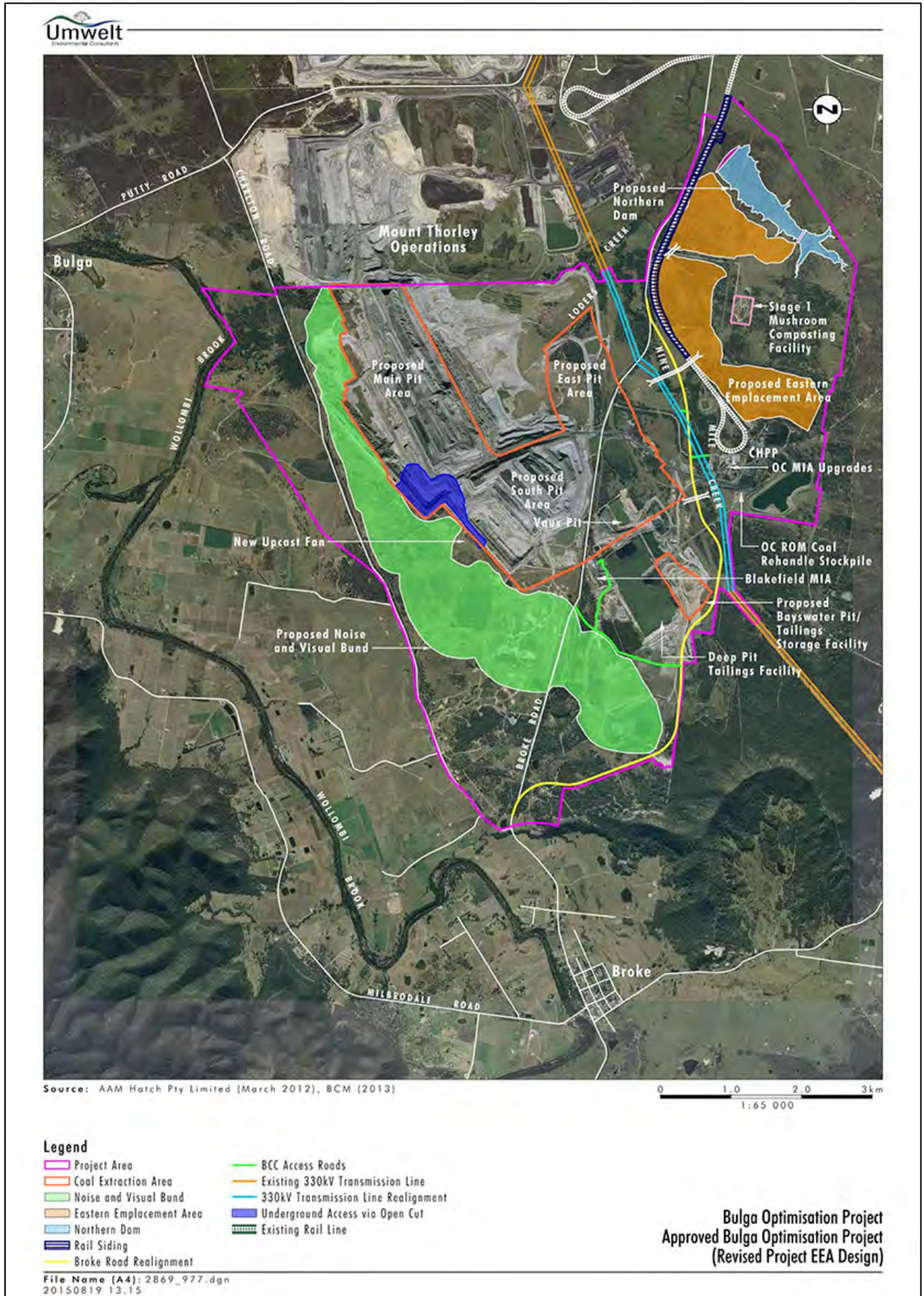
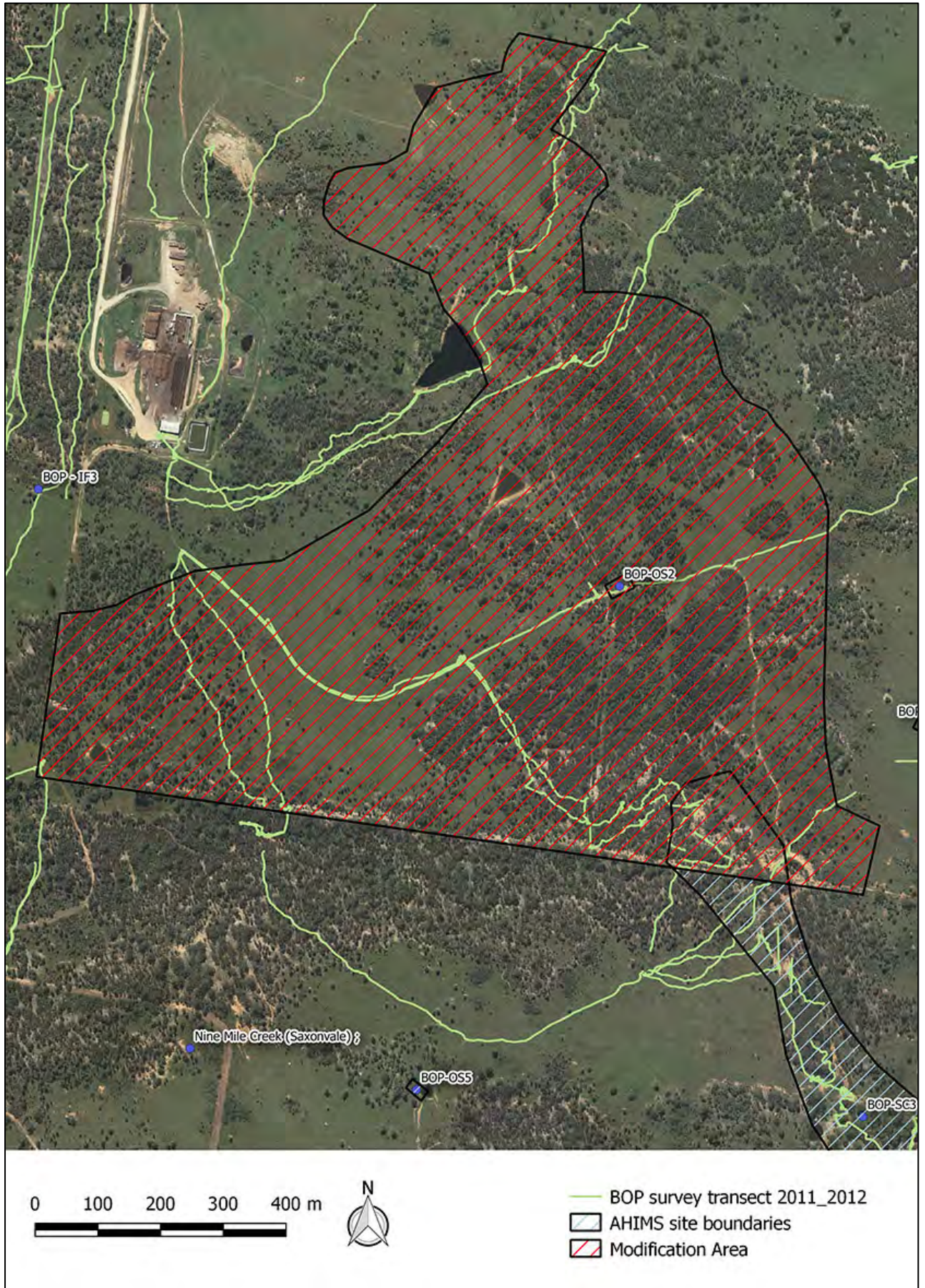


Figure 1-3: Modification Area showing previous assessment results.



1.3 PROPOSED MODIFICATION AND ASSOCIATED WORK

The proposed Modification relates only to the design of the EEA. **Figure 1–4** shows the indicative design of the amended EEA which will be the subject of the proposed Modification. The Stage 1 Composting Facility located on the Mushroom Composters land will remain under the modified EEA design.

Table 1–1 shows the aspects of the existing approved development that will be impacted by the proposed Modification.

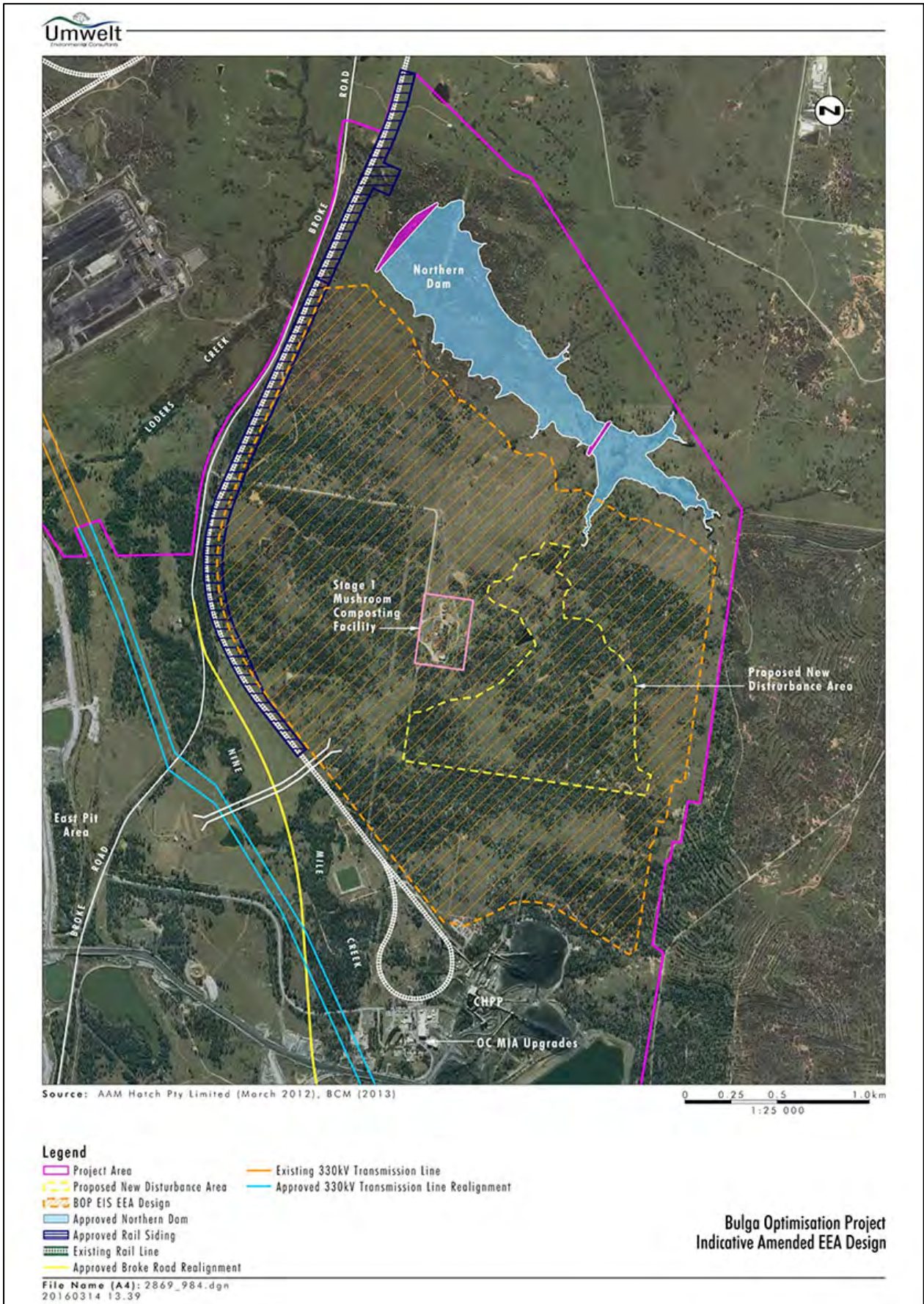
Table 1-1. Changes to the existing approved BOP development.

Approved Development Component	Proposed Modified Development
Mining Areas	No change.
Mining Methods	No change.
Production Rates	No change.
Open Cut MIA	No change.
Eastern Emplacement Area	Design as shown in Figure 1–4 . No change to emplacement schedule described in the revised Project Report.
Noise and Visual Bund	No change.
Underground Infrastructure	No change.
Public Roads	No change.
Tailings and Rejects Strategy	Additional tailings storage facility located within the confines of the existing mining operation, no change to the disturbance area.
External Coal Transport Infrastructure	No change.
Electricity Infrastructure	No change. The approved development includes the relocation of various infrastructure servicing the Stage 1 Mushroom Composting Facility. Some of this infrastructure may not require relocation as a result of the Modification.
Pipelines and Other Services Infrastructure	No change. The approved development includes the relocation of various infrastructure servicing the Stage 1 Mushroom Composting Facility. Some of this infrastructure may not require relocation as a result of the Modification.

Parts of the northern section of the approved EEA will no longer require disturbance as a result of the modified EEA design. Areas not required to be disturbed will be removed from the area of approved disturbance for the development.

The ground-disturbing works associated with the Modification would involve total impact of all landforms shown as ‘Proposed New Disturbance Area’ in **Figure 1–4** (the Modification Area). These works would include the clearing of vegetation, the stripping of topsoil, the emplacement of out of pit material within the area, as well as associated drainage works, sediment capture dams and topsoil stockpiles.

Figure 1-4: Proposed BOP modification for the amended EEA design (source: Umwelt).



1.4 MODIFICATION AREA

The Modification Area is located to the northeast of Glencore Coal Assets Australia Pty Ltd's Bulga Open Cut Operations, Bulga NSW. It is located within Lot 82 DP 1006883 and Lot 1 DP 136366 and covers approximately 89 hectares (**Figure 1-5**).

The Modification Area consists of gentle slopes generally tending to the east. The landforms have been previously cleared for agriculture; although some pockets of regrowth woodland are again becoming established.

Figure 1-5: Aerial showing the Modification Area.



1.5 RELEVANT LEGISLATION

Cultural heritage is managed by a number of state and national acts. Baseline principles for the conservation of heritage places and relics can be found in the *Burra Charter* (Australia ICOMOS 2013). The *Burra Charter* has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The *Burra Charter* generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a state level.

A number of Acts of parliament provide for the protection of heritage at various levels of government.

1.5.1 State Legislation

Environmental Planning and Assessment Act 1979 (EP&A Act)

This Act established requirements relating to land use and planning. The framework governing environmental and heritage assessment in NSW is contained within the following parts of the EP&A Act:

- **Part 4:** Local government development assessments, including heritage. May include schedules of heritage items;
 - **Division 4.1:** Approvals process for state significant development;
- **Part 5:** Environmental impact assessment on any heritage items which may be impacted by activities undertaken by a state government authority or a local government acting as a self-determining authority; and
- **Part 5.1:** Approvals process for state significant infrastructure.

National Parks and Wildlife Act 1974 (NPW Act)

Amended during 2010, the NPW Act provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (Part 6), an Aboriginal object is defined as: any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the NPW Act to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, such as:

- The harm was authorised by and conducted in accordance with the requirements of an *Aboriginal Heritage Impact Permit (AHIP)* under Section 90 of the Act;
- The defendant exercised 'due diligence' to determine whether the action would harm an Aboriginal object; or
- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the Office of Environment and Heritage (OEH) Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on the Aboriginal Heritage Information Management System (AHIMS).

1.5.2 Commonwealth Legislation

***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)**

Amendments in 2003 established the National Heritage List and the Commonwealth Heritage List, both administered by the Commonwealth Department of the Environment. Ministerial approval is required under the EPBC Act for proposals involving significant impacts to National/Commonwealth heritage places.

1.5.3 Applicability to the Modification

A modification of the BOP Consent will be sought under section 96(2) of the EP&A Act.

Any Aboriginal sites within the Modification Area are afforded legislative protection under the NPW Act.

It is noted there are no Commonwealth or National heritage listed places within the Modification Area, and as such, the heritage provisions of the EPBC Act do not apply.

1.6 ASSESSMENT APPROACH

The current assessment follows the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010).

2 THE ARCHAEOLOGICAL ASSESSMENT

2.1 PURPOSE AND OBJECTIVES

The purpose of the current study is to identify and assess heritage constraints relevant to the proposed works.

2.1.1 Aboriginal Archaeological Assessment Objectives

The current assessment will apply the Code of Practice, in the completion of an Aboriginal archaeological assessment, in order to meet the following objectives:

Objective One: Identify and record Aboriginal objects, sites and sensitive landforms within the Modification Area;

Objective Two: To locate previously recorded AHIMS sites 37-6-2836 and 37-6-2847 and assess and record their current status and distribution; and

Objective Three: Assess the likely impacts of the proposed works to any recorded sites and provide management recommendations.

2.2 DATE OF ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk on Friday 12 February 2016.

2.3 ABORIGINAL COMMUNITY INVOLVEMENT

The Modification is considered to be part of the BOP and as such the Modification utilised the BOP Registered Aboriginal Parties list.

The survey methodology (**Appendix 2**) was sent to all RAPs and the four service providers, Wonnarua Nation/Wonnarua People Native Title Group, Tocomwall Pty Ltd, Hunter Valley Aboriginal Corporation and Wonnarua Traditional Custodians, by OzArk on 1 February 2016 for review and advised the closing date for comment on the methodology was 10 February 2016. No specific comment was received from RAPs although Tocomwall Pty Ltd asked OzArk why only 10 days was given to review the methodology. OzArk replied that this survey not be regarded as a new project but rather a continuing part of the BOP process as all areas had been recently assessed with RAP involvement. Moreover, the methodology proposed for the Modification was prepared to be consistent with the methodology used during the BOP. As such, the methodology was seen as part of the on-going consultation regarding the BOP.

Wonnarua Nation/Wonnarua People Native Title Group, Tocomwall Pty Ltd, Hunter Valley Aboriginal Corporation and Wonnarua Traditional Custodians were contacted by OzArk on 10 February 2016 on behalf of the Proponent to request attendance for the survey. Leanne Kirkman attended the fieldwork on behalf of Hunter Valley Aboriginal Corporation and Adam

Sweeny from Tocomwall Pty Ltd. Despite invitations to survey being provided to Wonnarua Nation/Wonnarua People Native Title Group or Wonnarua Traditional Custodians no representatives were provided to attend the fieldwork.

A log and copies of correspondence with Aboriginal community stakeholders is presented in **Appendix 1**.

2.3.1 RAP comments on this report

A draft version of this report was sent to all RAPs with a 28 day review and comment period.

In this time, two comments (by Suzie Worth for Arthur C Fletcher Wonn1 [Kauwul Pty Ltd] and David Ahoy for Lower Hunter Aboriginal Incorporated) were received although the Wanaruah Local Aboriginal Land Council (WLALC) asked for a further 14 days for comment which was granted. However, no comment was forthcoming from the WLALC. The RAP responses are presented in **Appendix 3** although Keith Simkin (Glencore) also spoke with Ms Worth and Mr Arthur Fletcher (for whom Ms Worth is a representative) further on the telephone and took notes of their conversation.

Wonn1 written response

Ms Worth's written response contains the following three comments:

- *We believe that the survey coverage was insufficient, being a one day walk/drive over undertaken by the archaeologist and only two (2) RAP representatives being one representative each from Tocomwal and Hunter Valley Aboriginal Corporation, to cover an area of 86ha. No wonder that only one (1) new site was recorded and no artefacts found at site BOP OS-2.*
- *We feel that further investigation must be carried out over the proposed disturbance area including test excavations at both BOP OS-2 and SC-3 as well as the salvage program.*
- *We want to be included in the record/tag and bag/analyses process.*

OzArk response

- The 2016 survey was a re-survey of areas previously assessed for the BOP in early 2012. As stated in the survey methodology, the main intent of the 2016 survey was to inspect the current condition of known sites and to re-reconnoitre the Modification Area to visually inspect for any changes that may have occurred in the landscape during the intervening four years. Four RAPs were invited to attend the survey, but only two were able to attend on the day. However, this did not diminish the survey effectiveness and OzArk believes the survey coverage of the Modification Area is adequate given the coverage of the 2012 and 2016 surveys. The number of people in the survey team did not hamper the recording of artefacts at BOP OS-2 as the area in which the artefacts were previously recorded was closely inspected. As stated in this report, the site is recorded on a farm track within a landform with a moderate slope and it is likely the artefacts have either been moved downslope by water action or have become obscured

by sediment wash that was noted at the site. While further 'eyes' is always an advantage, the survey was able to establish that the current condition of BOP OS-2 is disturbed and not as it was recorded in 2012. The low 'new' recordings is not testament to 'inadequate survey coverage', but rather, indicative of the generally low archaeological potential of the landforms within the Modification Area.

- As set out above, OzArk does not believe that 'further investigation' (such as survey) will alter our understanding of the Aboriginal cultural heritage values of the Modification Area. OzArk has also assessed that test excavation at BOP SC-3 and BOP OS-2 is not required in order to understand the scientific significance of the sites. The reasons for this are set out below:
 - At BOP SC-3 where sheet wash erosion has been widespread, the soil layers are skeletal and artefacts are recorded resting on B Horizon clays in obviously redeposited locations. Away from the erosion scalds, the A Horizon soil layers remain thin and unlikely to contain intact archaeological deposits. Further, the southern portion of BOP SC-3 was salvaged during 2015 by a surface collection of artefacts as part of the BOP. During this salvage program it was determined that BOP SC-3 contains a low artefact density and that there was no evidence of the artefacts originating from close by subsurface deposits. This information was used in determining that subsurface deposits would be extremely rare within the portion of the site within the Modification Area.
 - At BOP OS-2 two artefacts were recorded on a farm track at obviously re-deposited locations. Therefore test excavation would not be able to ascertain the nature of deposits associated with the artefacts' primary context as this location is unknown. Archaeologically testing the secondary find location of the artefacts would have no scientific basis.
- Ms Worth's third point is noted and should any salvage works be required in the Modification Area this will be done with the assistance of RAPs.

OzArk thanks Wonn1 for its consideration of the report and hopes that the response above alleviates some of the concerns raised by Wonn1.

Wonn1 telephone conversation

Keith Simkin (Glencore) spoke with Ms Worth on the telephone (21 April 2016) and took the following record of the conversation:

Conversation with Suzie Worth:

Summary:

Suzie Worth (SW) rang back Keith Simkin (KS) after KS sent an email requesting a discussion (didn't have her phone number). Discussion about SW response on behalf of Arthur Fletcher to the Eastern Emplacement Area Modification OzArk Report.

Stakeholder Comments:

- *Upset that only two RAPs were part of the survey.*

- *A lot of things change in an area in five years, lots of erosion, lots of land changes, and there should have been a new survey of the area.*
- *It appeared that most of the survey was undertaken in a vehicle, and they would not have seen much that was new at all.*
- *Compared with how Coal & Allied perform their surveys, they include more people, undertake proper transects, do about 75-80% coverage of areas. This survey only covered a very low % for the landforms.*
- *Things do change, we need a full survey redone over the area.*
- *Archaeological sites change a lot - they can move up and down the length of the soil.*
- *Finding more artefacts in an area can indicate the presence of more sub-surface artefacts, these areas should be test excavated.*
- *Questioned how many people were in the field in total for the survey.*
- *We needed more people, particularly for a mine site as sensitive as it is.*
- *Questioned why the Nation didn't get back to us about the survey. Had Bulga Coal contacted more people they would have been able to get more groups involved.*
- *In the future can Bulga Coal contact the groups instead?*
- *Believes that more work needs to be done in the Eastern Emplacement Area.*
- *We will have to look at getting more RAPs involved in the resurvey - should be at least two people from each group, with two OzArk archaeologists to make people feel satisfied that nothing has been overlooked.*
- *SW reviewed the DPE guidelines referred to in the report and looked at the assessment matrix. SW feels that the matrix is unfair from a cultural point of view (acknowledged that this is not Bulga's fault), feels that the matrix is weighted towards the scientific point of view, and that the matrix should be carefully used. If you don't understand the matrix, it can maybe be misinterpreted. They feel that OzArk don't have full understanding of the matrix.*
- *Individual matrix should be used for all sites, not one matrix for the whole area.*

Team Response:

- *KS reminded SW initially that it was a resurvey, and that a detailed survey of the area was undertaken for the BOP EA.*

- *Explained that RAPs for project were invited by OzArk, and that invitations were extended to four RAPs, not just two.*
- *Answered that three people were involved in the survey - two RAPs and Ben Churcher.*
- *Explained that in this case engagement of the RAPs was undertaken by OzArk and not Bulga.*
- *KS thanked SW for the comments, explained that they will be taken seriously, and reported internally.*

During a second telephone conversation with Mr Arthur Fletcher (Wonn1) on 22 April 2016, Keith Simkin noted that Mr Fletcher commented that a stakeholder meeting should have been called to discuss the findings of the survey.

OzArk response

The majority of comments raised by Ms Worth concerning numbers of people involved with the survey and survey effectiveness have been dealt with above in relation to the Wonn1 written response.

The only new comment concerns the determination of overall heritage impact arising from the proposed works that is presented in **Section 5.8** of this report. While this rubric is not part of the finalised *Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (DP&E 2016), OzArk, nevertheless, feels it is a useful tool for bringing together heritage values and the degree of impact to arrive at an overall assessment of heritage impact arising from the proposed Modification. In the matrix there is absolutely no weighting of one heritage value (i.e. scientific values) as opposed to another (i.e. cultural values) to arrive at the 'significance of heritage value' score (as required, this takes into account the four heritage values [cultural, scientific, aesthetic and historic] to arrive at a single heritage value). This is then compared to the degree of planned impact to arrive at an 'overall value of heritage impact'. In this way a site of high heritage significance that is only minimally impacted will have a lower 'overall value of heritage impact' than if it was totally impacted. Similarly, as is the case in this report, sites of low significance that are planned to be totally impacted will have a low 'overall value of heritage impact' indicating that the loss arising from impacts associated with the proposed Modification Area will not be greatly diminish the area's heritage values (as the existing values are low).

In **Section 5.8** the matrix has been applied to individual sites and not the area as a whole.

Mr Fletcher's request for a stakeholder meeting is noted but stakeholder meetings are not normally required for an assessment of this scale and OzArk believes little would be achieved by calling such a meeting.

Lower Hunter Aboriginal Incorporated response

Mr Ahoy's response states in part "*We have endorsed and agreed that all bases were covered and no relevant comments were needed to be incorporated in the modification of the ACHA.*"

OzArk thanks the Lower Hunter Aboriginal Incorporated for its consideration of the report.

2.4 OZARK INVOLVEMENT

2.4.1 Field Assessment

The fieldwork component of the Modification heritage assessment was undertaken by:

- Fieldwork Director: Ben Churcher (OzArk Principal Archaeologist; BA[Hons], University of Queensland, Dip Ed, University of Sydney).

2.4.2 Reporting

The reporting component of the Modification heritage assessment was undertaken by:

- Report Author: Stephanie Rusden (OzArk Project Archaeologist; BA University of New England, BSc University of Wollongong).
- Reviewer: Ben Churcher.

3 LANDSCAPE CONTEXT

An understanding of the environmental contexts of a Modification Area is requisite in any Aboriginal archaeological investigation (DECCW 2010b). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. In addition, natural geomorphic processes of erosion and/or deposition, as well as humanly activated landscape processes, influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

Refer to OzArk 2012 for the general landscape context of the BOP Project Area. The specific landscape context of the Modification Area is detailed below.

3.1 TOPOGRAPHY AND HYDROLOGY

The Modification Area consists of sloping landforms with a ridge in the southwestern portion that generally slopes to the east/northeast towards an unnamed drainage line (northeast drainage). The majority (76 per cent) of the Modification Area is characterised as mid-slopes (**Figure 3–1**; **Table 3–1**).

Hydrological features within the Modification Area are limited to one tributary of the northeast drainage which flows to the northeast and the headwaters of another unnamed drainage line (northeast minor drainage 2; **Figure 3–1**) that flows to the southeast. Both drainage lines were assessed for their entire length during the 2011 BOP survey with BOP SC-3 being recorded along the banks of northeast minor drainage 2. Erosion is reasonably extensive in the environs of drainage systems throughout the BOP Project Area which indicate that larger volumes of water come down the system at certain times (OzArk 2012). The tributary to the northeast drainage was dry at the time of the current assessment while the headwaters of the northeast minor drainage 2 contained some pools of standing water.

Table 3-1: Landforms within the Modification Area.

Landform type	Landform type within Modification Area (m ²)	Percentage of Modification Area	Plates
Ridge/crest	156,590	17.6	Plate 1
Upper slope	115,230	12.9	Plate 2
Mid slope	566,573	63.7	Plate 3
Minor drainage	51,607	5.8	Plate 2
Total	890,000 (89ha)	100	

3.2 GEOLOGY AND SOILS

The geology of this landscape features coal seams, claystone, tuff, siltstone, shale, conglomerate, with red-brown to yellow brown harsh texture-contrast soils on slopes,

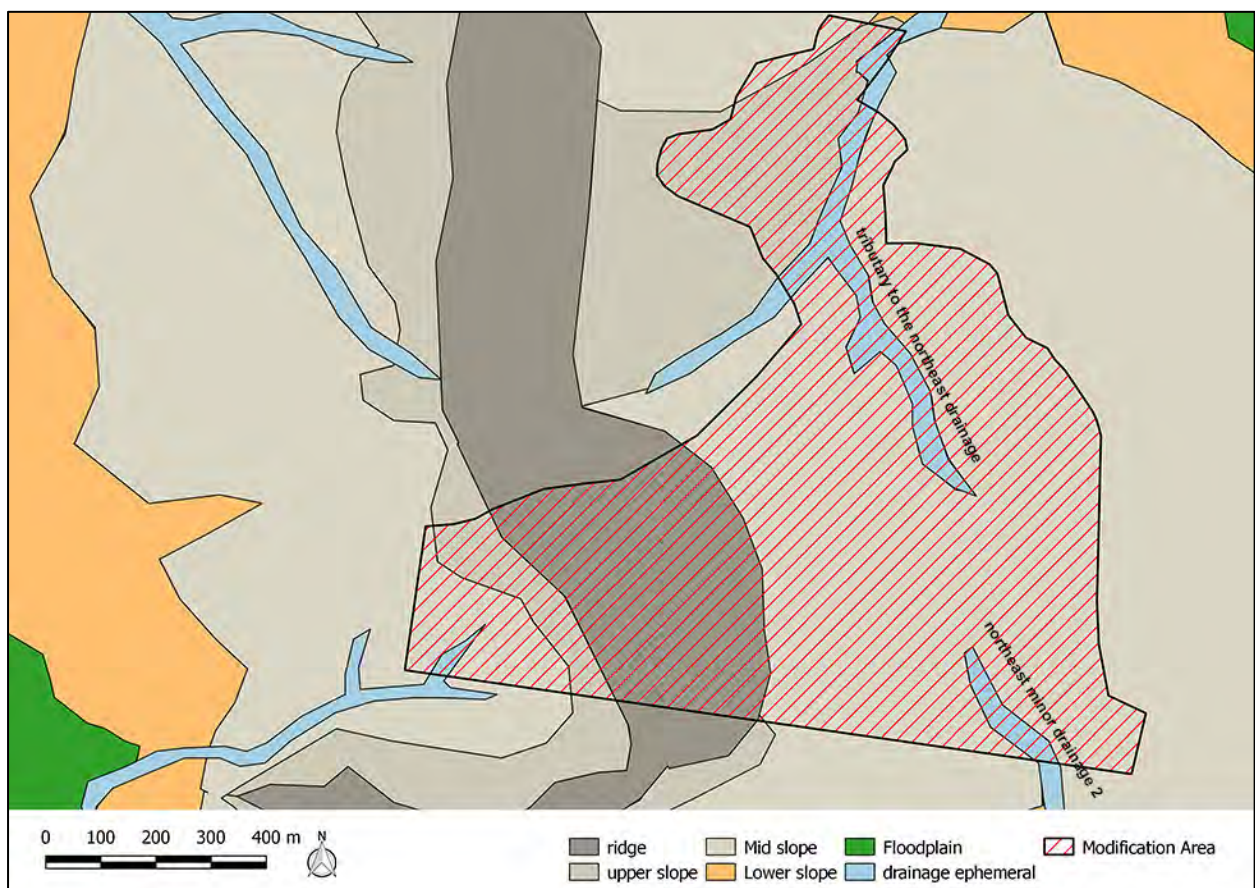
dark coloured clays in valleys and limited accumulations of sand and gravel in streams (Mitchell 2002: 73).

No large rock formations outcrop within the Modification Area. Soils within the Modification Area display two distinct depositional units. The A Horizon is generally red-brown to yellow brown, containing fine sand, silt and gravel while the B Horizon consists of brown-red gravel clay (OzArk 2012).

3.3 VEGETATION

Vegetation within the Modification Area has been historically altered as it has been cleared for agricultural land use. Vegetation now comprises an open woodland of regenerating Eucalypt and Casuarina tree species. The remainder of the Modification Area is primarily vegetated by exotic grasses, weeds and cereal species, which in some areas is very dense thereby inhibiting ground surface visibility.

Figure 3-1: Landforms of the Modification Area.



3.4 CLIMATE

The Sydney Basin Bioregion (SBB) exhibits a temperate climate. Summers are warm and there is no dry season. The northeast portion of the SBB (within which the Modification Area is located) is described as sub-humid. Climate statistics recorded by the Bureau of Meteorology (BOM 2016)

indicate that temperatures in the vicinity of the Modification Area are currently highest in January (31.5° Celsius) and lowest in August (4.1° Celsius). Rainfall recorded at the same site during the same period indicates that rainfall is also highest in February (98.2 millimetres) and lowest in July (26.1 millimetres).

3.5 LAND–USE HISTORY AND EXISTING LEVELS OF DISTURBANCE

The Modification Area is historically agricultural land and is surrounded by more recent mining activity.

The Modification Area consists of cleared paddocks and areas of former grazing land for sheep and cattle. The Modification Area has been subject to vegetation clearance, stock trampling and erosion; most notably sheet wash erosion being exacerbated by tree clearance. In addition, these areas display past disturbances in the form of farm infrastructure with tracks and fences being reasonably common.

3.6 CONCLUSION

The topography, hydrology and climate of the Modification Area would have been conducive to year-round occupation by Aboriginal people in the past. In such a relatively hospitable environment one could expect wide-spread evidence of Aboriginal occupation. Rather than being confined to the banks of waterways, as is often the case in drier environments, the Modification Area could expect evidence of occupation in all landforms apart from the slopes of steep gradient hills which are confined to the west of the Modification Area.

Reference to the landform map (**Figure 3–1**) indicates that the impact to potential archaeological deposits will vary depending on the landform in which they may exist. With respect to the landforms within the Modification Area, the following observations can be made:

- Ridge and crest landforms can preserve archaeological deposits, particularly as this landform unit within the Modification Area is reasonably broad. This ridge landform separates the catchments of Nine Mile Creek from that of the northeast drainage and could have been used for both transit and reconnaissance. However, given that there are no known sources of permanent water in this landform, any occupation is likely to have been short-term or sporadic and it is not expected that this landform would contain numerous or complex sites. Further, as a degrading environment with soil loss stemming from vegetation clearing, it is likely that such sites, should they existed in the past, have been removed or dissipated;
- Upper slopes are characterised by very thin soils due to soil loss following clearing and/or logging. Intact sites are highly unlikely to be located on the flank of slopes and any finds in this environment would be in a secondary context as a result of erosion;
- Mid slopes preserve few opportunities for the retention of archaeological deposits. As with steep slopes, the flanks of the slope are both unsuitable for camping or for the retention of archaeological deposits. Further, the ridge lines within this landform type are unlikely to have been prominent enough to act as a pathway and therefore evidence

of transit camps would be lacking. Moderate slopes are within a degrading environment where soil loss would impact any sites had they existed. Creek systems in this landform type are generally steep-sided and unsuitable for long-term occupation; and

- Drainage landforms are not a hindrance for occupation in the past. However, evidence of this occupation may have become obscured or dissipated due to the impact of flooding events in this landform type. Further, with respect to the Modification Area, these drainage systems are ephemeral and, as such, probably only supported short-term occupation resulting in sites with a low artefact density and a low level of site complexity.

There are no known natural resource sites within the Modification Area that may have been a focus for past Aboriginal occupation.

4 ABORIGINAL ARCHAEOLOGY BACKGROUND

Refer to OzArk (OzArk 2012: 51–98) for ethno-historic sources of regional Aboriginal culture and the Regional Archaeological Context of the Modification Area.

4.1 LOCAL ARCHAEOLOGICAL CONTEXT

4.1.1 Desktop Database Searches Conducted

A desktop search was conducted on the following databases to identify any potential previously-recorded heritage within the Modification Area. The results of this search are summarised here in **Table 4–1**.

Table 4-1: Aboriginal heritage: desktop-database search results.

Name of Database Searched	Date of Search	Type of Search	Comment
Commonwealth Heritage Listings	22.2.16	Singleton LGA	No places listed on either the National or Commonwealth heritage lists are located within the Modification Area
National Native Title Claims Search	22.2.16	NSW	An active Native Title Claim exists for potentially claimable land covering a broad area of the region. The Modification Area lies within the claim area.
Local Environment Plan (LEP)	22.2.16	Singleton LEP of 2013	None of the Aboriginal places noted occur near the Modification Area.

In **Table 4–1**, as much as the Modification Area is entirely freehold land, it is noted that the Modification Area lies within an area that is currently subject to a Native Title Claim by Scott Franks and Anor on behalf of the Plains Clans of the Wonnarua People (Tribunal File No. NC2013/006, Federal Court No. NSD1680/2013).

A search of the OEH administered AHIMS database was not completed over the Modification Area as the Proponent maintains an up-to-date, accurate GIS system of recorded sites within its lease area. In addition, OzArk has undertaken all archaeological assessments at the Bulga Coal Complex during the past five years including the authoring of the Bulga Coal Complex *Aboriginal Cultural Heritage Management Plan* (ACHMP) in late 2014 and as such the current status of Aboriginal sites is well known.

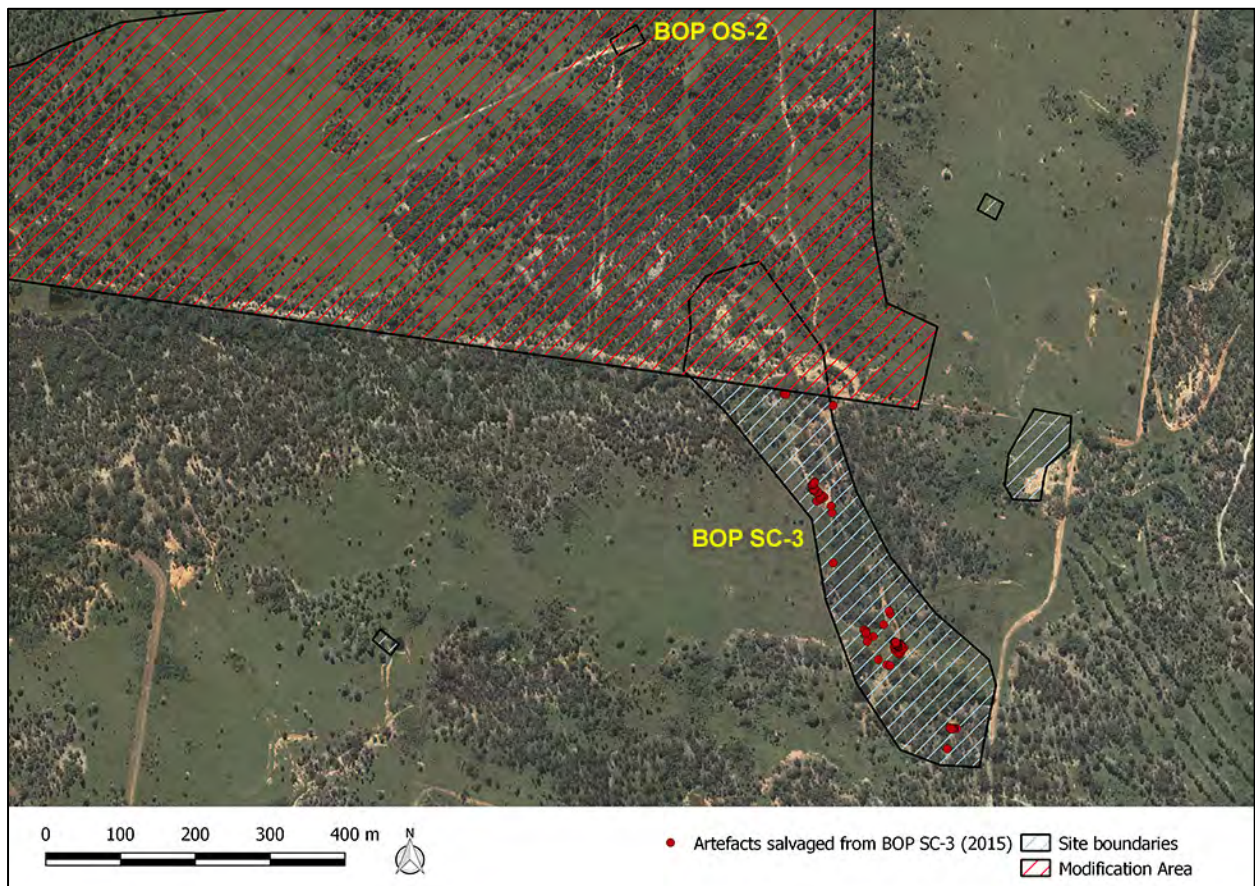
The Bulga Coal GIS displayed that the Modification Area comprises two sites, BOP OS-2 (AHIMS #37-6-2836) an artefact scatter and BOP SC-3 (AHIMS #37-6-2847) a site complex. Both BOP OS-2 and BOP SC-3 were recorded by OzArk in 2012 as a result of the *Aboriginal Archaeological Values Assessment for the Bulga Optimisation Project* (OzArk 2012).

BOP OS-2 is a low density artefact scatter comprising two artefacts that was detected on a farm track as it traversed a hill slope. The site is in a mostly cleared paddock and there is no obvious

topographic reason for this location to have been used. With only two artefacts, BOP OS-2 was noted as probably representing a one-time event. BOP OS-2 was assessed as having low scientific significance as it is a low artefact density artefact scatter in areas of thin A Horizon soil depth.

BOP SC-3 is a low density amalgam of artefact scatters along the unnamed drainage line in an area affected by erosion. BOP SC-3 stretches a total of 0.748km and encompasses an area of approximately 8.7ha. BOP SC-3 displays a low density of artefacts recorded across six exposures with thin A Horizon soils and localised disturbance from erosion. It was assessed as having low scientific significance by OzArk in 2012. Exposures 1 and 2 are within the Modification Area while Exposures 3–6 were salvaged during the BOP salvage program during 2015 (**Figure 4–1**). A total of 124 artefacts were collected during the BOP salvage program with artefact types including blades, flakes, flaked pieces, cores and shatter. Mudstone was the predominant raw material recorded at BOP SC-3 followed by silcrete, with chert, volcanics, quartzite and quartz also recorded.

Figure 4-1: BOP SC-3 showing extent and numbers of artefacts salvaged in 2015.



4.2 PREDICTIVE MODEL FOR SITE LOCATION

Across Australia, numerous archaeological studies in widely varying environmental zones and contexts have demonstrated a high correlation between the permanence of a water source and

the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural/mythological significance. Consequently sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter.

In formulating a predictive model for Aboriginal archaeological site location within any landscape it is also necessary to consider post-depositional influences on Aboriginal material culture. In all but the best preservation conditions very little of the organic material culture remains of ancestral Aboriginal communities survives to the present. Generally it is the more durable materials such as stone artefacts, stone hearths, shell, and some bones that remain preserved in the current landscape. Even these however may not be found in their original depositional context since these may be subject to either (a) the effects of wind and water erosion/transport - both over short and long time scales or (b) the historical impacts associated with the introduction of European farming practices including: grazing and cropping; land degradation associated with exotic pests such as goats and rabbits and the installation of farm related infrastructure including water-storage, utilities, roads, fences, stockyards and residential quarters. Scarred trees may survive for up to several hundred years but rarely beyond.

Using knowledge of the environmental contexts of the Modification Area (see **Section 3.6** for a review of the landform implications for site preservation) and a desktop review of the known local and regional archaeological record (**Section 4.1**), the following predictions are made concerning the probability of site types being recorded within the Modification Area:

- Isolated finds may be indicative of: random loss or deliberate discard of a single artefact, the remnant of a now dispersed and disturbed artefact scatter, or an otherwise obscured or sub-surface artefact scatter. They may occur anywhere within the landscape but are more likely to occur in topographies where open artefact scatters typically occur.
 - As isolated finds can occur anywhere, particularly within disturbed contexts, it is predicted that this site type could be recorded within the Modification Area.
- Open artefact scatters are defined as two or more artefacts, not located within a rock shelter, and located no more than 50 metres away from any other constituent artefact. This site type may occur almost anywhere that Aboriginal people have travelled and may be associated with hunting and gathering activities, short or long term camps, and the manufacture and maintenance of stone tools. Artefact scatters typically consist of surface scatters or sub-surface distributions of flaked stone discarded during the manufacture of tools, but may also include other artefactual rock types such as hearth and anvil stones. Less commonly, artefact scatters may include archaeological stratigraphic features such as hearths and artefact concentrations which relate to activity areas. Artefact density can vary considerably between and across individual sites. Small ground exposures revealing low density scatters may be indicative of background scatter rather than a spatially or temporally distinct artefact assemblage. These sites are classed as 'open', that is,

occurring on the land surface unprotected by rock overhangs, and are sometimes referred to as 'open camp sites'.

Artefact scatters are most likely to occur on level or low gradient contexts, along the crests of ridgelines and spurs, and elevated areas fringing watercourses or wetlands. Larger sites may be expected in association with permanent water sources.

Topographies which afford effective through-access across, and relative to, the surrounding landscape, such as the open basal valley slopes and the valleys of creeks, will tend to contain more and larger sites, mostly camp sites evidenced by open artefact scatters.

- As a majority of the Modification Area is within sloping landforms distant to permanent water, this site type is not predicted to be common. However, in flat or ridge landforms this site type is possible although the moderate degree of disturbance in the Modification Area will probably mean that the scatter has become displaced. It is likely that any sites associated with such landforms are likely to have a low artefact density and a low complexity of tool types as the sites are either one-off events or only infrequently used. It is noted that the Modification Area already has recorded two artefact scatters (BOP SC-3 and BOP OS-2) and this raises the possibility that the area contains further sites of this type.
- Aboriginal scarred trees contain evidence of the removal of bark (and sometimes wood) in the past by Aboriginal people, in the form of a scar. Bark was removed from trees for a wide range of reasons. It was a raw material used in the manufacture of various tools, vessels and commodities such as string, water containers, roofing for shelters, shields and canoes. Bark was also removed as a consequence of gathering food, such as collecting wood boring grubs or creating footholds to climb a tree for possum hunting or bark removal. Due to the multiplicity of uses and the continuous process of occlusion (or healing) following removal, it is difficult to accurately determine the intended purpose for any particular example of bark removal. Scarred trees may occur anywhere old growth trees survive. The identification of scars as Aboriginal in origin can be problematical because some forms of natural trauma and European bark extraction create similar scars. Many remaining scarred trees probably date to the historic period when bark was removed by Aboriginals for both their own purposes and for roofing on early European houses. Consequently the distinction between European and Aboriginal scarred trees may not be clear.
 - Due to the historical clearance of trees from within the Modification Area, this site type is predicted to be very rare.
- Quarry sites and stone procurement sites typically consist of exposures of stone material where evidence for human collection, extraction and/or preliminary processing has survived. Typically these involve the extraction of siliceous or fine grained igneous and meta-sedimentary rock types for the manufacture of artefacts. The presence of quarry/extraction sites is dependent on the availability of suitable rock formations.
 - This site type could be recorded within the Modification Area should suitable rock outcroppings be available.
- Burials are generally found in soft sediments such as aeolian sand, alluvial silts and rock shelter deposits. In Hunter Valley floor and plains contexts, burials may occur in

locally elevated topographies rather than poorly drained sedimentary contexts. Burials are also known to have occurred on rocky hilltops in some limited areas. Burials are generally only visible where there has been some disturbance of sub-surface sediments or where some erosional process has exposed them.

- Although it is possible that this site type could be found within the Modification Area, it is considered a rare site type especially given the lack of suitable landforms within the Modification Area that mostly consist of slopes.

5 RESULTS OF ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

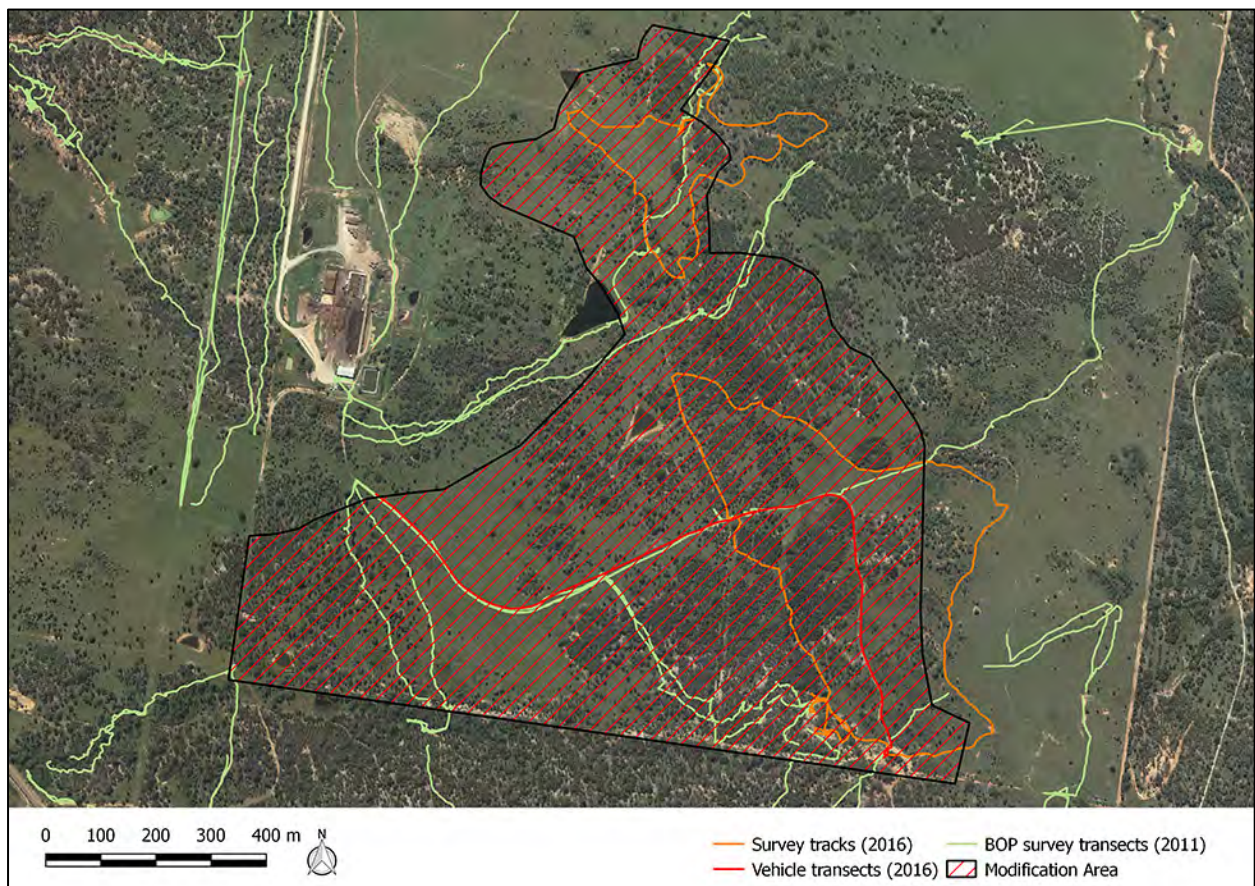
5.1 SAMPLING STRATEGY AND FIELD METHODS

Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004). Two transects were completed as part of the survey to satisfy Objects One and Two (**Section 2.1.1**). Transect 1 was designed to investigate the southern portion of the Modification Area, an area that was not a major focus of the 2011 BOP survey. Transect 2 was undertaken to provide a cross-section of the northern portion of the Modification Area. When combined with the areas assessed during the BOP assessment, the Modification Area has had all constituent landforms and all ephemeral waterways assessed. (**Figure 5–1**).

The location and recording of surface artefacts and locations associated with sites 37-6-2836 and 37-6-2847 was completed utilising a hand held differential GPS and location coordinates as recorded by OzArk (OzArk 2012).

Figure 5–1 illustrates the survey effort of the Modification Area by one person over two survey campaigns (2011 and 2016).

Figure 5-1: Survey of the Modification Area.



5.2 EFFECTIVE SURVEY COVERAGE

Two of the key factors influencing the effectiveness of archaeological survey are ground surface visibility (GSV) and exposure. These factors are quantified in order to ensure that the survey data provides adequate evidence for the evaluation of the archaeological materials across the landscape. For the purposes of the current assessment, these terms are used in accordance with the definitions provided in the *Code of Practice* (DECCW 2010).

GSV is defined as:

... the amount of bare ground (or visibility) on the exposures which might reveal artefacts or other archaeological materials. It is important to note that visibility, on its own, is not a reliable indicator of the detectability of buried archaeological material. Things like vegetation, plant or leaf litter, loose sand, stone ground or introduced materials will affect the visibility. Put another way, visibility refers to 'what conceals' (DECCW 2010: 39).

Exposure is defined as:

... different to visibility because it estimates the area with a likelihood of revealing buried artefacts or deposits rather than just being an observation of the amount of bare ground. It is the percentage of land for which erosion and exposure was sufficient to reveal archaeological evidence on the surface of the ground. Put another way, exposure refers to 'what reveals' (DECCW 2010: 37).

The survey included two transects performed by pedestrian transects (**Figure 5–1**). It needs to be borne in mind that this is the recorded track of the archaeologist only and is therefore representative of the areas assessed: as areas on either side of these tracks were assessed by the attending RAPs who spread out to cover more ground. Effective survey coverage over the Modification Area was variable; mostly either due to exposure incidence or the amount of ground surface visibility away from exposures. **Table 5–1** and **Table 5–2** display that the most effectively surveyed landform was along the smaller drainage (3%), being the landform of greatest archaeological potential, where GSV was reasonably afforded by eroding scalds on the banks of the drainage. This landform unit also recorded the highest number of sites (**Table 5–2**) demonstrating the higher archaeological potential of this landform type, as well as the greater GSV afforded by erosion. GSV was very low on ridge, upper slope and mid slope landforms within the Modification Area due to thick grass cover. Exposures within the mid slope landform were largely afforded by existing access tracks. Although the low GSV did not allow a full investigation of the ground surface in these landform types, there were sufficient exposures (tracks, fence lines and any mounds) to allow the archaeological potential of the landform to be assessed.

It should be noted that the calculations displayed in **Table 5–1** often result in seemingly low effective survey figures. It is often the case that when in the field it does not seem that GSV is

hampered to such an extent. As a result the figures in **Table 5–1** should be seen as relative whereby it can be seen the best GSV and exposures were along the ephemeral drainage lines, then in descending order: ridge lines, mid slope landforms and finally upper slopes. **Table 5–2** indicates that the greater survey effectiveness along the minor drainage lines of the Modification Area facilitated the recording of the greatest number of sites; although these landforms also have the greater archaeological potential for site location. The recording of a site in a mid-slope landform is seemingly not supported by the low effective survey coverage within this landform, although in reality, the recording was due to exposure along a farm track.

Table 5-1: Survey coverage data.

Landform	Survey Unit Area (sq m)	Visibility %	Exposure %	Effective Coverage Area (sq m) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)
Ridge	156,590	15%	5%	1,174	0.75
Upper slope	115,230	5%	3%	173	0.15
Mid slope	566,573	5%	7%	1,983	0.35
Minor drainage	51,607	30%	15%	2,322	4.5

Table 5-2: Landform summary—sampled areas.

Landform	Landform area (sq m)	Area Effectively Surveyed (sq m) (= Effective Coverage Area)	% of Landform Effectively Surveyed (= Area Effectively Surveyed / Landform x 100)	Number of Sites
Ridge	156,590	1,174	0.75	0
Upper slope	115,230	173	0.15	0
Mid slope	566,573	1,983	0.35	1
Minor drainage	51,607	2,322	4.5	2

5.3 ABORIGINAL SITES RECORDED

One Aboriginal site, BOP IF-8, was recorded as a result of the current assessment (**Table 5–3**).

BOP-IF8

Site Type: Isolated Find

GPS Coordinates: GDA Zone 55 325031E 6385068N

Location of Site: BOP IF-8 is located within Lot 82 DP 1006883 within the tributary of an unnamed drainage line (northeast drainage) (**Figure 5–2**).

Description of Site: The site consists of an isolated mudstone flake. It is a proximal fragment with a maximum length of 27mm by a maximum width of 71mm (**Figure 5–3**). The flake was recorded within the in-stream channel of the drainage line and is therefore definitely in a secondary context. As a result, it is assessed that BOP IF-8 is not associated with further, intact, archaeological deposits.

Table 5-3: Survey results.

Site Number	Feature(s)	GPS Coordinates	Landform
BOP IF-8	Isolated find	GDA Zone 55 325031E 6385068N	In-stream channel

Figure 5-2: Location of BOP IF-8 in relation to the Modification Area.

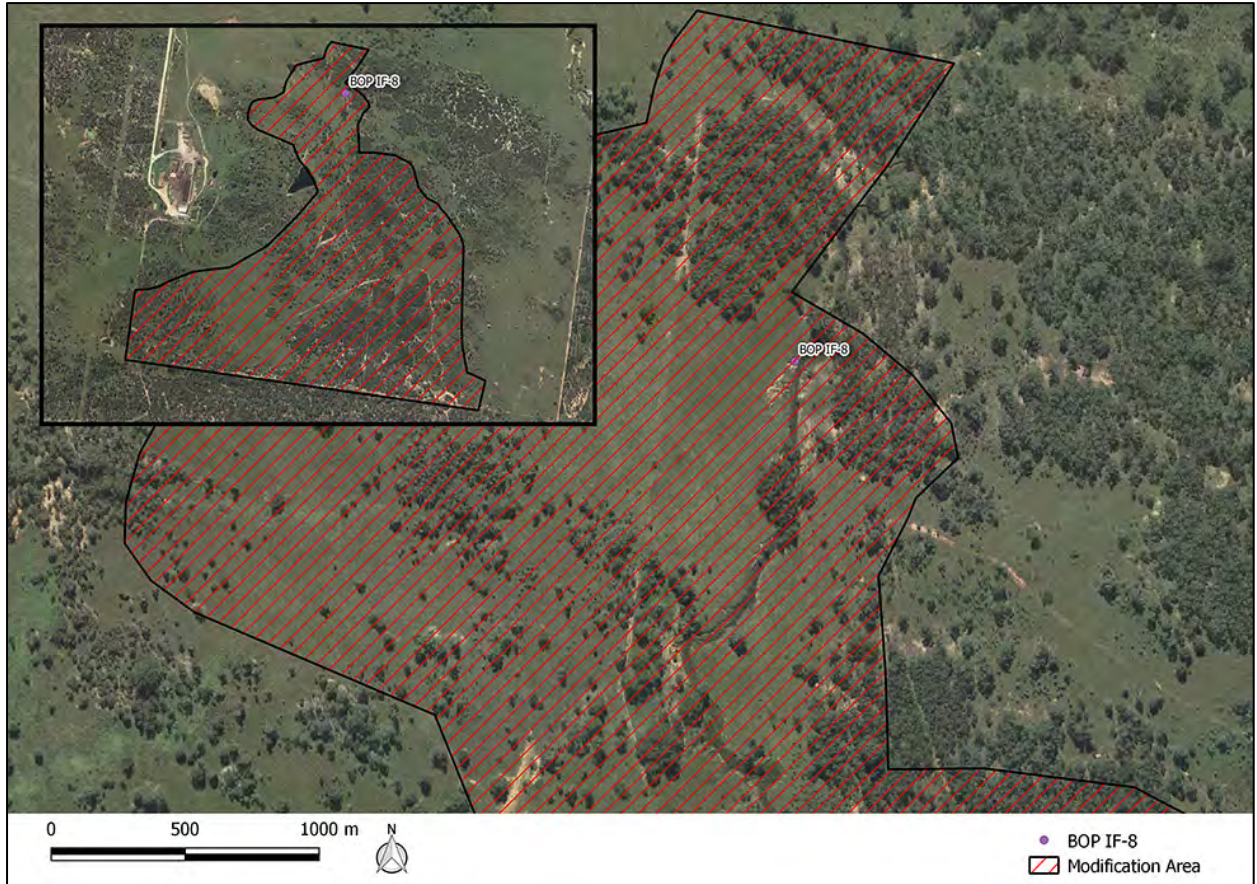
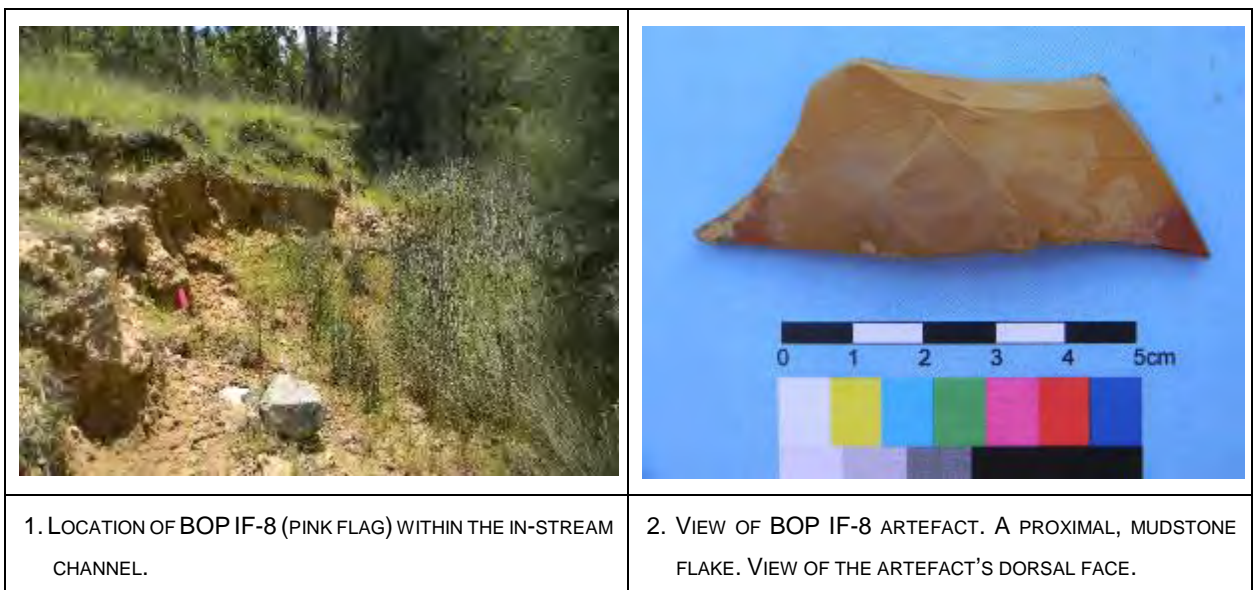


Figure 5-3: View of location of BOP IF-8 and BOP IF-8 artefact.



5.4 PREVIOUSLY RECORDED ABORIGINAL SITES LOCATED

BOP OS-2 (37-6-2836) is located within the central portion of the Modification Area along an access track comprising two artefacts (**Figure 5-4**). BOP OS-2 was revisited during the survey as part of Transect 1 (**Figure 5-1**) to satisfy Objective Two of the survey (**Section 2.1.1**): to see if conditions for site preservation have changed since the 2011 survey. No surface artefacts were recorded during the survey of BOP OS-2 despite high GSV along the existing access track. There were clear signs of water movement on the track (deposited silts) and it is possible the artefacts have been displaced by water movement or obscured by silt aggradation.

Figure 5-4: Environment of BOP OS-2.



The valid portion of BOP SC-3 (37-6-2847) which includes exposures one and two, is located within the southern portion of the Modification Area (**Figure 5-1**; **Table 5-4**). BOP SC-3 is located on both banks of an unnamed drainage line (northeast minor drainage 2) that flows to the southeast and out of the Modification Area. BOP SC-3 was revisited during the survey as part of Transect 1 with the same objective as with BOP OS-2: to see if conditions for site preservation have changed since the 2011 survey. Surface artefacts were recorded at both exposures, largely in areas of erosion alongside the banks of the drainage line (**Figure 5-5**). Artefacts recorded were comprised largely of mudstone flakes, with some volcanics and silcrete also recorded (**Figure 5-6**).

The environs of the drainage line have been extensively cleared of native woodland vegetation and the area has been used extensively, over time, for grazing livestock. The clearing of the native tree cover has resulted in widespread erosion of the A Horizon soils and a sometimes weedy regrowth. As a result of these disturbances, it is likely that the recorded artefacts are in a secondary context having eroded from nearby areas.

The landform containing BOP SC-3 contains few areas of any A Horizon soil depth and while thin A Horizon soils survive in some areas, it was assessed that there was little likelihood of there being further, subsurface artefact concentrations in the vicinity of the observed exposures.

Table 5-4: BOP SC-3: locations of exposure one and exposure two.

Exposure number	GDA Zone 56 Coordinates. Eastings / Northings	Type
1	325274.694698 6384036.193379	Artefact Scatter
2	325271.436368 6383976.794908	Artefact Scatter

Figure 5-5: Environment of BOP SC-3 in 2016.

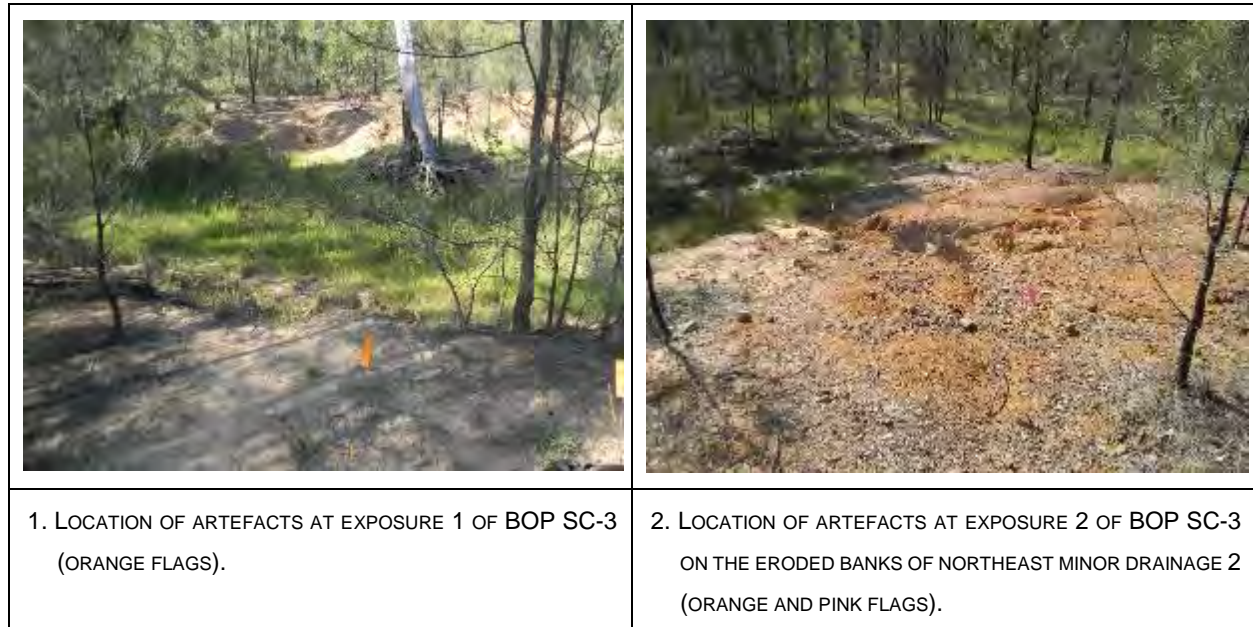
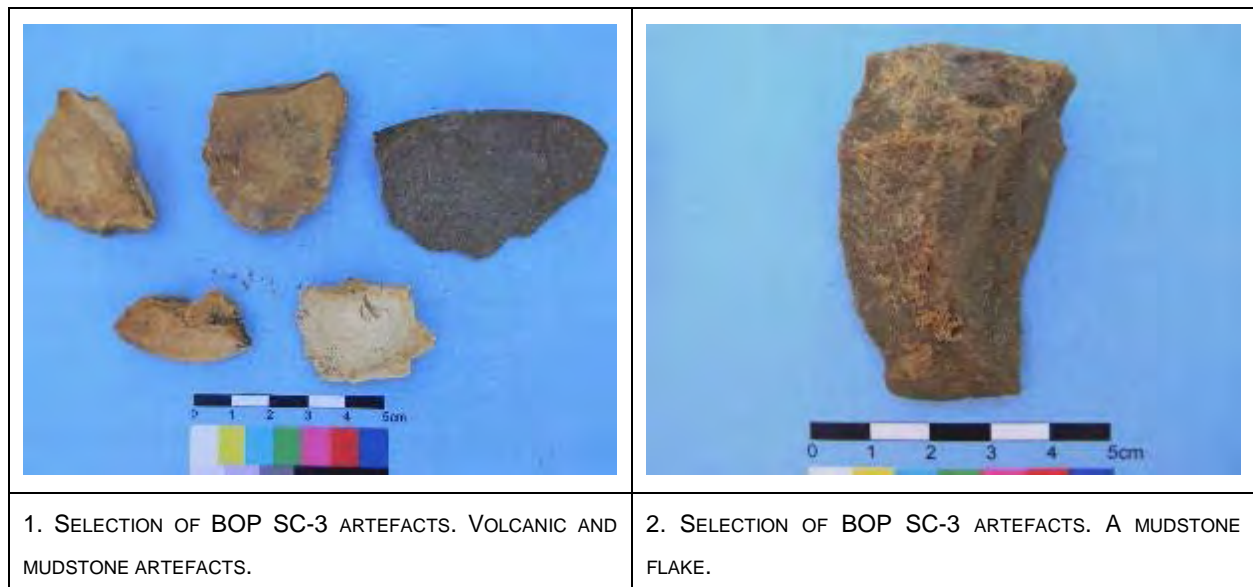
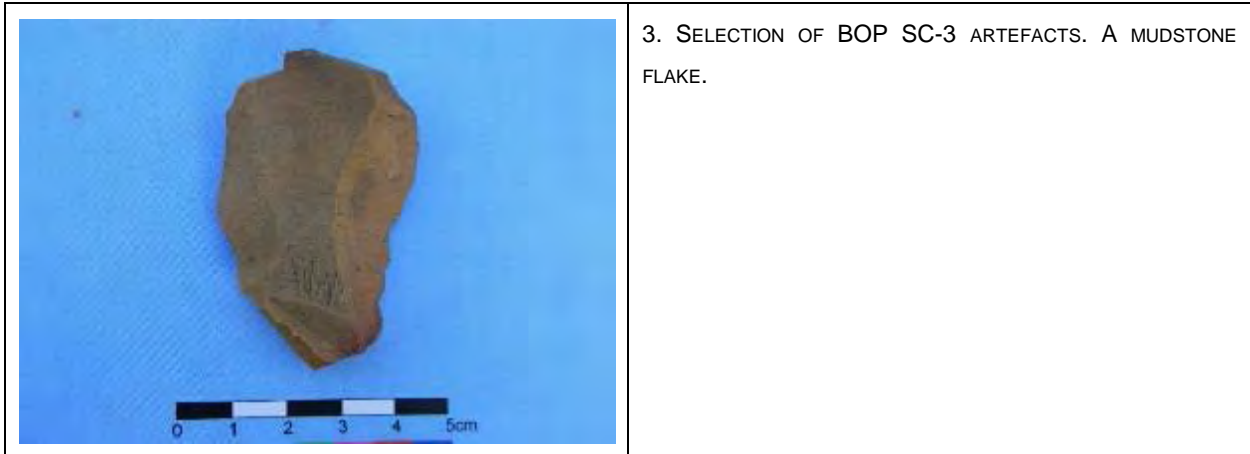


Figure 5-6: Selection of artefacts recorded at BOP SC-3 in 2016.





5.5 ABORIGINAL COMMUNITY CONSULTATION

The BOP assessment (Umwelt 2013a: 192–193) included the following concerning the cultural connections to the BOP Project Area of which the Modification Area formed part:

The RAPs consulted for the [BOP] ACHA [Aboriginal Cultural Heritage Assessment] identified a range of cultural values and attachments to the [BOP] Project area and the broader region, ranging from traditional connection to the area, historical attachments, connection to traditional homelands (Country), connection to community, and reconnecting attachments.

In identifying their cultural values of place, some RAPs focused on the significance of the [BOP] Project area as a whole, rather than the significance of individual places and objects; stating that the [BOP] Project area and all components within it and external to it can only be understood as part of a larger cultural landscape defined by its cultural, spiritual and social connectivity.

... RAPs identified the [BOP] Project area to be of high social, cultural and spiritual significance to Traditional Owners and Knowledge Holders and other RAPs, because it has spiritual and ceremonial associations to extremely high value sacred Creation and ceremonial places located within the region.

5.6 DISCUSSION

The site type recorded during the survey and the previously recorded sites within the Modification Area, namely isolated finds and artefact scatters, accord with the predictive model set out in **Section 4.2**. The absence of other sites such as scarred trees is certainly due to a lack of endemic trees of sufficient age for Aboriginal cultural scarring throughout the Modification Area as a result of land clearance. The absence of hearths and grinding grooves is unsurprising given the level of past disturbance and the absence of suitable rock outcropping respectively.

No archaeologically sensitive landforms were recorded during the current assessment or the 2011 survey of the land within the Modification Area. GSV was generally low across the

Modification Area with areas of exposure afforded by access tracks and areas subject to erosion. The most likely explanation for the lack of discernible archaeological material in the Modification Area is the types of landforms within the Modification Area (in the majority sloping landforms), the lack of permanent water sources within the Modification Area and degree of land-use disturbances linked to vegetation clearance, grazing and erosion.

The absence of artefacts at BOP OS-2 can be attributed to the low number of artefacts previously recorded at the site and the level of disturbance arising from water movement on the access track on which the site is located. Artefacts were present at BOP SC-3 during the current assessment, however since the site's recording in 2011, the recorded artefacts are likely to have been further displaced by sheet wash erosion.

5.7 ASSESSMENT OF SIGNIFICANCE

5.7.1 Introduction

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Social or Cultural Value

This area of assessment concerns the importance of a site or features to the relevant cultural group: in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

Archaeological/Scientific Value

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of value relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked

when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

Aesthetic Value

This refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (Australia ICOMOS 2013).

Historic Value

Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have 'shared' historic values with other (non-Aboriginal) communities.

Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage. Consequently the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives. This means it is often necessary to collect oral histories along with archival or documentary research to gain a sufficient understanding of historic values.

5.7.2 Assessed Significance of the Recorded Sites

Social or Cultural Value

In **Section 5.5** it was noted that the Aboriginal community hold the area in which the Modification Area is located as having high cultural significance. In Umwelt 2013a, no particular location within the Modification Area was identified as holding cultural significance but it is understood that the landscape itself holds value rather than individual items within it.

For the purposes of this assessment, all sites recorded within the Modification Area will be assigned **high cultural values**.

Archaeological/Scientific Value

BOP IF-8 is an isolated stone artefact in a disturbed context and therefore the site does not have the potential to add to the archaeological record in any significant way. Therefore BOP IF-8 has **low archaeological values**.

Aesthetic Value

BOP IF-8 does not contain any features that are likely to be appreciated on aesthetic grounds, either as individual objects or in terms of setting as it is within a heavily disturbed landscape. Therefore, the site is considered to have **low aesthetic value**.

Historic Value

There are no known historical associations for Aboriginal site BOP IF-8 this site therefore has a **low historic value**.

Table 5–5 summarises the significance assessment for BOP IF-8.

Table 5-5: Significance assessment of BOP IF-8.

Site Name	Social or Cultural Value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
BOP IF-8	High	Low	Low	Low

In 2012, OzArk assessed the heritage significance of previously recorded sites BOP OS-2 and BOP SC-3. OzArk (2012: 251) describes BOP OS-2 as a ‘very small artefact scatter’ consisting of two artefacts detected on a farm track. The landform occupied by the site is a mid-slope over 200 metres from water and is located within a mostly cleared paddock. OzArk (2012: 140) describes BOP SC-3 as a ‘low density amalgam of artefact scatters’. The site is located on both banks of the northeast minor drainage 2 that flows to the southeast. Across BOP SC-3, soil depths are shallow and have been affected by ongoing sheet wash erosion as well as past disturbances including agricultural land use practices.

The scientific significance assessment of BOP SC-3 and BOP OS-2 has been taken from OzArk (2012: 431, 433) (**Table 5–6**).

Table 5-6: BOP OS-2 and BOP SC-3: scientific significance assessment.

Site Name	Scientific Significance	Scientific Background
BOP OS-2	Low	Site occupies ridge line that may have been used for transit in the past. Site represents an eroded surface scatter with low density of artefacts. The site has undergone impacts from agricultural land use and erosion.
BOP SC-3	Low	Low densities of artefacts recorded in several exposures. BOP SC-3 displays a low density of artefacts and a low site complexity. Thin A Horizon soils. Localised disturbance from erosion extensive in some areas.

5.8 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE MODIFICATION

Due to the nature of the proposed work across the entirety of the Modification Area, newly recorded Aboriginal site, BOP IF-8, and previously recorded sites, BOP OS-2 and partially destroyed BOP SC-3, would be totally destroyed should the Modification Area be approved (**Table 5–7**).

Table 5-7: Impact assessment.

Site Name	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)
BOP IF-8	Direct	Total	Total loss of value
BOP OS-2	Direct	Total	Total loss of value
BOP SC-3	Direct	Total	Total loss of value

5.8.1 Ecological Sustainable Development Principles

The goal of Ecological sustainable development (ESD) is:

Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The Core Objectives of ESD are:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and life-support systems.

As such, the ESD principles have limited applicability to cultural heritage although the notion of inter-generational equity is relevant. This is understood to refer to future generations being able to enjoy, interact with and study aspects of cultural heritage that are available to current generations.

5.8.1.1 Applicability to the Modification

The Modification will result in the destruction of three Aboriginal sites. How to quantify this loss of heritage value to future generations is difficult. In an effort to understand the overall impact to heritage values, a series of guidelines have been developed by the Department of Planning and Environment to quantify and standardise impact assessments (DP&E 2016). The rubric outlined in DP&E 2016 leads to all impacts being graded within the matrix shown in **Figure 5–7**. **Table 5–8** assesses each heritage item to arrive at a standardised ‘value of impact’.

As can be seen in **Table 5–8** the overall heritage impact of the Modification is a ‘low value of heritage impact’. As such, the intergenerational loss arising from the Modification is considered to be minimal and of low value.

5.8.2 Cumulative Harm

As noted in **Section 5.8.1** the Modification will result in a low loss of heritage value from the Modification Area. The loss of these low density artefact scatters and an isolated find contributes marginally to cumulative harm in the region but as the sites themselves are neither remarkable

in their manifestation nor contain artefacts that are not commonly represented in the region, this loss of heritage values will not greatly add to the cumulative harm to Aboriginal cultural heritage in the region.

Figure 5-7: Potential impact to heritage items reference matrix.

		Significance of heritage object or place			
		Very high	High	Medium	Low
Degree of potential impact on heritage item	Total impact	Very high value	High value	Medium value	Low value
	High partial impact	High value	High value	Medium value	Low value
	Medium partial impact	Medium value	Medium value	Low value	Minimal value
	Minimal partial impact	Low value	Low value	Minimal value	Minimal value

Table 5-8: Value of heritage impact on heritage items.

	Heritage item 1	Heritage item 2	Heritage item 3
Name or location of the heritage object or place	BOP SC-3	BOP OS-2	BOP IF-8
Social or cultural value	2	2	2
Historical	0	0	0
Scientific	0	0	0
Aesthetic	0	0	0
Significance of heritage item	Low importance	Low importance	Low importance
Degree of impact (partial or full)	Full impact	Full impact	Full impact
Overall value of potential impact on heritage item	Low value	Low value	Low value
Reasoning behind scores	General disturbance at site; low artefact density; no association with subsurface deposits; already partially salvaged.	General disturbance at site; low artefact density; no associated subsurface deposits.	Isolated find; unassociated with subsurface deposits; in a secondary context.

As can be seen in **Table 5-8**, the proposed impact to the recorded sites (BOP SC-3, BOP OS-2 and BOP IF-8) has been evaluated as having a low value when heritage significance and degree of impact are evaluated. As such, the management measures set out in **Section 6** will be required to mitigate this heritage impact value.

6 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

6.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. **Section 5.7.2** and **Section 5.8** describe, respectively, the significance / potential of the recorded sites and the likely impacts of the development. In **Section 5.8.2** the overall heritage impact was assessed as having a low value for all sites. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- Avoid impact by altering the development proposal or in this case by avoiding impact to a recorded Aboriginal site. If this can be done, then a suitable curtilage around the site must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.
- If impact is unavoidable then approval to disturb sites will be required under the authority of a revised Bulga Coal Complex ACHMP. Aboriginal community consultation will need to continue during the formulation of the ACHMP and the revised ACHMP would need approval from the Department of Planning and Environment. The ACHMP would establish the fate of any artefacts salvaged from within the Modification Area.

6.2 MANAGEMENT AND MITIGATION OF RECORDED ABORIGINAL SITES

One previously recorded site complex, BOP SC-3, one previously recorded open site, BOP OS-2 and one newly recorded isolated find, BOP IF-8 have been identified within the Modification Area. Due to the nature of the proposed works, the three sites cannot be avoided. As the current survey has been undertaken in association with the BOP assessment, the sites should be managed as 'Category 3' sites based on their low scientific significance (**Section 5.7.2**) and the low heritage impact of the proposed works (**Section 5.8**). 'Category 3' archaeological salvage equates to a recorded surface collection of all artefacts. More specifically, this should include:

- All visible artefacts at the sites should be flagged in the field;
- The sites should be photographed after flagging and before recording;
- All artefacts should have the following artefact information entered directly into a GPS unit:
 - Location;
 - Artefact class;
 - Artefact type;

- Size;
 - Reduction level;
 - Raw material; and
 - Notes.
- Analysis will attempt to record a statistically valid artefact assemblage with which to compare to other sites salvaged under the terms of the Bulga Coal Complex ACHMP during 2015 as part of the BOP (see OzArk 2012: 465).

All staff and contractors involved in the proposed work should undergo cultural heritage inductions to ensure they are aware of the legislative protection of all Aboriginal sites and objects.

7 RECOMMENDATIONS

Under Section 89A of the NPW Act it is mandatory that all Aboriginal sites recorded under any auspices be registered with OEH AHIMS. As a professional in the field of cultural heritage management it is the responsibility of OzArk to ensure this process is undertaken.

To this end it is noted that **one new Aboriginal site** (BOP IF-8) was recorded during the assessment.

The following recommendations are made on the basis of these impacts and with regard to:

- Legal requirements under the terms of the NPW Act whereby it is illegal to damage, deface or destroy an Aboriginal place or object without the prior written consent of OEH;
- The findings of the current investigations undertaken within the Modification Area; and
- The interests of the Aboriginal community.

Recommendations concerning the Modification Area are as follows:

1. As BOP IF-8, BOP OS-2 and BOP SC-3 are unavoidable by the proposed work, all surface artefacts should be collected for safe-keeping. The collection process should be undertaken under a revised Bulga Coal Complex ACHMP and follow the requirements of the 'Category 3' salvage process listed in **Section 6.2** and as described by OzArk (OzArk 2012: 465).
2. At BOP OS-2 no surface artefacts were visible at the time of the 2016 inspection. Salvage of this site should be undertaken, although it may be necessary to use shovels/trowels to remove accumulated silts from the road to fully determine if the recorded artefacts remain within the site boundary.
3. Outside of BOP IF-8, BOP OS-2 and BOP SC-3 there are no constraints to the proposed work, however, the following precautions should be made:
 - a. The proposed works should stay within the assessed area. If the works are required to deviate from the assessed area then further archaeological assessments may be required; and
 - b. Should any items be noted during the proposed work that are suspected to be of Aboriginal origin, then work in the area should cease and the advice from a suitably qualified archaeologist sought to assess the nature of the find and to suggest an appropriate path forward. Protocols contained in the Bulga Coal Complex ACHMP (BUL SD PLN 0046) should be followed.

REFERENCES

- Australia ICOMOS 2013 International Council on Monuments and Sites 2013. *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013.*
- Burke & Smith 2004 Burke, H. and Smith, C. 2004. *The Archaeologist's Field Handbook*, Blackwell, Oxford.
- DECCW 2010 DECCW. 2010. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. Department of Environment, Climate Change and Water, Sydney.
- DP&E 2016 Department of Planning and Environment. *Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*.
- Mitchell 2002 Mitchell, P. 2002. *NSW Ecosystems Database Mapping Unit Descriptions*, Groundtruth Consulting.
- OzArk 2012 OzArk Environmental & Heritage Management Pty Limited. 2012. *Aboriginal Archaeological values Assessment: Bulga Optimisation Project, near Broke, NSW, Singleton LGA*. Report for Bulga Coal Management Pty Limited.
- Umwelt 2013a Umwelt (Australia) Pty Ltd. *Environmental Impact Statement. Bulga Optimisation Project*. On behalf of Bulga Coal Management Pty Ltd.
- Umwelt 2013b Umwelt (Australia) Pty Ltd. *Revised and Amended Project Application Assessment Report. Bulga Optimisation Project*. On behalf of Bulga Coal Management Pty Ltd.
- Umwelt 2016 Umwelt (Australia) Pty Ltd. *Proposed BOP modification for the revised EEA design*. Internal briefing paper.

PLATES

Plate 1: View of the ridge landform looking towards the Mushroom Composters.



Plate 2: View from upper slope overlooking the Modification Area. Note no GSV.



Plate 3: View of mid-slope landform surveyed by Transect 1. Note the regenerating vegetation.



Plate 4: View of tributary to the northeast drainage showing gully erosion and incision.



APPENDIX 1: ABORIGINAL COMMUNITY CONSULTATION LOG

Date	Organisation	Contact Name	Comment
1.2.16	Aboriginal Native Title Consultants	Margaret Matthews	Sheridan Burke (SB) sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Aliera French Trading	Aliera French	Stephanie Rusden (SR) sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Amanda Hickey Cultural Consultants	Amanda Hickey	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Bawurra Consultants	Kevin Sampson	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Bigundi Biame Gunnedarr Traditional People	Wayne Griffiths	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Breeza Plains Culture & Heritage Consultants	Terry Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Bullem Bullem	Lloyd Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Bunda Consultants	Tammy Knox	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Cacatua Culture Consultants	George Sampson	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Carrawonga Consultants	Justin Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Cheryl Moodie Consulting	Cheryl Moodie	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Culturally Aware	Tracey Skene	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Deslee Talbot Consultant	Deslee Matthews	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Divine Diggers ACC	Gary Perkins	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	DRM Cultural Management	Helen Faulkner	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Esther Tighe- EMT Culture & Heritage	Esther Tighe	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Galamaay Consultant	Karen Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Gidawaa Walang Cultural Heritage Consultancy	Ann Hickey	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Giwirr Consultants	Rodney Matthews	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Gomery Cultural Consultants	David Horton	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16

1.2.16	Heilamon Cultural Consultants	Clifford Johnson	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Hecmo Consultants	Kerren Boyd	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Huckada Dreamin Heritage Group	Robert Slater	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Hunter Traditional Owner Management Services	Paulette Ryan	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Hunter Valley Natural and Cultural Resources Management	David French	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Hunter Valley Cultural Surveying	Luke Hickey	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Jarban & Mugrebea	Les Atkinson	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Jeffrey Matthews	Jeffrey Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	JLC Cultural Services		SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Kauma Pondee Consultants	Gail Beale	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Kawal Cultural Services	Vicky Slater	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Kayaway Eco Cultural and Heritage Services	Mark Hickey	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	KL.KG Saunders Trading Services	Krystal Saunders	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Lower Hunter Wonnarua Council Incorporated	Thomas Miller	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Lower Hunter Wonnarua Incorporated	David Ahoy	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Minga Consultants	Clifford Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Muswellbrook Cultural Consultants	Brian Horton	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Myland Cultural & Heritage Group	Warren Schillings	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Ngarramang- Kurri Aboriginal Cultural Heritage Group	Abie Wright	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16		Warren Taggart	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16

1.2.16		Kevin Taggart	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Roger Noel Matthews	Roger Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Smith Dhagaans Cultural Group	Timothy Smith	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	T & G Culture Consultants	Tony Griffiths	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Ungooroo Aboriginal Corporation	Allen Paget	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Ungooroo Cultural and Community Services	Rhonda Ward	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Upper Hunter Heritage Consultants	Darrel Matthews	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Upper Hunter Wonnarua Council	Rhoda Perry	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Waabi Gabinya Cultural Consultancy	Elizabeth Howard	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wallangan Cultural Services	Maree Waugh	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wanaruah Local Aboriginal Land Council	Noel Downs	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Warragil Cultural Services	Aaron Slater	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wattaka Wannarua	Des Hickey	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Widescope	Amanda Hickey	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wonn 1 Contracting	Arthur Fletcher	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wonnarua Cultural Heritage	Gordon Griffiths	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wonnarua Cultural Heritage Cultural Services	Rebecca Lester	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wunda Cultural Consultants	Travis Matthews	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Wurrumay Consultants	Kerrie Slater	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Yinarr Cultural Services	Kathleen Stewart Kinchella	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	AGA Services	Adam Sampson	SR sent cover letter and survey methodology. Asking for comment by the 10.2.16

1.2.16	Cyril Sampson	Cyril Sampson	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
1.2.16	Hunter Valley Cultural Consultants	Christine Archibald	SB sent cover letter and survey methodology. Asking for comment by the 10.2.16
29.1.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SR Sent invitation to participate in survey in the 12th February 2016
29.1.16	Wonnarua Traditional Custodians	Des Hickey and WTC Spokespersons	SR Sent invitation to participate in survey in the 12th February 2016
29.1.16	Wonnarua Nation/ Wonnarua People Native Title Group	Laurie Perry	SR Sent invitation to participate in survey in the 12th February 2016
29.1.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Scott Franks	SR Sent invitation to participate in survey in the 12th February 2016
5.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SR received call from Rhonda advising she would be sending Leanne Kirkman or Kylie Saunders to survey. She will call on Monday to confirm and comment on methodology.
5.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SR received email from Rhonda "In regards to feed back on the Eastern Emplacement Area Modification Archaeological Assessment the Board of the Hunter Valley Aboriginal Corporation has indicated that in relation to providing comment on projects and reports, the Corporation supports the views and wishes of the local Land Council, in this case the Wonnarua Local Aboriginal Land Council"
8.2.16	Wonnarua Nation/ Wonnarua People Native Title Group	Laurie Perry	SB rang to inform of cancellation of Fridays site work- Answering service said that this number is not connected
8.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Scott Franks	Sb rang and left a message for Scott that the site work has been cancelled for this Friday (12.2.16). <i>"the project is currently on hold and RAPs will be advised should the project be re-activated in the future".</i>
8.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SR received email from Rhonda "Good Morning Stephanie, Just to confirm that Leanne Kirkman will be working under Hunter Valley Aboriginal Corporation on the 12th February"
8.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SB rang and spoke to Rhonda and cancelled worker for Friday 12th. Informed Rhonda that <i>"the project is currently on hold and RAPs will be advised should the project be re-activated in the future".</i>
8.2.16	Wonnarua Traditional Custodians	Des Hickey and WTC Spokespersons	Sb rang and left a message for Scott that the site work has been cancelled for this Friday (12.2.16). <i>"the project is currently on hold and RAPs will be advised should the project be re-activated in the future".</i>
8.2.16	Wonnarua Nation/ Wonnarua People Native Title Group	Laurie Perry	SB sent email notification that Site work is cancelled for Friday the 12th Feb.
8.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Scott Franks	SB sent email notification that Site work is cancelled for Friday the 12th Feb.

8.2.16	Wonnarua Traditional Custodians	Des Hickey and WTC Spokespersons	SB sent email notification that Site work is cancelled for Friday the 12th Feb.
8.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Scott Franks	SB received a call from Scott Franks, confirming work cancelled. Scott will forward the email through to Danny @tocomwall.com.au. Danny looks after the site officer work
10.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SB rang Rhonda and confirmed that the site work for Friday was back on again. SB confirmed that the details in the letter are still correct for a meeting time and place. Rhonda will have Leanne Kirkman in attendance
10.2.16	Wonnarua Traditional Custodians	Des Hickey and WTC Spokespersons	SB rang to inform Des of the reengagement of Friday's site work. The phone rang out
10.2.16	Wonnarua Nation/ Wonnarua People Native Title Group	Laurie Perry	SB rang to inform Laurie of the reengagement of Friday's site work. The phone number is disconnected
10.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Danny Franks	SB rang Danny and confirmed that the site work for Friday was back on again. SB confirmed that the details in the letter are still correct for a meeting time and place. Danny will have a site officer in attendance. SB will resend the invitation letter to Danny@tocomwall.com.au
10.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Danny Franks	SB sent invitation again and confirmed work
10.2.16	Hunter Valley Aboriginal Corporation	Rhonda Griffiths	SB sent invitation again and confirmed work
10.2.16	Wonnarua Traditional Custodians	Des Hickey and WTC Spokespersons	SB sent invitation again and confirmed work
10.2.16	Wonnarua Nation/ Wonnarua People Native Title Group	Laurie Perry	SB sent invitation again and confirmed work
10.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Danny Franks	SB received email from Danny questioning the 28 day period for feedback on the methodology.
10.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Danny Franks	SB sent email confirming that Ben will respond/contact Danny.
10.2.16	Tocomwall Pty Ltd on behalf of the Plains Clan of the Wonnarua People Native Title Group	Danny Franks	Ben Churcher emailed Danny and explained why 28 days was not provided. Accepted by Tocomwall.

The draft report was sent to all BOP RAPs by Keith Simkin (BCM) with a 28 day review period. The WLALC asked for a 14 day extension to this period which was granted. All RAP responses on the draft report were sent to Keith Simkin.

APPENDIX 2: SURVEY METHODOLOGY (ABRIDGED)



LOCATION OF BOP OS-2 WITHIN THE MODIFICATION AREA.

ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

SURVEY METHODOLOGY

BULGA OPTIMISATION PROJECT

EASTERN EMPLACEMENT AREA: DISTURBANCE BOUNDARY MODIFICATION

JANUARY 2016

PREPARED BY

OZARK ENVIRONMENTAL & HERITAGE MANAGEMENT PTY LTD



**Environmental and
Heritage Management P/L**

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Background

The Bulga Coal Complex (BCC) is an open cut and underground coal mining operation located approximately 12 kilometres west of Singleton in the Hunter Valley in NSW. Bulga Coal Management (BCM) operates the Bulga Surface Operations at the BCC on behalf of the Bulga Joint Venture. Approval for the Bulga Optimisation Project (BOP), which related to ongoing operation of the Bulga Surface Operations to 31 December 2035, was granted by the Planning Assessment Commission (under delegation from the Minister for Planning) on 1 December 2014 (SSD-4960; BOP Consent). The underground operations at the BCC operate under a separate development consent (DA 376-8-2003) granted in 2004 (Bulga Underground Consent).

BCM proposes a change to the design of the Eastern Emplacement Area (EEA) approved as part of the BOP to a more efficient design, reducing the need for some currently approved infrastructure construction. It is intended that a modification of the BOP Consent will be sought under section 96(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to obtain approval for the proposed modified development. No modification to the Bulga Underground Consent is required.

The Environmental Impact Statement submitted for the BOP (Umwelt 2013) (EIS) assessed the environmental impacts of the original BOP design which included the EEA; an out-of-pit emplacement area located to the north of the BCC Infrastructure Area (**Figure 1**). This included part of an area of land owned by Mushroom Composters Pty Ltd (Mushroom Composters). The Response to Submissions and Revised and Amended Project Application Assessment Report prepared for the BOP (Revised Project report) assessed an amended EEA design which did not involve emplacement on the land owned by Mushroom Composters (**Figure 2**). The amended EEA design is approved under the BOP Consent.

Ongoing consultation with the Mushroom Composters has identified an amended design for the EEA which would meet the needs of both companies. The amended design occupies some of the Mushroom Composters land but does not directly impact on the Stage 1 Composting Facility. A modification to the consent is proposed to obtain approval for this amended design.

Proposed Modification

The proposed modification relates only to the design of the EEA. **Figure 3** shows the indicative design of the amended EEA which will be the subject of the proposed modification. The Stage 1 Composting Facility located on the Mushroom Composters land will remain under the modified EEA design.

Table 1 shows the aspects of the existing approved development that will be impacted by the proposed modification.

Table 1. Changes to the existing approved BOP development.

Approved Development Component	Proposed Modified Development
Mining Areas	No change.
Mining Methods	No change.
Production Rates	No change.
Open Cut MIA	No change.
Eastern Emplacement Area	Design as shown in Figure 3. No change to emplacement schedule described in the revised Project Report.
Noise and Visual Bund	No change.
Underground Infrastructure	No change.
Public Roads	No change.
Tailings and Rejects Strategy	No change.
External Coal Transport Infrastructure	No change.
Electricity Infrastructure	No change. The approved development includes the relocation of various infrastructure servicing the Stage 1 Mushroom Composting Facility. Some of this infrastructure may not require relocation as a result of the modification.
Pipelines and Other Services Infrastructure	No change. The approved development includes the relocation of various infrastructure servicing the Stage 1 Mushroom Composting Facility. Some of this infrastructure may not require relocation as a result of the modification.

Parts of the northern section of the approved EEA will no longer require clearing as a result of the modified EEA design. Areas not required to be cleared will be removed from the area of approved clearing for the development. The area will require a new mining lease and therefore a site verification certificate is required.

Figure 1. Design of the BOP Disturbance Area from the original EIS.

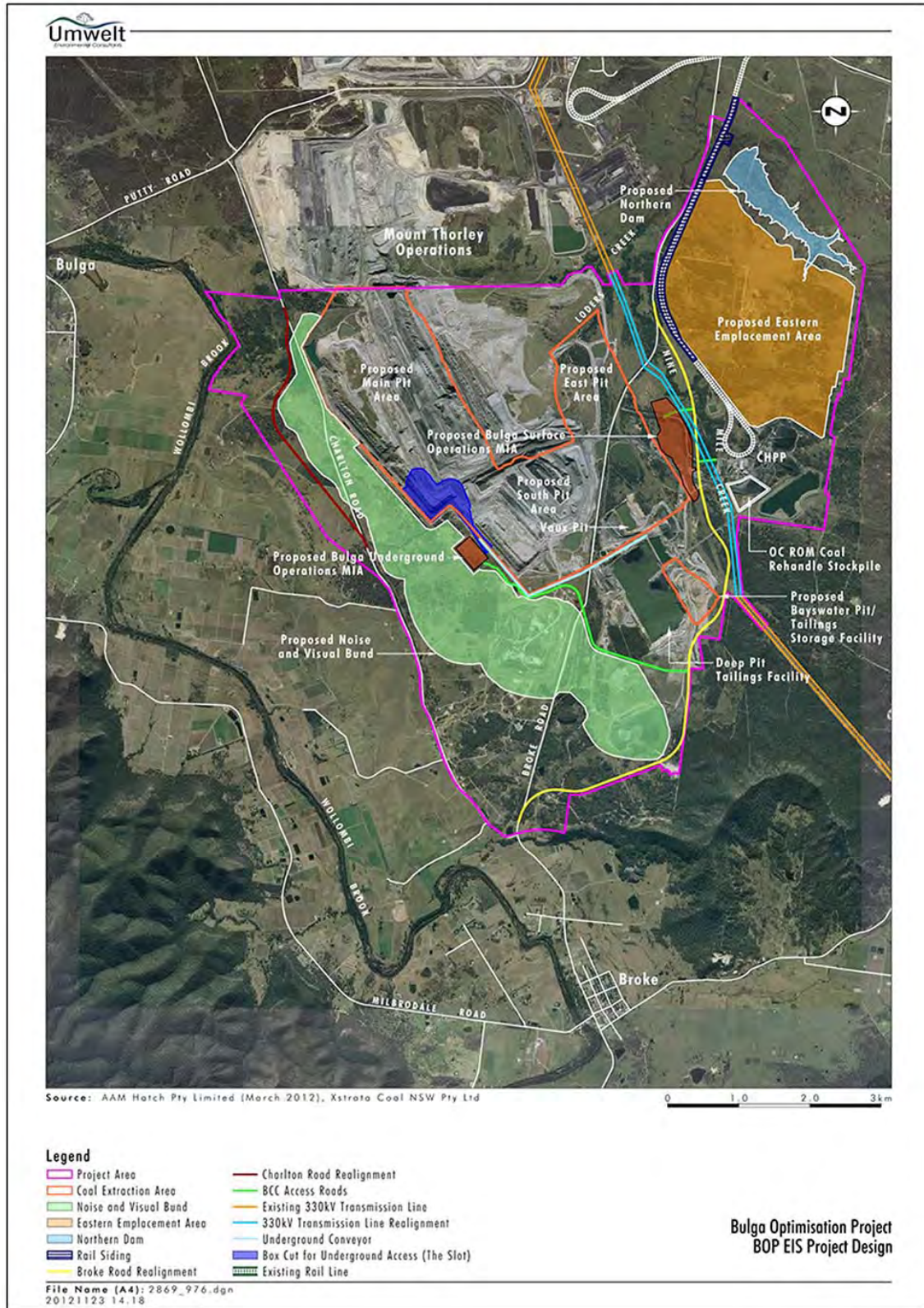


Figure 2. Design of the BOP Disturbance Area from the revised EIS.

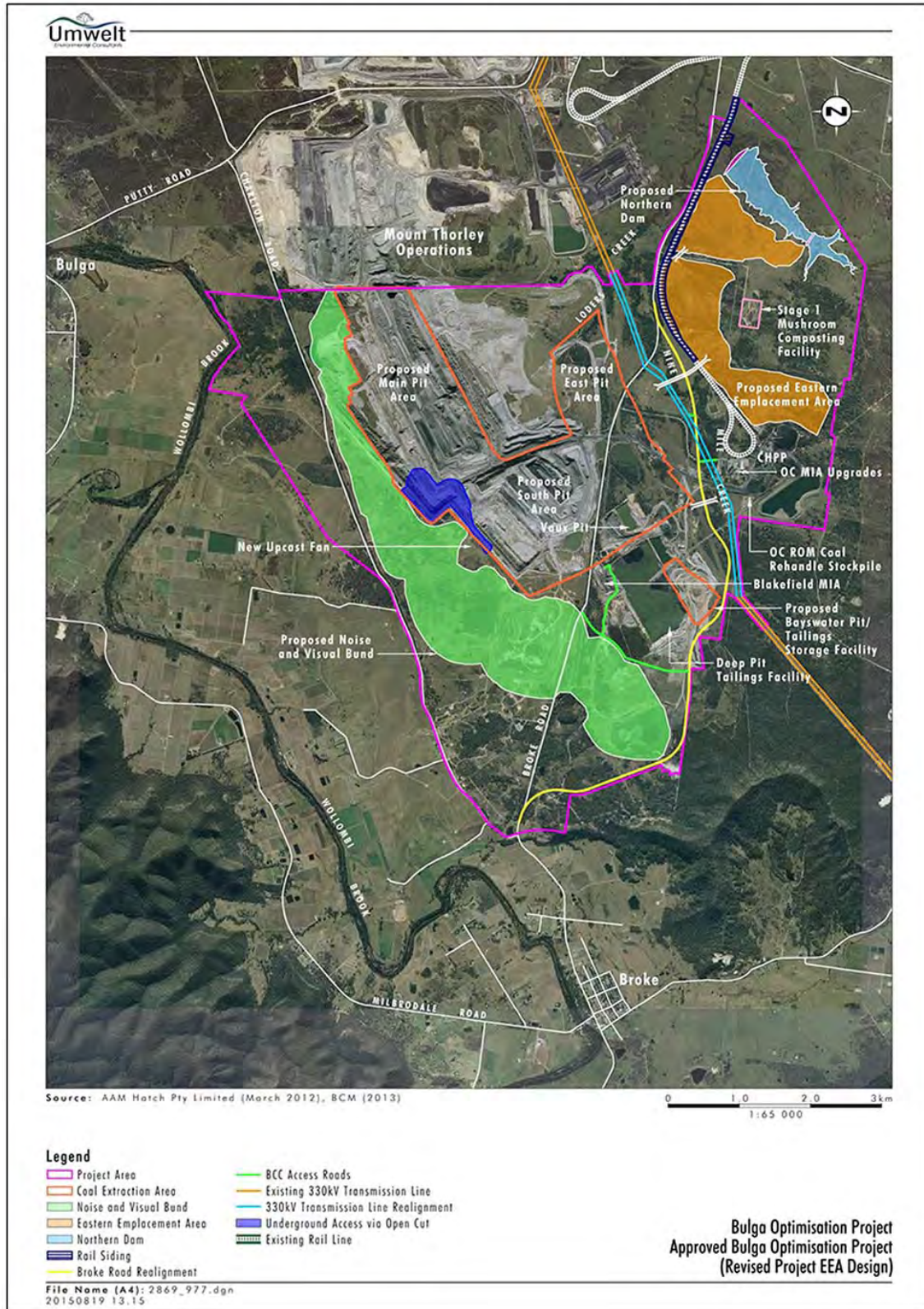
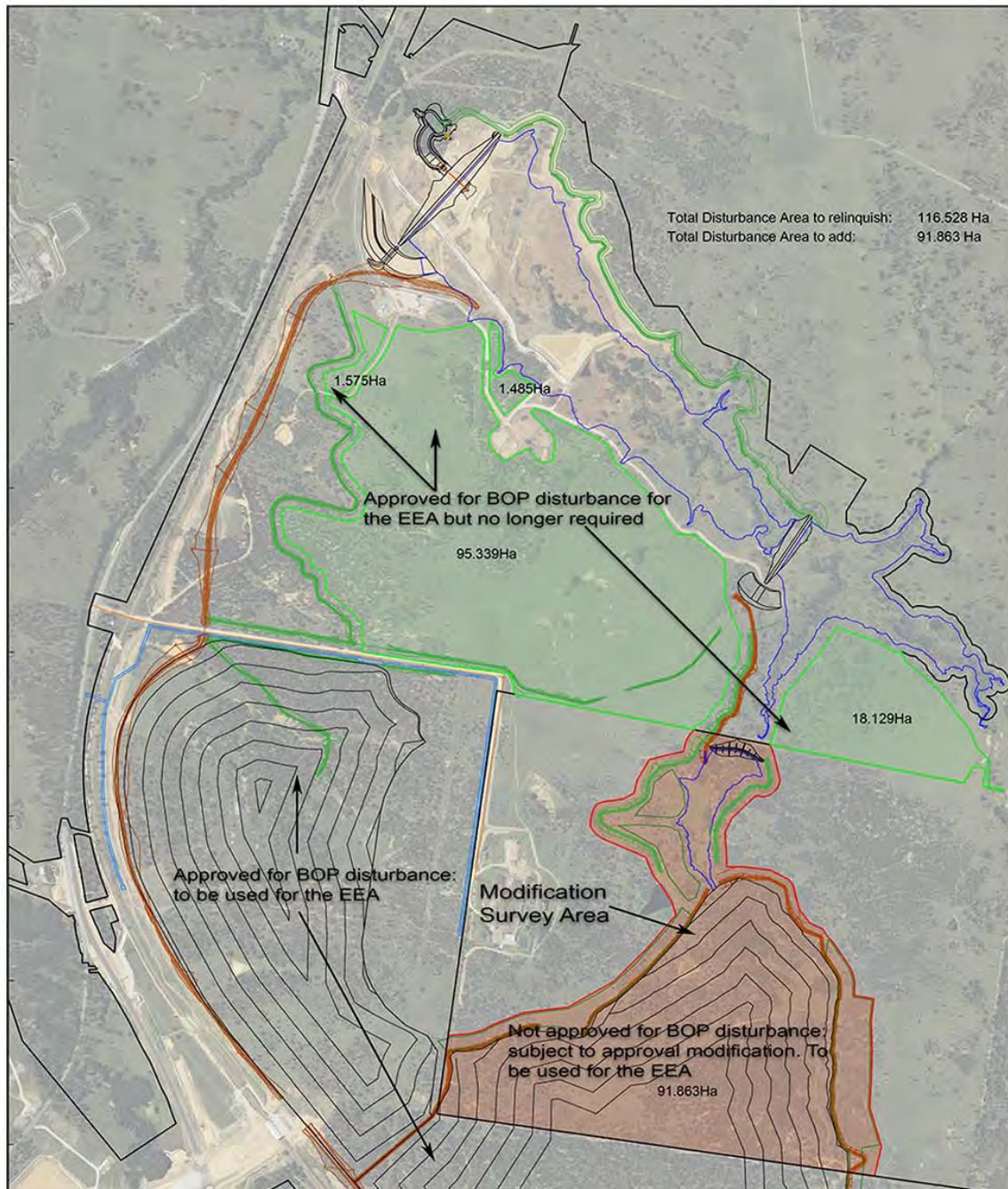


Figure 3. Proposed BOP modification for the revised EEA design.



Description of proposed works

The ground-disturbing works associated with the Modification would involve the total modification of all landforms shown the brown shade in **Figure 3** (the Modification Area). These works would include the clearing of vegetation, the stripping of topsoil, the dumping of out of pit material within the area, as well as associated drainage works and sediment capture dams.

History of assessment within the Modification Area

The entirety of the Modification Area was assessed during the BOP field survey in December 2011. This survey was undertaken with the assistance of BOP Registered Aboriginal Parties (RAPs). **Figure 4** shows the survey transects undertaken in 2011 for the BOP although this figure shows the survey track of one archaeologist whereas there were up to 12 RAPs present for the survey giving a greater survey coverage than is shown in this figure.

The BOP assessment identified two sites within the Modification Area: BOP OS-2 and the northern portions of BOP SC-3. The southern portions of BOP SC-3 are in the area of approved disturbance by the BOP and were salvaged during the BOP salvage program during 2015.

Figure 4. Modification Area showing previous assessment results.



Proposed survey methodology

Survey Rationale

The Modification is regarded to be part of the BOP and as such the Modification will inherit the BOP RAP list and this survey methodology is for RAP review and comment but the 28 day review period as stipulated in the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* is not applicable in this instance as this Modification is a continuation of an existing, current, Project.

Further, as the Modification Area was subject to full pedestrian assessment in the company of RAPs in late 2011, full pedestrian assessment of the Modification Area is not recommended here. Rather the proposed survey methodology will be to allow RAPs and Wonnarua Knowledge Holders, in the company of an OzArk archaeologist, to visit the Modification Area to reacquaint themselves with the area, to revisit previously recorded sites to assess their current condition and to spend time undertaking focused assessment of landforms with archaeological potential in order to determine if conditions for site preservation have changed since the 2011 survey.

Background

The Modification Area consists of sloping landforms that generally slope to the east/northeast towards an unnamed drainage line. Within the Modification Area is one tributary to this unnamed drainage line that was assessed for its entire length during the 2011 BOP survey (see **Figure 4**).

The landforms within the Modification Area consist of cleared paddocks and areas of regrowth trees on former grazing land.

The 2011/2012 BOP survey recorded two sites within the Modification Area. They are BOP SC-3 and BOP OS-2. Details of these sites from the BOP assessment report are provided in **Appendix 1**. It has been noted previously that the majority of BOP SC-3 has been salvaged during the BOP salvage program in 2015 as these portions of the site lay within the approved BOP Disturbance Area.

Proposed survey

It is proposed that the survey be conducted over one day with an OzArk archaeologist and a representative from each of the four Wonnarua service providers. This survey will involve:

1. Revisiting the northern portions of BOP SC-3 and BOP OS-2 to ascertain their current condition; and
2. Performing a pedestrian survey of landforms likely to contain sites to determine if conditions for site preservation have altered since the 2011/2012 BOP survey.

To meet these objectives it is proposed that BOP SC-3 is visited first followed by a direct transect to BOP OS-2 (it can be seen in **Figure 5** that this area was not directly assessed during the 2011

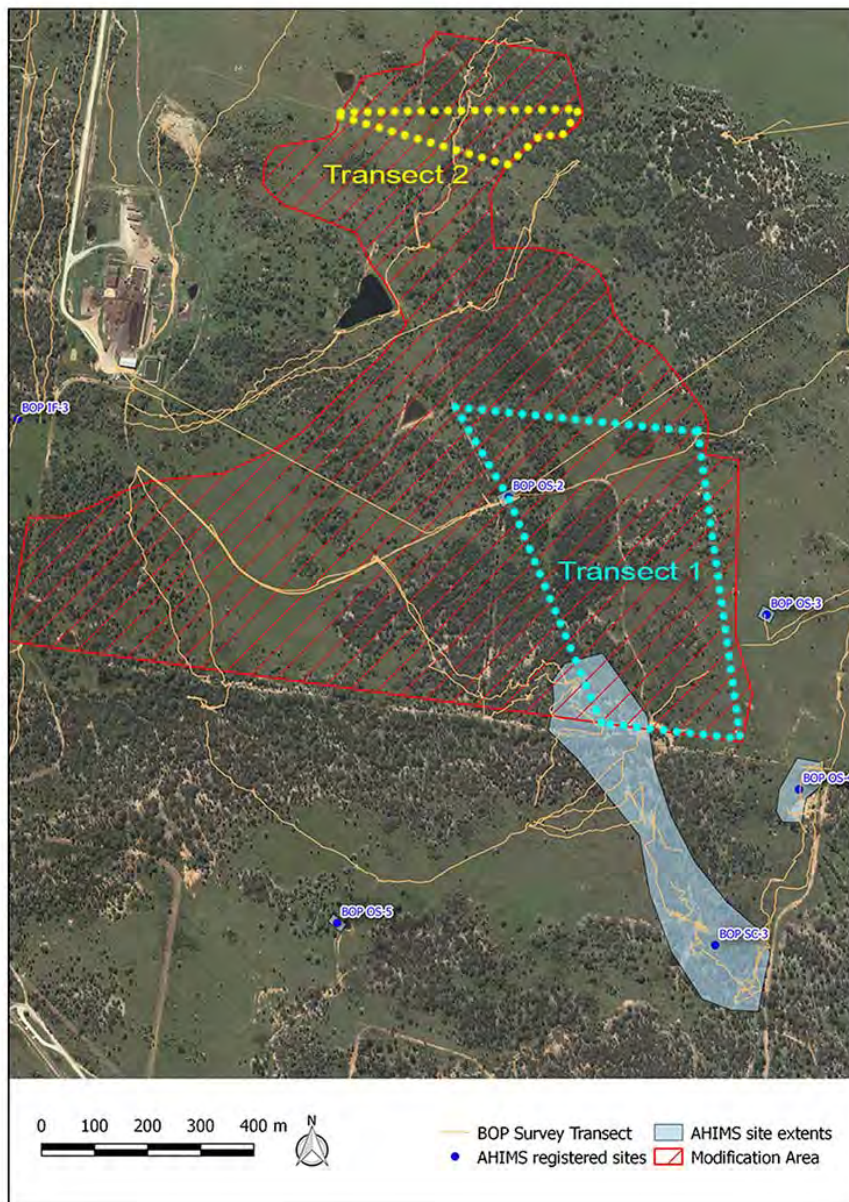
BOP survey). Following a re-assessment of BOP OS-2, it is proposed that Transect 1 (see **Figure 5**) be undertaken that would allow the characterisation of the southern portion of the Modification Area in an area that was not a focus for the 2011 survey (Transect 1: approx. 2km).

A further transect (Transect 2: see **Figure 5**) will also be undertaken to provide a cross-section of the northern portion of the Modification Area (Transect 2: approx. 1km).

Should time allow, further transects will be undertaken following consultation between the archaeologist and RAPs present.

In conjunction with the results of the 2011 BOP survey, this additional survey day will allow the current archaeological characteristics of the Modification Area to be understood.

Figure 5. Proposed survey transects.



APPENDIX 3: RAP COMMENTS TO THIS REPORT



Wonn1
Entity of Kauwul Pty Ltd

619 Main Road Glendale, 2285

PHONE: 0249547751 Mobile: 0402146193

ABN: 27 153 953 363

20 April 2016

Mr K Simkin
Environment and Community Officer
Bulga Open Cut
Email: keith.simkin@glencore.com.au

Dear Keith

**RE: COMMENTS ON ABORIGINAL CULTURAL HERITAGE ASSESSMENT –
MODIFICATION TO THE BULGA OPTIMISATION PROJECT; EASTERN
EMPLACEMENT AREA – DISTURBANCE BOUNDARY MODIFICATION**

We have reviewed the above report dated March 2016 and wish to comment as follows:

- We believe that the survey coverage was insufficient, being a one day walk/drive over undertaken by the archaeologist and only two (2) RAP representatives being one representative each from Tocomwal and Hunter Valley Aboriginal Corporation, to cover an area of 86ha. No wonder that only one (1) new site was recorded and no artefacts found at site BOP OS-2.
- We feel that further investigation must be carried out over the proposed disturbance area including test excavations at both BOP OS-2 and SC-3 as well as the salvage program.
- We want to be included in the record/tag and bag/analyses process.

Overall, we find this study to be a disrespectful and with an unsatisfactory coverage of the proposed disturbance area, this is particularly from an Aboriginal cultural aspect.

Yours sincerely

Suzie Worth
For Arthur C Fletcher
Wonn1 (Kauwul Pty Ltd)

Lower Hunter Aboriginal Incorporated

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ABN: 8192 4628 138



16/04/2016

Keith Simkin
Environment and Community Officer
Bulga Open Cut – A Glencore Company

Dear Keith,

Re: Modification to the Bulga Optimisation project.

On behalf of Lower Hunter Aboriginal Incorporated I would to state that the LHAI traditional owners and relevant members has been presented with the Aboriginal Cultural Heritage Assessment Review for the Boundary disturbance modification on the Eastern emplacement area.

We have endorsed and agreed that all bases were covered and no relevant comments were needed to be incorporated in the modification of the ACHA.

Executive Summary

The Lower Hunter Aboriginal Incorporated (LHAI) has a responsibility to its members for ongoing protection and conservation of the Aboriginal Culture and Heritage in the hunter region and recommends that all proposed projects and cultural heritage works within Wonnarua boundary to be assessed by a Lower Hunter Aboriginal Incorporated Cultural and Heritage Officer.

Yours sincerely



David Ahoy
Sites Manager
LHAI



APPENDIX 7

Site verification



global environmental solutions

Biophysical Strategic Agricultural Land Assessment
Bulga Optimisation Project – Modification Area

Report Number 630.11560

May 2016

Umwelt (Australia) Pty Ltd
75 York Street
Teralba NSW 2284

Version: Final

Biophysical Strategic Agricultural Land Assessment

Bulga Optimisation Project – Modification Area

PREPARED BY:

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This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Umwelt (Australia) Pty Ltd. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
630.11560	Initial Draft	February 2016	Murray Fraser		
630.11560	Final Draft	February 2016	Murray Fraser	Clayton Richards	Clayton Richards
630.11560	Final	May 2016	Murray Fraser	Clayton Richards	Clayton Richards

Table of Contents

1	INTRODUCTION	6
1.1	Study Area	6
1.2	Legislation and Standards	6
1.2.1	Interim Protocol for Site Verification and Mapping of BSAL	6
1.3	Assessment Standards	6
2	METHODOLOGY	9
2.1	Step 1: Identify the project area which will be assessed for BSAL	9
2.2	Step 2: Confirm access to a reliable water supply	9
2.3	Step 3: Choose the appropriate approach to map the soils information	9
2.4	Step 4: Risk assessment	10
2.5	Step 5: Field Soil Survey and BSAL Assessment	10
2.6	Field Soil Survey Methodology	10
2.6.1	Exclusion Zones	10
2.6.1.1	Soil Survey Density	12
2.6.1.2	Soil Survey Observation Types	12
3	SOILS ASSESSMENT	15
4	BIOPHYSICAL STRATEGIC AGRICULTURAL LAND ASSESSMENT	37
5	CONCLUSION	39

TABLES

Table 1	Soil Survey Density	12
Table 2	BSAL Soil Laboratory Analysis Parameters	12
Table 3	Soils Assessment Summary	15
Table 4	Summary: Eutrophic Red Chromosol (Site 1)	16
Table 5	Profile: Eutrophic Red Chromosol (Site 1)	17
Table 6	Chemical Parameters: Eutrophic Red Chromosol (Site 1)	17

Table of Contents

Table 7	Summary: Eutrophic Red Chromosol (Site 2)	18
Table 8	Profile: Eutrophic Red Chromosol (Site 2)	19
Table 9	Chemical Parameters: Eutrophic Red Chromosol (Site 2)	19
Table 10	Summary: Eutrophic Brown Chromosol (Site 4)	20
Table 11	Profile: Eutrophic Brown Chromosol (Site 4)	21
Table 12	Chemical Parameters: Eutrophic Brown Chromosol (Site 4)	21
Table 13	Summary: Subnatric Brown Sodosol (Site 5)	22
Table 14	Profile: Subnatric Brown Sodosol (Site 5)	23
Table 15	Chemical Parameters: Subnatric Brown Sodosol (Site 5)	23
Table 16	Summary: Mesonatric Brown Sodosol (Site 6)	24
Table 17	Profile: Mesonatric Brown Sodosol (Site 6)	25
Table 18	Chemical Parameters: Mesonatric Brown Sodosol (Site6)	25
Table 19	Summary: Subnatric Brown Sodosol (Site 8)	26
Table 20	Profile: Subnatric Brown Sodosol (Site 8)	27
Table 21	Chemical Parameters: Subnatric Brown Sodosol (Site 8)	27
Table 22	Summary: Brown Sodosol (Site 9)	28
Table 23	Profile: Brown Sodosol (Site 9)	29
Table 24	Field Chemical Parameters: Brown Sodosol (Site 9)	29
Table 25	Summary: Brown Sodosol (Site 10)	30
Table 26	Profile: Brown Sodosol (Site 10)	31
Table 27	Field Chemical Parameters: Brown Sodosol (Site 10)	31
Table 28	Summary: Subnatric Red Sodosol (Site 3)	32
Table 29	Profile: Subnatric Red Sodosol (Site 3)	33
Table 30	Chemical Parameters: Subnatric Red Sodosol (Site 3)	33
Table 31	Summary: Red Sodosol (Site 7)	34
Table 32	Profile: Red Sodosol (Site 7)	35
Table 33	Field Chemical Parameters: Red Sodosol (Site 7)	35

Table of Contents

Table 34	BSAL Assessment Summary	37
Table 35	BSAL Assessment	38

FIGURES

Figure 1	Site Layout	7
Figure 2	BSAL Study Area	8
Figure 3	Slope Analysis	13
Figure 4	Soil Sampling Locations and Exclusion Areas	14
Figure 5	Soil Units	36

DIAGRAMS

Diagram 1	BSAL Soil Laboratory Analysis Parameters	11
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APPENDICES

Appendix A	Certificates of Analyses
Appendix B	Slope Analysis Methodology

1 INTRODUCTION

Umwelt (Australia) Pty Limited engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a Biophysical Strategic Agricultural Land (BSAL) Assessment for the Bulga Coal Complex modification of the Proposed Eastern Emplacement Area, which comprises part of the Bulga Optimisation Project and is located approximately 5 kilometres south east of Mount Thorley in the Upper Hunter Valley.

Bulga Coal Management is proposing to modify the design of the Eastern Emplacement Area which was approved as part of the Bulga Optimisation Project, and as such are required to complete a BSAL Assessment to obtain a Site Verification Certificate as per *Part 4AA of the Division 3 of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*. The modification of the Proposed Eastern Emplacement Area, referred to as the Site Verification Study Area (89 hectares) is shown in **Figure 1**.

1.1 Study Area

The Study Area for this BSAL Assessment is the modification of the Proposed Eastern Emplacement Area (89 hectares), plus a 100 metre buffer totalling 143 hectares (**Figure 2**). The Study Area is not mapped as BSAL according to the NSW Government (DP&I, 2012).

Preliminary desktop assessment found the Study Area is covered by the Rothbury Soil Landscape Unit (Kovac and Lawrie, 1991), which is dominated by the Australian Soil Classification (ASC) type Kurosol. Kurosol soils are soils that have a strong texture contrast between the topsoil and subsoil horizons with strongly acidic subsoils and have moderate to moderately low inherent fertility. The Study Area has been digitally mapped by the Office of Environment and Heritage (OEH) as Land and Soil Capability (LSC) Class 5. LSC Class 5 is moderately low capability land with high limitations for high-impact agricultural land uses and is largely restricted to grazing, orchards, forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.

1.2 Legislation and Standards

1.2.1 Interim Protocol for Site Verification and Mapping of BSAL

In April 2013, the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Interim Protocol) ((Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OASFS), 2013)) was released by the NSW Government. This Interim Protocol outlines the process for seeking verification of whether or not land mapped as BSAL meets the Interim Protocol's BSAL criteria. The *State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment) requires certain types of developments to verify whether the proposed site is on BSAL.

1.3 Assessment Standards

The key standards for this assessment include:

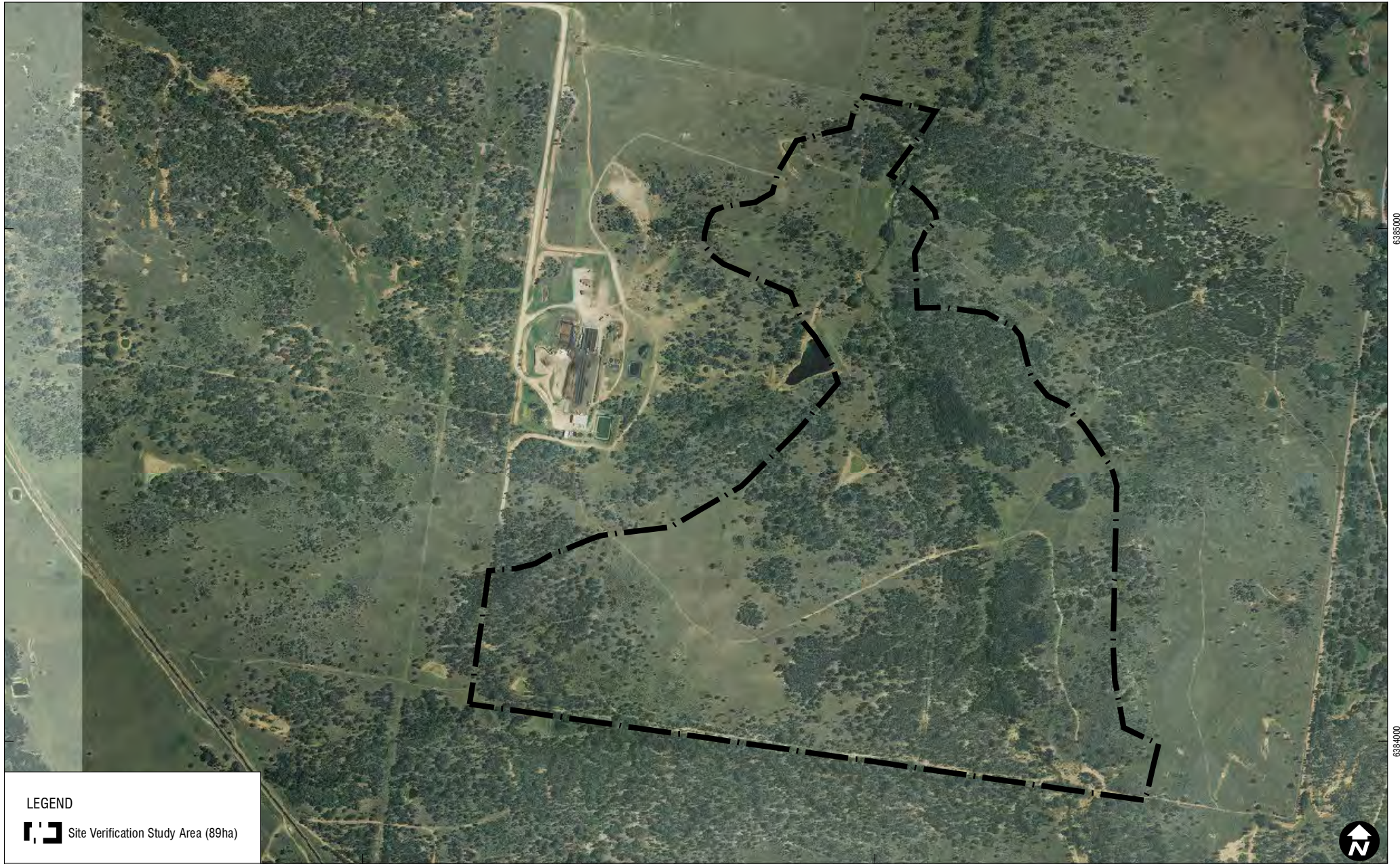
- Interim Protocol.
- Australian Soil Classification (ASC) system (Isbell, 1996).
- Guidelines for Surveying Soil and Land Resources (NCST, 2008).
- Australian Soil and Land Survey Field Handbook (NCST, 2009).

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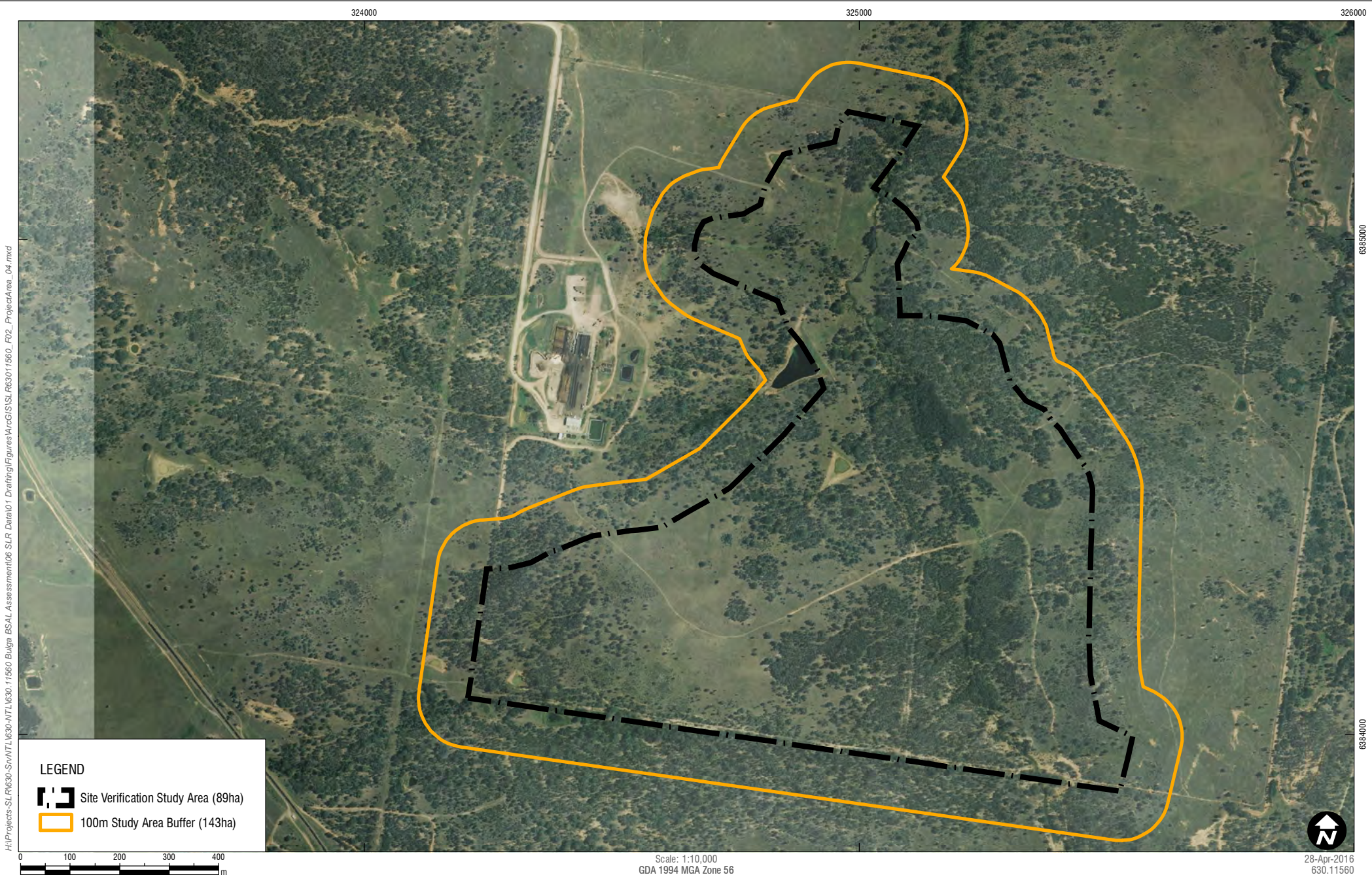
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 Site Verification Study Area (89ha)



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GDA 1994 MGA Zone 56

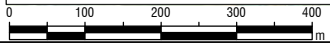


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-  Site Verification Study Area (89ha)
-  100m Study Area Buffer (143ha)



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2 METHODOLOGY

The site verification and methodology for the Study Area reported in the following sections has been undertaken based on the Interim Protocol; including the following steps:

1. Identify the project area (termed Study Area in this report) which will be assessed for BSAL;
2. Confirm access to a reliable water supply;
3. Choose the appropriate approach to map the soils information;
4. Risk assessment; and
5. Field Soil Survey and BSAL Assessment.

2.1 Step 1: Identify the project area which will be assessed for BSAL

The Interim Protocol requires that:

"The assessment area should include the entire project area and include at least a 100 m buffer to take into account minor changes in design, surrounding disturbance and minor expansion. If BSAL is part of a larger contiguous mass of BSAL then the boundary of this area must also be identified."

The Study Area for this BSAL Assessment is shown in **Figure 2** which includes a 100 metre buffer surrounding the Study Area, totalling 143 hectares.

2.2 Step 2: Confirm access to a reliable water supply

The Interim Protocol requires that:

"BSAL lands must have access to a reliable water supply."

Representative rainfall data for the Study Area has been obtained from the nearest Bureau of Meteorology (BOM) weather station located at Bulga. The Bulga BOM Station (061143) has recorded an average annual rainfall of 699.6 mm (based on records from 1963 – present); therefore the Study Area meets the minimum average annual rainfall of 350 mm to have access to reliable water supply.

2.3 Step 3: Choose the appropriate approach to map the soils information

The Interim Protocol states that:

"Access to the project area will define the level of investigation that the proponent can undertake. If the proponent has access to the land then the BSAL verification requirements for on-site soils assessment as described in sections 6 and 9 of the Interim Protocol should be met. If the proponent does not have access then the proponent should develop a model of soils distribution guided by sections 6 and 9 based on landscape characteristics using the information listed in Section 5 of the Interim Protocol."

The Proponent has reasonable access to the majority of the Study Area, however some land access was also constrained by physical access due to slopes and forested terrain. Where land access is not available, soil distribution will be based on landscape characteristics in accordance with the *Interim Protocol*.

2.4 Step 4: Risk assessment

The Interim Protocol states that:

“The proponent should undertake a risk assessment as this will influence the density of soil sampling required as explained in Section 9.6.1. The proposed activity on parts or all of the project area may be of low risk to agriculture and so may only require a sampling density of 1:100 000. Alternatively other areas may be at higher risk of impact and so should have a sampling density of 1:25 000.”

The Project consists of the construction of an emplacement area and SLR has assessed the following potential impacts of the project activities within the Study Area on agriculture:

- Consequence: Level 2 – Significant and/or long term impact to agricultural resources or industries with long term management implications
- Probability: A – Almost certain.

The risk matrix result was A2 which is considered a high risk. The Study Area therefore requires an inspection density of 1:25,000.

For the purpose of this survey the 100 metre buffer area is also considered to require an inspection density of 1:25,000.

2.5 Step 5: Field Soil Survey and BSAL Assessment

Murray Fraser (Senior Agronomist) undertook the fieldwork and sampling during January 2016, supervised by Clayton Richards (CPSS 2). Murray conducted the BSAL Assessment while Clayton was responsible for technical review of the BSAL Assessment.

2.6 Field Soil Survey Methodology

For soil to be classified as BSAL it must follow the criteria outlined in the flow chart shown in **Diagram 1**. If any criteria is not met (except step 5 or step 6), the site is not BSAL and there is no need to continue the assessment. The design of the soil survey was developed following a process of applying the BSAL methodology as a desktop exercise to identify any areas that would obviously not meet the criteria (termed exclusion zones). The field survey program was then developed to ensure that areas of relatively higher likelihood of meeting BSAL criteria were targeted for field analysis.

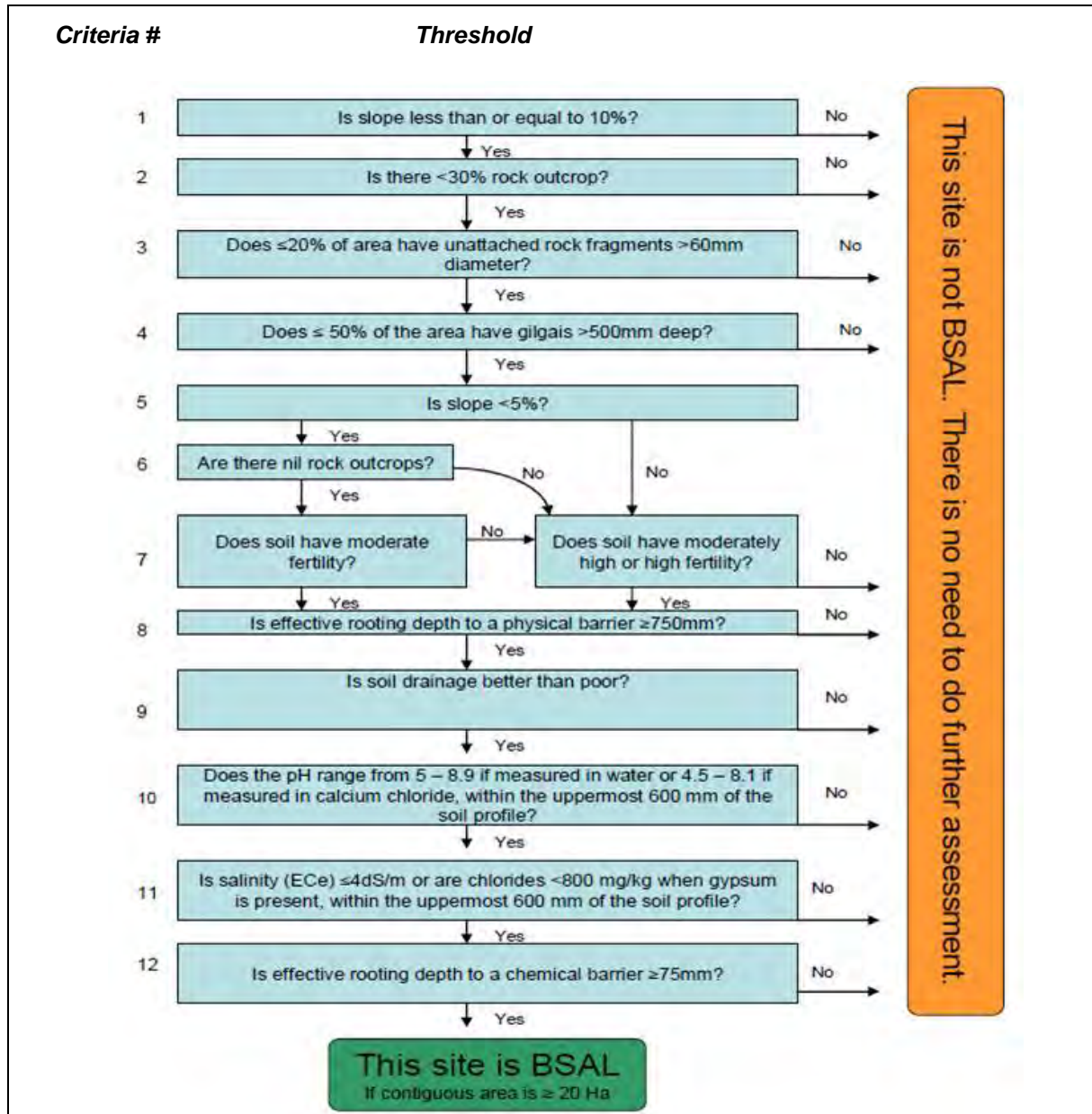
2.6.1 Exclusion Zones

Initially, land greater than 10% slope (**Figure 3**) within the Study Area was identified using topographical data from the LIDAR data. Areas with slope greater than 10% slope were excluded. In total 37 hectares was determined not to meet the BSAL methodology Criteria 1 (**Figure 3**). Slope Analysis methodology is provided in **Appendix B**.

Subsequently, any land that did not meet the minimum 20 hectares of contiguous area to be classified as BSAL was also excluded (3 hectares). In total 40 hectares was determined not to meet the BSAL methodology Criteria 1 within the Study Area (**Figure 3**). Land contiguous to the Study Area was taken into consideration when classifying areas of land to be less than 20 hectares.

In summary, 40 hectares were determined not to meet the BSAL methodology criteria within the Study Area. This comprised 37 hectares of land with slope greater than 10% and 3 hectares of land less than 20 hectares contiguous area. This reduced the land to be assessed by the field soil survey program to 103 hectares. (Table 1 and Figure 3).

Diagram 1 BSAL Soil Laboratory Analysis Parameters



1.1.1 Soil Survey Density

To satisfy the Interim Protocol requirements, the field soil survey program was comprised of 10 observations which consisted of 7 detailed sites and 3 check sites (**Figure 3**).

Table 1 Soil Survey Density

Survey Area	Hectares	Survey Scale	Protocol Required Sites	Sites Completed
<10% slope & >20 hectares	103	1:25,000	3*	10
>10% Slope	37	N/A	-	-
<20 hectares contiguous	3	N/A	-	-
Total	143	-	3*	10

* A minimum of 3 observation sites per soil mapping unit (Soil Unit) are required according to the Interim Protocol

1.1.2 Soil Survey Observation Types

Detailed Sites

Soil profiles were assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was pit excavated with a backhoe to a depth of 1.2 metres. After assessment, pits were backfilled with the remaining soil. Detailed soil profile morphological descriptions recorded information that covered the parameters specified in the Interim Protocol.

Samples were sent to the Scone Research Centre (NSW, Australia) for analysis for the suite of parameters as listed in **Table 2**. This laboratory is National Association of Testing Authority (NATA) accredited. Certificates of Analysis are contained in **Appendix A**.

Table 2 BSAL Soil Laboratory Analysis Parameters

Laboratory Analysis	
<ul style="list-style-type: none"> Electrical conductivity (EC) pH (1:5) Total cation exchange and exchangeable cations 	<ul style="list-style-type: none"> Cation exchange capacity (CEC) Particle size Analysis Munsell colour

Soil salinity data was determined through measurement of electrical conductivity (EC) of soil:water (1:5) suspensions. These values are converted to the EC of a saturated extract (ECe) based on soil texture in accordance with the Interim Protocol.

Check Sites

Check sites are mapping observations examined in sufficient detail to allocate the site to a specific soil type and map unit.

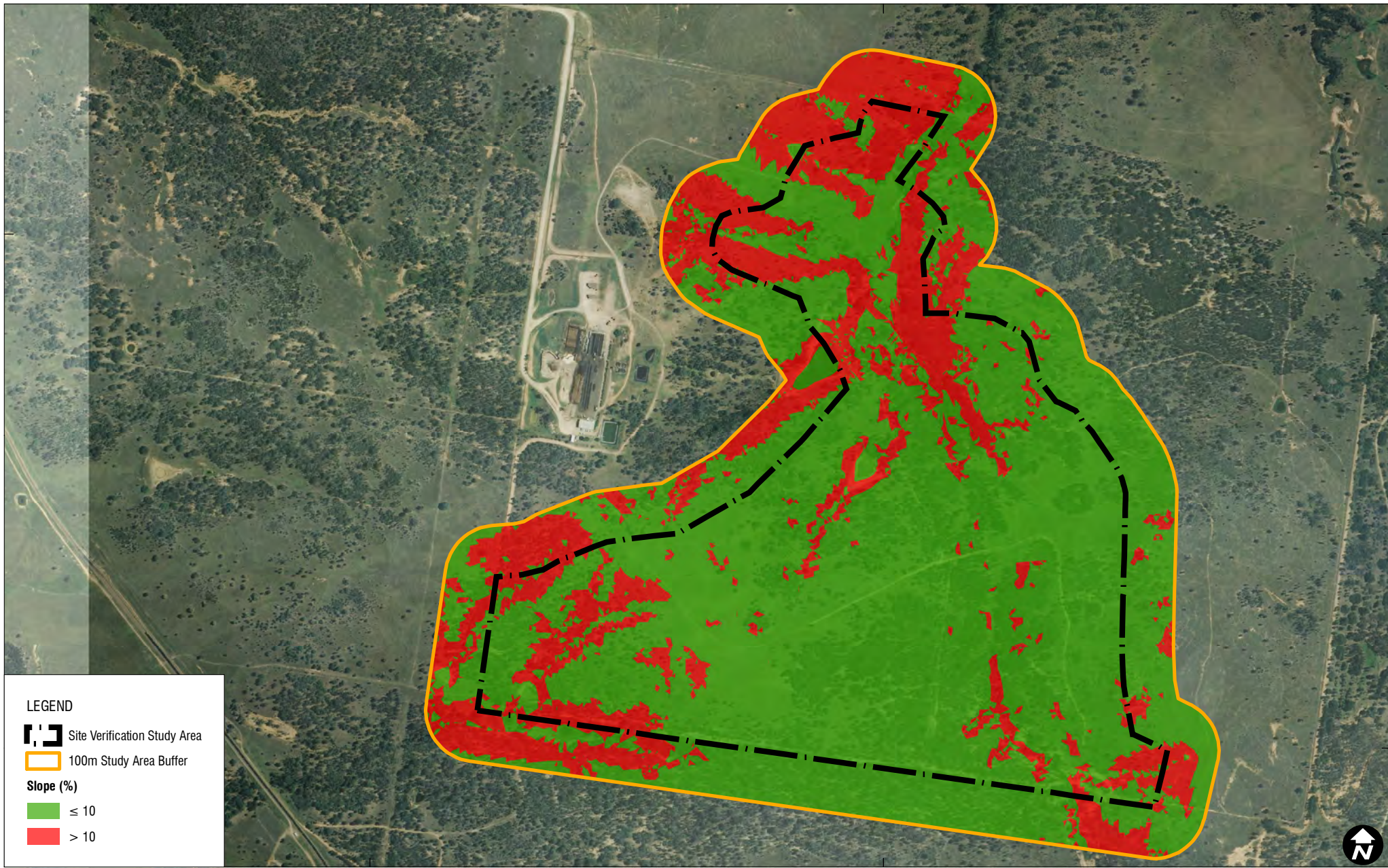
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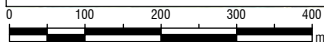
 Site Verification Study Area

 100m Study Area Buffer

Slope (%)

 ≤ 10

 > 10

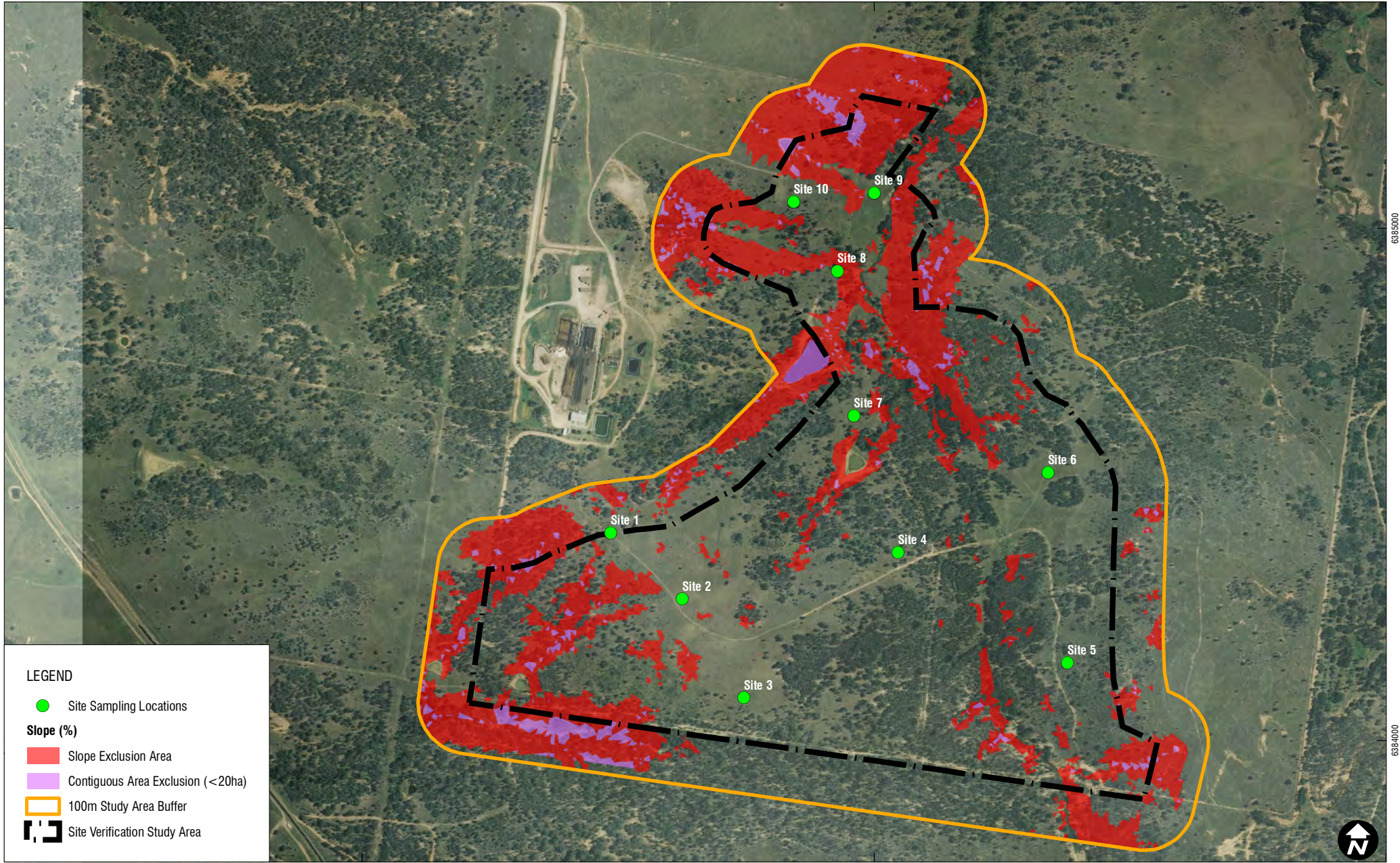


Scale: 1:10,000
GDA 1994 MGA Zone 56



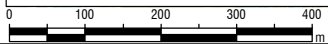
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LEGEND

- Site Sampling Locations
- Slope (%)**
- Slope Exclusion Area
- Contiguous Area Exclusion (<20ha)
- 100m Study Area Buffer
- Site Verification Study Area



Scale: 1:10,000
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28-Apr-2016
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Sampling Locations & Exclusion Areas

FIGURE 4

3 SOILS ASSESSMENT

In accordance with the Interim Protocol, a soil mapping unit (Soil Unit) may contain some soil variation, but will typically only contain a single dominant soil type. The dominant soil type will comprise greater than 70% of the Soil Unit. Therefore, a Soil Unit may contain a dominant soil type as well as subdominant and/or soil variants. When a Soil Unit does not have a clear dominant soil type soil variation must be accepted.

Within the Study Area two Soil Units have been identified based on the dominant soil type (**Table 3; Figure 4**), a Chromosol and a Sodosol.

Table 3 Soils Assessment Summary

Soil Unit	Soil Type	Area	Survey Type	Site #
1 Chromosol	Dominant: Red Chromosol	17 Hectares	Detailed	1, 2
			Check	Nil
	Sub-Dominant: Brown Chromosol		Detailed	4
			Check	Nil
2 Sodosol	Dominant: Brown Sodosol	86 Hectares	Detailed	5, 6, 8
			Check	9, 10
	Sub-Dominant: Red Sodosol		Detailed	3
			Check	7

Three soil profiles from the dominant soil type of Soil Unit 1 (**Section 3.1**) and seven profiles from Soil Unit 2 (**Section 3.2**) are described below.

3.1 Soil Unit 1: Eutrophic Red Chromosol

Soil Unit 1 is a Eutrophic Red Chromosol. Chromosols are soils with a strong texture contrast between the A and B horizons, where the B horizon is not strongly acidic or sodic. Within the Study Area Soil Type 1 showed little variance in physical and chemical parameters. Profiles consisted of loamy sand A horizons with a clear boundary to a medium-heavy clay B horizons. All profiles were non-sodic and non-saline, with the exception of Site 4 which was marginally saline at 50-60 cm.

Three representative sites for Soil Unit 1 are described below.

Table 4 Summary: Eutrophic Red Chromosol (Site 1)

Overview	
	
Landscape Site 1	
ASC Name	Eutrophic Red Chromosol
Representative Site	Site 1
Survey Type	Detail
Dominant Topography	Hillcrest Plateau
Dominant Land Use	Cattle Grazing
Vegetation	Casuarina, Lantana, Grevillea
Inherent Soil Fertility	Moderately High
Slope	7%

Table 5 Profile: Eutrophic Red Chromsol (Site 1)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (7.5YR 3/4) loamy sand, weakly structured 2-5 mm crumb peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Moderately drained with a gradual and even boundary.
	A2 0.15 – 0.35	Strong brown (7.5YR 4/6) loamy sand, weakly structured 5-10 mm crumb peds with weak consistence and a rough fabric. Nil mottling, <5% pebbles 10-20 mm, abundant fine roots. Moderately drained with a clear and even boundary.
	B21 0.35 – 0.50	Yellowish red (5YR 5/8) medium clay, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct yellow mottles; nil stone content, few coarse roots. Poorly drained with a gradual and even boundary.
	B22 0.50 – 0.90	Strong brown (7.5YR 5/8) medium clay, moderately structured 40-80 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct yellow and 30% distinct red mottles, nil stone content, few coarse roots. Poorly drained with a gradual and even boundary.
	BC +0.90	Weathered parent material

Table 6 Chemical Parameters: Eutrophic Red Chromsol (Site 1)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	6.1	Slightly Acidic	3.2	Non-sodic	0.2	Non-saline	6.2	Low
20-30	6.5	Slightly Acidic	3.3	Non-sodic	0.1	Non-saline	6.0	Very Low
40-50	5.7	Moderately Acidic	1.7	Non-sodic	0.2	Non-saline	18.0	Moderate
50-60	5.7	Moderately Acidic	2.4	Non-sodic	0.3	Non-saline	16.9	Moderate
65-75	5.6	Moderately Acidic	2.3	Non-sodic	0.2	Non-saline	17.2	Moderate

Table 7 Summary: Eutrophic Red Chromosol (Site 2)


Overview	
	
Landscape Site 2	
ASC Name	Eutrophic Red Chromosol
Representative Site	Site 2
Survey Type	Detail
Dominant Topography	Hillcrest Plateau
Current Land Use	Cattle Grazing
Vegetation	Casuarina, Lantana, Wiregrass, Saffron Thistle
Inherent Soil Fertility	Moderately High
Slope	7%

Table 8 Profile: Eutrophic Red Chromsol (Site 2)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (7.5YR 4/4) loamy sand, weak crumb structure 1-5 mm peds with weak consistence and a rough fabric. Nil mottling. <5% pebbles 10-20 mm, abundant fine roots. Well drained with a gradual and even boundary.
	A2 0.10 – 0.30	Strong brown (7.5YR 4/6) loamy sand, weak crumb structure 2-10 mm peds with weak consistence and a rough fabric. Nil mottling, 5% pebbles 10-20 mm, abundant fine roots. Well drained with a clear and wavy boundary.
	B21 0.30 – 0.40	Red (2.5YR 4/8) medium clay, moderate structure of 20-40 mm subangular blocky peds with a moderate consistence and a rough fabric. 20% distinct yellow mottles, nil stone content, few coarse roots. Moderately drained with a gradual and wavy boundary.
	B22 0.40 – 0.60	Yellowish red (5YR 4/6) clay loam, moderate structure of 40-80 mm subangular blocky peds with a strong consistence and a rough fabric. 30% distinct yellow mottles, <10% pebbles 10-20 mm, few coarse roots. Poorly drained with a clear and wavy boundary.
	BC +0.60	Weathered parent material

Table 9 Chemical Parameters: Eutrophic Red Chromsol (Site 2)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	5.8	Moderately Acidic	4.2	Non-sodic	0.1	Non-saline	4.8	Very Low
20-30	6.1	Slightly Acidic	2.8	Non-sodic	0.1	Non-saline	7.1	Low
30-40	5.8	Moderately Acidic	1.6	Non-sodic	0.1	Non-saline	18.7	Moderate
50-60	7.3	Neutral	1.0	Non-sodic	1.4	Non-saline	19.1	Moderate

Table 10 Summary: Eutrophic Brown Chromosol (Site 4)

Overview	
	
Landscape Site 4	
ASC Name	Eutrophic Brown Chromosol
Representative Site	Site 4
Survey Type	Detail
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Casuarina, Lantana, Panic
Inherent Soil Fertility	Moderately High
Slope	8%

Table 11 Profile: Eutrophic Brown Chromosol (Site 4)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Brown (7.5YR 3/3) loamy sand, weak crumb structure 1-5 mm peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary.
	A2 0.15 – 0.30	Strong brown (7.5YR 4/6) bleached loamy sand, weak crumb structure 2-10 mm peds with weak consistence and a rough fabric. Nil mottling, <5% pebbles 10-20 mm, abundant fine roots. Well drained with a clear and wavy boundary.
	B21 0.30 – 0.50	Dark yellowish brown (10YR 4/6) heavy clay, moderate structure of 20-40 mm subangular blocky peds with a moderate consistence and a rough fabric. 30% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with a gradual and wavy boundary. 20% hard calcium nodules 10 mm.
	B22 0.50 – 0.90	Strong brown (7.5YR 5/8) light clay, moderate structure of 40-80 mm subangular blocky peds with a strong consistence and a rough fabric. 40% distinct yellow mottles, <5% pebbles 10-20 mm, few coarse roots. Poorly drained with a clear and wavy boundary. 30% hard calcium nodules 10 mm.
	BC +0.90	Weathered parent material

Table 12 Chemical Parameters: Eutrophic Brown Chromosol (Site 4)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	5.1	Strongly Acidic	1.6	Non-sodic	0.1	Non-saline	6.4	Low
20-30	5.6	Moderately Acidic	3.7	Non-sodic	0.1	Non-saline	5.4	Very Low
35-45	6.4	Slightly Acidic	4.4	Non-sodic	0.7	Non-saline	25.0	Moderate
50-60	8.4	Moderately Alkaline	4.2	Non-sodic	2.0	Slightly Saline	31.1	High
65-75	8.7	Strongly Alkaline	4.6	Non-sodic	1.5	Non-saline	26.2	High

3.2 Soil Unit 2: Subnatric Brown Sodosol

Soil Unit 2 is a Subnatric Brown Sodosol. Sodosols are soils with a strong texture contrast between the A horizon and a sodic B horizon which is not strongly acidic. Within the Study Area Soil Type 2 showed little variance in physical and chemical parameters. Profiles were generally loamy sand in the A horizons with a clear boundary to a light-medium clay B horizons.

Seven representative sites for Soil Unit 2 are described below.

Table 13 Summary: Subnatric Brown Sodosol (Site 5)


Overview	
	
Landscape Site 5	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 5
Survey Type	Detail
Dominant Topography	Lower Hillslope
Current Land Use	Cattle Grazing
Vegetation	Casuarina, Acacia, Pigeon Grass
Inherent Soil Fertility	Moderately Low
Slope	7%

Table 14 Profile: Subnatric Brown Sodosol (Site 5)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark yellowish brown (10YR 4/4) loamy sand, weak crumb structure 1-10 mm peds with weak consistence and a rough fabric. Nil mottling, 5% pebbles 10-20 mm, abundant fine roots. Well drained with a clear and even boundary.
	B21 0.15 – 0.50	Dark yellowish brown (10YR 4/6) light medium clay, moderate structure of 20-40 mm subangular blocky peds with a moderate consistence and a rough fabric. 20% distinct red mottles, 5% pebbles 10-20 mm, common coarse roots. Moderately drained with a gradual and even boundary.
	B22 +0.50	Dark yellowish brown (10YR 4/6) light clay, moderate structure of 40-80 mm subangular blocky peds with a strong consistence and a rough fabric. 30% distinct grey mottles, 15% gravel 10-20 mm, few coarse roots. Moderately drained with a gradual and even boundary.

Table 15 Chemical Parameters: Subnatric Brown Sodosol (Site 5)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	6.0	Moderately Acidic	5.9	Non-sodic	0.2	Non-saline	6.8	Low
20-30	6.7	Neutral	14.4	Strongly Sodic	2.0	Non-saline	20.1	Moderate
50-60	7.1	Neutral	19.4	Strongly Sodic	4.7	Moderately saline	19.1	Moderate
65-75	7.6	Mildly Alkaline	19.9	Strongly Sodic	5.2	Moderately saline	18.6	Moderate

Table 16 Summary: Mesonatric Brown Sodosol (Site 6)

Overview	
	
Landscape Site 6	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site 6
Survey Type	Detail
Dominant Topography	Lower Hillslope
Current Land Use	Cattle Grazing
Vegetation	Casuarina, Acacia, Paspalum
Inherent Soil Fertility	Moderately Low
Slope	6%

Table 17 Profile: Mesonatric Brown Sodosol (Site 6)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/3) loamy sand, weak crumb structure 1-10 mm peds with weak consistence and a rough fabric. Nil mottling, <5% pebbles 10-20 mm, abundant fine roots. Well drained with a gradual and even boundary.
	A2 0.20 – 0.35	Dark yellowish brown (10YR 4/4) bleached loamy sand, weak crumb structure 2-10 mm peds with weak consistence and a rough fabric. Nil mottling, <5% pebbles 10-20 mm, abundant fine roots. Well drained with a clear and even boundary.
	B21 0.35 – 0.60	Dark yellowish brown (10YR 4/6) light medium clay, moderate structure of 20-40 mm subangular blocky peds with a moderate consistence and a rough fabric. 20% distinct brown mottles; nil stone content, common coarse roots. Poorly drained with a gradual and even boundary.
	B22 0.60 – 1.10	Dark yellowish brown (10YR 4/6) light clay, moderate structure of 40-80 mm subangular blocky peds with a strong consistence and a rough fabric. 20% distinct red and 20% distinct grey mottles, nil stone content, few coarse roots. Poorly drained with a gradual and even boundary.
	BC +1.10	Weathered parent material

Table 5 Chemical Parameters: Mesonatric Brown Sodosol (Site6)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	5.2	Strongly Acidic	3.3	Non-sodic	0.2	Non-saline	6.1	Low
20-30	6.1	Slightly Acidic	3.9	Non-sodic	0.1	Non-saline	5.1	Very Low
50-60	6.8	Neutral	18.2	Strongly Sodic	3.5	Slightly saline	18.7	Moderate
65-75	6.8	Neutral	19.3	Strongly Sodic	4.2	Moderately saline	16.6	Moderate

Table 19 Summary: Subnatric Brown Sodosol (Site 8)


Overview	
	
Landscape Site 8	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 8
Survey Type	Detail
Dominant Topography	Drainage Flat
Current Land Use	Cattle Grazing
Vegetation	Ironbark, Stringybark, Wiregrass, Lantana
Inherent Soil Fertility	Moderately Low
Slope	10%

Table 20 Profile: Subnatric Brown Sodosol (Site 8)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.05	Brown (7.5YR 4/3) loamy sand, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, <5% pebbles 20 mm, abundant fine roots. Well drained with a gradual and even boundary.
	A2 0.05 – 0.20	Dark yellowish brown (10YR 4/6) bleached loamy sand, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, <5% pebbles 20 mm, common fine roots. Well drained with a clear and even boundary.
	B21 0.20 – 0.60	Dark yellowish brown (10YR 4/6) light medium clay, strong structure 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct-red mottles, <5% pebbles 20 mm, common coarse roots. Poorly drained with a gradual and even boundary.
	B22 +0.60	Yellowish red (5YR 4/6) medium clay loam, strong structure 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles, <5% gravel 10-20 mm, few coarse roots. Poorly drained.

Table 21 Chemical Parameters: Subnatric Brown Sodosol (Site 8)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-5	5.2	Strongly Acidic	3.0	Non-sodic	0.2	Non-saline	6.6	Low
10-20	6.2	Slightly Acidic	2.3	Non-sodic	0.4	Non-saline	12.8	Moderate
25-35	5.8	Moderately Acidic	7.6	Marginally Sodic	0.9	Non-saline	17.0	Moderate
50-60	6.2	Slightly Acidic	9.0	Marginally Sodic	2.2	Slightly Saline	18.8	Moderate
65-75	6.9	Neutral	9.8	Marginally Sodic	4.7	Moderately Saline	16.4	Moderate

Table 22 Summary: Brown Sodosol (Site 9)

Overview	
	
Landscape Site 9	
ASC Name	Brown Sodosol
Representative Site	Site 9
Survey Type	Check
Dominant Topography	Drainage Flat
Current Land Use	Cattle Grazing
Vegetation	Ironbark, Spotted Gum, Wiregrass, Lantana
Inherent Soil Fertility	Moderately Low
Slope	5%

Table 23 Profile: Brown Sodosol (Site 9)


Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (7.5YR 3/2) loamy sand, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, 10% gravel <10 mm, abundant fine roots. Well drained with a gradual and even boundary.
	A2 0.10 – 0.20	Brown (7.5YR 5/4) bleached loamy sand, weak crumb structure 10-20 mm with weak consistence and a rough fabric. Nil mottling, 10% gravel <10 mm, abundant fine roots. Well drained with a clear and even boundary.
	B21 0.20 – 0.50	Brown (7.5YR 5/4) light medium clay, moderate structure 20-50 mm subangular blocky peds with moderate consistence and a rough fabric. 10% faint grey mottles, 10% gravel <10 mm, common coarse roots. Poorly drained with a gradual and even boundary.
	B22 +0.50	Strong brown (7.5YR 5/6) medium clay, moderate structure 40-60 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct grey mottles, 10% gravel <10 mm, common coarse roots. Poorly drained. Dispersive B22 horizon.

Table 24 Field Chemical Parameters: Brown Sodosol (Site 9)

Horizon	Field pH		Dispersivity
	Unit	Rating	Rating
A1	6.0	Moderately Acidic	Non
A2	6.0	Moderately Acidic	Slightly
B21	7.0	Neutral	Moderately
B22	9.0	Strongly Alkaline	Highly

Table 25 Summary: Brown Sodosol (Site 10)


Overview	
	
Landscape Site 10	
ASC Name	Brown Sodosol
Representative Site	Site 10
Survey Type	Check
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Ironbark, Casuarina, Wiregrass, Lantana
Inherent Soil Fertility	Moderately Low
Slope	8%

Table 26 Profile: Brown Sodosol (Site 10)

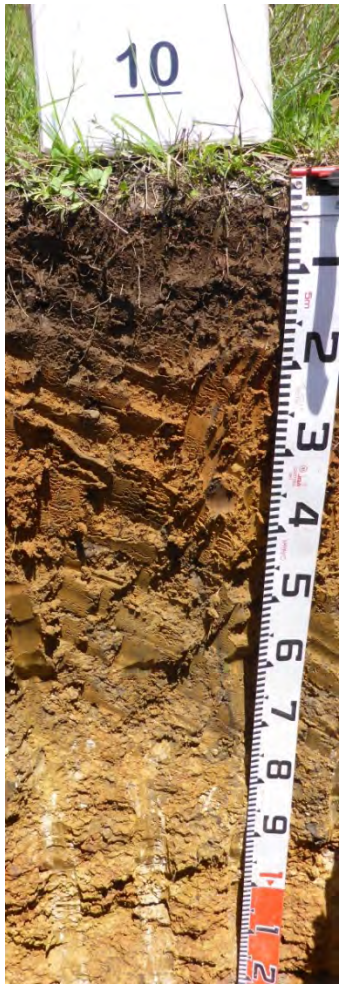
Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (7.5YR 3/2) sandy loam, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, 20% gravel 20 mm, abundant fine roots. Well drained with a clear and wavy boundary.
	B21 0.15 – 0.40	Strong brown (7.5YR 5/6) medium clay, moderate structure 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 10% distinct brown mottling, 10% gravel 20 mm. Moderately drained with a gradual and wavy boundary.
	B22 0.40 – 0.70	Brown (7.5YR 5/4) medium clay, moderate structure 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct grey mottling, 10% gravel 20 mm. Poorly drained with a gradual and wavy boundary. Dispersive B22 horizon
	B23 0.70 – 1.0	Reddish yellow (7.5YR 6/6) medium clay, moderate structure 60-80 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct brown mottling, 50% gravel 20 mm, 20% hard calcium nodules 20 mm at +0.70. Poorly drained with a gradual and wavy boundary. Dispersive B23 horizon.
	BC +1.00	Weathered parent material

Table 27 Field Chemical Parameters: Brown Sodosol (Site 10)

Horizon	Field pH		Dispersivity
	Unit	Rating	Rating
A1	6.0	Moderately Acidic	Non
A2	7.0	Neutral	Slightly
B21	8.0	Moderately Alkaline	Moderately
B22	9.0	Strongly Alkaline	Highly
B23	9.0	Strongly Alkaline	Highly

Table 28 Summary: Subnatric Red Sodosol (Site 3)


Overview	
	
Landscape Site 3	
ASC Name	Subnatric Red Sodosol
Representative Site	Site 3
Survey Type	Detail
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Ironbark, Casuarina, Grevillea, Wiregrass
Inherent Soil Fertility	Moderately Low
Slope	1%

Table 29 Profile: Subnatric Red Sodosol (Site 3)

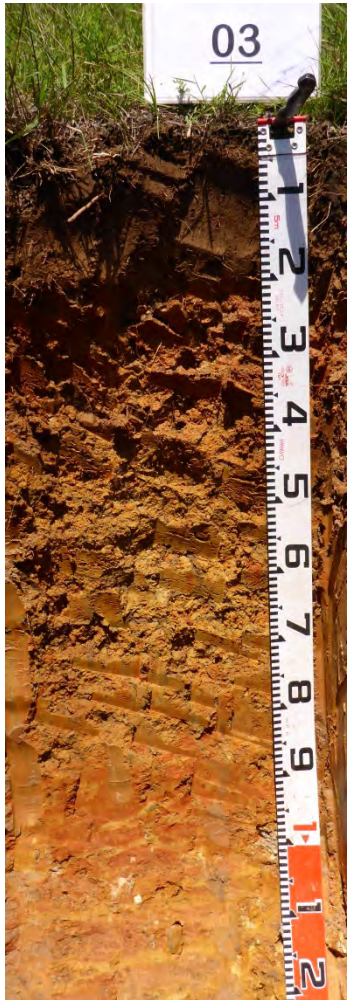
Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/3) loamy sand, weak crumb structure 2-5 mm peds with weak consistence and a rough fabric. Nil mottling, <5% pebbles 10-20 mm, abundant fine roots. Well drained with a clear and wavy boundary.
	B21 0.20 – 0.35	Yellowish red (5YR 4/6) heavy clay, moderate structure of 20-40 mm subangular blocky peds with a moderate consistence and a rough fabric. 30% distinct yellow mottles; nil stone content, common coarse roots. Moderately drained with a gradual and wavy boundary.
	B22 0.35 – 0.85	Yellowish brown (10YR 5/6) medium clay, moderate structure of 40-80 mm subangular blocky peds with a moderate consistence and a rough fabric. 40% distinct red mottles, nil stone content, common coarse roots. Poorly drained with a clear and wavy boundary.
	BC +0.85	Weathered parent material

Table 30 Chemical Parameters: Subnatric Red Sodosol (Site 3)

Layer (cm)	pH (1:5 water)		ESP		ECe (1:5)		CEC	
	Unit	Rating	%	Rating	dS/m	Rating	cmol/kg	Rating
0-10	5.9	Moderately Acidic	2.5	Non-sodic	0.1	Non-saline	7.8	Low
20-30	5.7	Moderately Acidic	6.5	Marginally Sodic	0.4	Non-saline	18.6	Moderate
50-60	5.7	Moderately Acidic	11.0	Sodic	2.0	Non-saline	18.1	Moderate
65-75	7.5	Mildly Alkaline	14.7	Strongly Sodic	3.1	Slightly Saline	17.5	Moderate

Table 31 Summary: Red Sodosol (Site 7)

Overview	
	
Landscape Site 7	
ASC Name	Red Sodosol
Representative Site	Site 7
Survey Type	Check
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Ironbark, Casuarina, Wiregrass, Lantana
Inherent Soil Fertility	Moderately Low
Slope	8%

Table 32 Profile: Red Sodosol (Site 7)


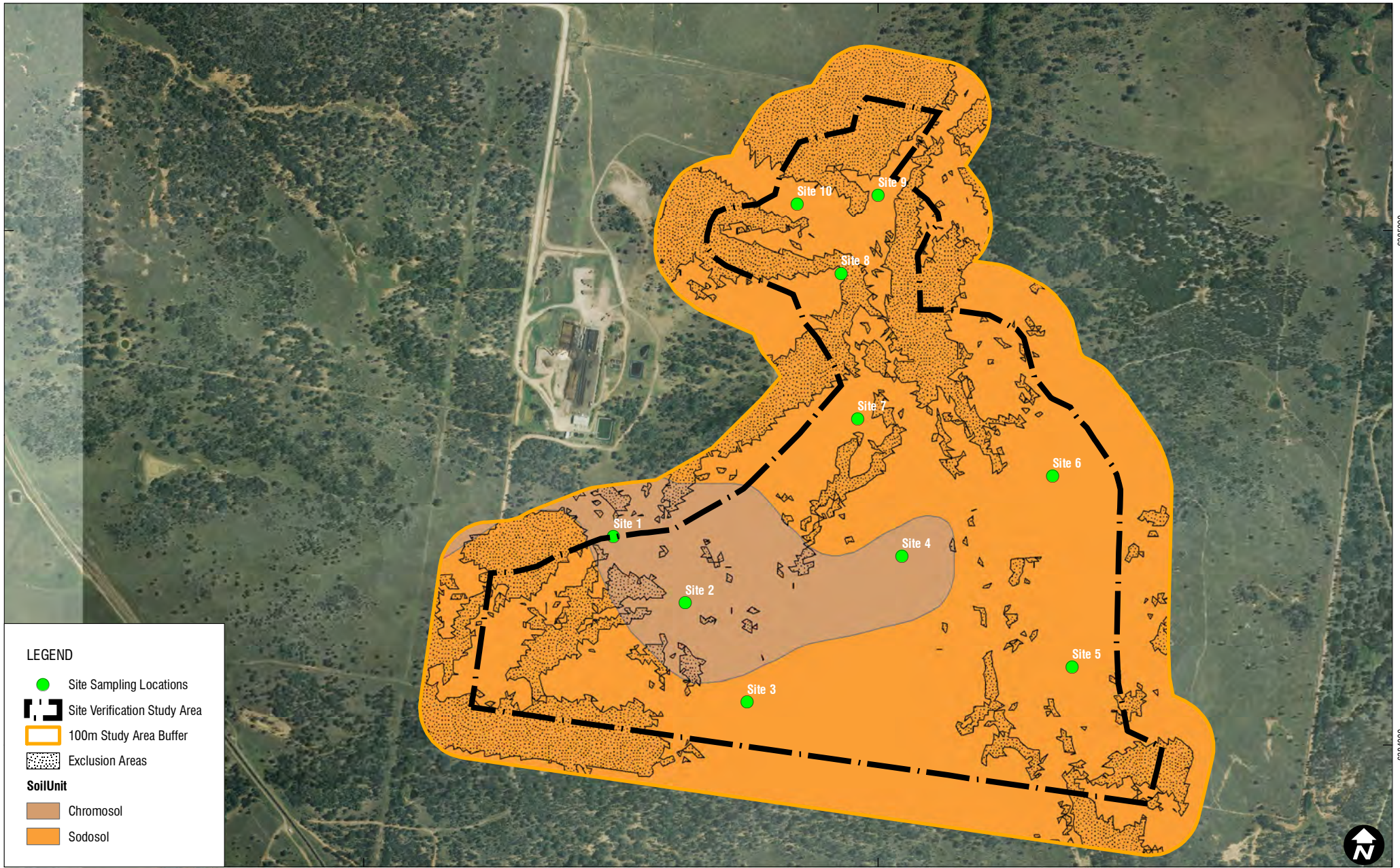
Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (7.5YR 3/2) loamy sand, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, 20% pebbles 20 mm, abundant fine roots. Well drained with a gradual and wavy boundary.
	A2 0.10 – 0.20	Brown (7.5YR 4/3) bleached loamy sand, weak crumb structure 5-10 mm with weak consistence and a rough fabric. Nil mottling, 20% pebbles 20 mm, abundant fine roots. Well drained with a clear and wavy boundary.
	B21 0.20 – 0.40	Yellowish red (5YR 5/6) medium clay, strong structure 20-40 mm subangular blocky peds with strong consistence and a rough fabric. 50% distinct-yellow mottles, 20% pebbles 20 mm, common coarse roots. Poorly drained with a gradual and even boundary.
	B22 0.40 – 0.85	Yellowish brown (7.5YR 5/6) medium clay, strong structure 40-80 mm subangular blocky peds with strong consistence and a rough fabric. 10% faint grey mottles; 20% gravel 10-20 mm, few coarse roots. Poorly drained with a gradual and wavy boundary.
	B23 +0.85	Reddish yellow (7.5YR 6/6) medium clay, strong structure 60-80 mm subangular blocky peds with strong consistence and a rough fabric. 20% faint red mottles; 20% gravel 10-20 mm, few coarse roots, <10% soft calcium nodules 10 mm at +0.85 m. Poorly drained.

Table 33 Field Chemical Parameters: Red Sodosol (Site 7)

Horizon	Field pH		Dispersivity
	Unit	Rating	Rating
A1	6.0	Moderately Acidic	Non
A2	6.0	Moderately Acidic	Non
B21	6.0	Moderately Acidic	Moderately
B22	5.5	Strongly Acidic	Moderately
B23	9.0	Strongly Alkaline	Highly

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LEGEND

- Site Sampling Locations
- Site Verification Study Area
- 100m Study Area Buffer
- Exclusion Areas
- SoilUnit**
- Chromosol
- Sodosol

Scale: 1:10,000
GDA 1994 MGA Zone 56

28-Apr-2016
630.11560

4 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND ASSESSMENT

This BSAL assessment has been conducted in accordance with the Interim Protocol. The BSAL status was determined on the dominant soil type within each Soil Unit. The BSAL assessment and limitations for each soil sample site is shown in **Table 35**.

Two Soil Units were identified and mapped with the Study Area, and all were verified as non-BSAL due their failure of Criteria 7, 8 and 9. There is 103 hectares of land verified as non-BSAL within the Study Area based on the soil survey results (**Table 34**).

Additionally, with 40 hectares excluded as BSAL due to greater than 10% slope or being a contiguous area less than 20 hectares. Therefore the total Study Area has been mapped as non-BSAL.

Table 34 BSAL Assessment Summary

Soil Survey BSAL Assessment	Area (hectares)
Verified BSAL	Nil
Verified Non-BSAL	103
Exclusion Zone (>10% slope)	37
Exclusion Zone (<20 hectares contiguous)	3
Study Area Total	143

Table 35 BSAL Assessment

Site	Soil Unit	Inspection Site Type	Soil Type: Australian Soil Classification (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does soil have Moderate Fertility?	7b. Does soil have Moderately High or High fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH (1:5 water) between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
Sampled Sites																	
1	Chromosol	Detailed	Eutrophic Red Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	No
2		Detailed	Eutrophic Red Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	
4		Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	
5	Sodosol	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	✓	✗	✗	
6		Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	✓	✗	✗	
8		Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓	
9		Check	Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	-	-	-	
10		Check	Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	-	-	-	
3		Detailed	Subnatric Red Sodosol	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	✓	✓	
7	Check	Red Sodosol	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	-	-	-	

✓ = passes the BSAL criteria ✗ = fails the criteria but not excluded as BSAL ✗ = fails the BSAL criteria

N/A = criteria is not assessed in accordance with Interim Protocol

5 CONCLUSION

This BSAL Assessment for the Bulga Optimisation Project – Modification Area was undertaken by SLR Consulting. The Study Area for this BSAL Assessment is the proposed modified portion of the Modification Area, plus a 100 metre buffer totalled 143 hectares and contained no BSAL according to NSW Government criteria (DP&I, 2012).

Of the two soil units identified in the soil survey, the Chromosol failed the BSAL Criteria 9, poor drainage, which was evident through mottling and limited plant root growth in the B horizons. Site 2 also failed Criteria 8, soil depth. The Sodosol failed Criteria 7, having poor inherent fertility.

In summary the results of this BSAL Assessment are:

- An Exclusion Zone of 37 hectares, based on land greater than 10% slope were identified and excluded from the soil survey.
- An Exclusion Zone of 3 hectares, land areas less than 20 contiguous hectares total size were identified and excluded from the soil survey.
- Two soil units, a Chromosol and a Sodosol, comprising 103 hectares were identified during the soil survey and neither of these were considered to be BSAL.

Therefore it can be concluded that there is no qualifying BSAL within the Study Area.

Appendix A



Certificates of Analysis



SOIL TEST REPORT

Page 1 of 3

Scone Research Centre

REPORT NO: SCO16/014R1

REPORT TO: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

REPORT ON: Twenty-six soil samples
Your ref: 630.11560 Bulga BSAL

PRELIMINARY RESULTS
ISSUED: Not issued

REPORT STATUS: Final

DATE REPORTED: 16 February 2016

METHODS: Information on test procedures can be obtained from Scone
Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

A handwritten signature in blue ink, appearing to read 'SR Young'.

SR Young
(Laboratory Manager)

SOIL CONSERVATION SERVICE
Scone Research Centre

Page 2 of 3

Report No: SCO16/014R1
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (cmol (+)/kg)					
	Sample Id	EC (dS/m)	pH	pH (CaCl ₂)	CEC	Na	K	Ca	Mg	Al
1	1 0-10cm	0.01	6.1	5.0	6.2	0.2	0.1	2.1	0.9	<0.5
2	1 20-30cm	<0.01	6.5	5.2	6.0	0.2	0.1	1.7	0.8	<0.5
3	1 40-50cm	0.02	5.7	4.5	18.0	0.3	0.1	7.8	2.5	0.6
4	1 50-60cm	0.03	5.7	4.6	16.9	0.4	0.2	8.2	2.1	<0.5
5	1 65-75cm	0.02	5.6	4.5	17.2	0.4	0.2	7.9	2.5	1.1
6	2 0-10cm	<0.01	5.8	4.6	4.8	0.2	0.7	1.9	1.0	<0.5
7	2 20-30cm	<0.01	6.1	4.7	7.1	0.2	0.5	2.1	1.0	<0.5
8	3 30-40cm	0.01	5.8	4.7	18.7	0.3	0.5	9.9	2.1	1.0
9	2 50-60cm	0.16	7.3	6.9	19.1	0.2	0.2	13.1	1.7	nt
10	3 0-10cm	<0.01	5.9	4.7	7.8	0.2	0.3	2.0	1.5	<0.5
11	3 20-30cm	0.07	5.7	4.5	18.6	1.2	0.4	2.1	8.4	<0.5
12	3 50-60cm	0.26	5.7	4.6	18.1	2.0	0.3	1.1	8.1	<0.5
13	3 65-75cm	0.36	7.5	6.5	17.5	2.6	0.5	1.0	7.8	nt
14	5 0-10cm	0.01	6.0	4.7	6.8	0.4	0.2	1.0	1.7	<0.5
15	5 20-30cm	0.23	6.7	5.6	20.1	2.9	0.3	1.5	9.6	nt
16	5 60-60cm	0.55	7.1	6.2	19.1	3.7	0.2	1.6	8.3	nt
17	5 65-75cm	0.61	7.6	6.6	18.6	3.7	0.4	1.1	7.7	nt
18	6 0-10cm	0.01	5.2	4.2	6.1	0.2	0.2	1.1	1.4	<0.5
19	6 20-30cm	<0.01	6.1	4.9	5.1	0.2	0.1	0.6	1.4	<0.5
20	6 50-60cm	0.41	6.8	5.8	18.7	3.4	0.5	1.7	6.9	nt
21	6 65-75cm	0.49	6.8	5.9	16.6	3.2	0.5	0.9	5.8	nt
22	8 0-5cm	0.01	5.2	4.2	6.6	0.2	0.2	1.2	1.3	<0.5
23	10-20cm	0.05	6.3	5.2	12.8	0.3	0.6	2.6	2.7	<0.5
24	25-35cm	0.10	5.8	4.8	17.0	1.3	0.3	5.1	5.3	<0.5
25	50-60cm	0.26	6.2	5.4	18.8	1.7	0.2	4.8	5.7	<0.5
26	65-75cm	0.55	6.9	6.2	16.4	1.6	0.3	3.9	4.9	nt

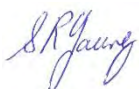
nt = not tested

SOIL CONSERVATION SERVICE
Scone Research Centre

Page 3 of 3

Report No: SCO16/014R1
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
1	1 0-10cm	5	13	49	33	<1	7.5YR 5/3	7.5YR 3/4
2	1 20-30cm	5	14	47	32	2	7.5YR 6/4	7.5YR 4/6
3	1 40-50cm	48	11	20	21	<1	7.5YR 5/8	5YR 5/8
4	1 50-60cm	38	20	30	12	<1	7.5YR 6/8	7.5YR 5/8
5	1 65-75cm	46	12	20	22	<1	7.5YR 6/6	7.5YR 5/8
6	2 0-10cm	5	14	49	31	1	7.5YR 5/4	7.5YR 4/4
7	2 20-30cm	7	14	45	28	6	7.5YR 5/4	7.5YR 4/6
8	3 30-40cm	49	14	28	9	<1	5YR 5/8	2.5YR 4/8
9	2 50-60cm	31	11	22	29	7	7.5YR 5/8	5YR 4/6
10	3 0-10cm	5	16	66	12	1	10YR 5/3	7.5YR 3/3
11	3 20-30cm	54	12	29	5	<1	7.5YR 5/6	5YR 4/6
12	3 50-60cm	47	12	35	6	<1	10YR 6/6	10YR 5/6
13	3 65-75cm	39	16	37	8	<1	7.5YR 6/6	7.5YR 5/6
14	5 0-10cm	7	23	57	8	5	10YR 5/3	10YR 4/4
15	5 20-30cm	43	14	35	7	1	10YR 5/6	10YR 4/6
16	5 60-60cm	31	10	38	8	13	10YR 5/6	10YR 4/6
17	5 65-75cm	32	11	43	10	4	10YR 5/6	10YR 4/6
18	6 0-10cm	8	15	67	9	1	7.5YR 4/3	7.5YR 3/3
19	6 20-30cm	5	15	68	8	4	10YR 6/3	10YR 4/4
20	6 50-60cm	45	8	44	3	0	10YR 6/6	10YR 4/6
21	6 65-75cm	37	10	48	5	<1	10YR 6/6	10YR 4/6
22	8 0-5cm	8	14	66	9	3	7.5YR 5/3	7.5YR 4/3
23	10-20cm	27	11	52	9	1	10YR 8/4	10YR 4/6
24	25-35cm	40	11	42	6	1	10YR 6/6	10YR 4/6
25	50-60cm	38	12	39	8	3	7.5YR 6/8	7.5YR 5/8
26	65-75cm	32	14	43	9	2	5YR 5/8	5YR 4/6



END OF TEST REPORT



SOIL TEST REPORT

Page 1 of 2

Scone Research Centre

REPORT NO: SCO16/019R1

REPORT TO: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

REPORT ON: Twenty-six soil samples
Your ref: 630.11560 Bulga BSAL

PRELIMINARY RESULTS
ISSUED: Not issued

REPORT STATUS: Final

DATE REPORTED: 16 February 2016

METHODS: Information on test procedures can be obtained from Scone
Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
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SR Young
(Laboratory Manager)

SOIL CONSERVATION SERVICE
Scone Research Centre

Page 2 of 2

Report No: SCO16/019R1
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (cmol (+)/kg)					
	Sample Id	EC (dS/m)	pH	pH (CaCl ₂)	CEC	Na	K	Ca	Mg	Al
1	4 0-10	<0.01	5.1	4.2	6.4	0.1	0.2	0.6	1.4	<0.5
2	4 20-30	<0.01	5.6	4.4	5.4	0.2	<0.1	0.5	1.4	<0.5
3	4 35-45	0.12	6.4	5.7	25.0	1.1	0.1	12.1	4.5	nt
4	4 50-60	0.27	8.4	7.6	31.1	1.3	0.3	16.1	4.7	nt
5	4 65-75	0.18	8.7	7.9	26.2	1.2	0.5	17.5	4.0	nt

nt = not tested

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
1	4 0-10	5	10	59	26	<1	7.5YR 5/3	7.5YR 3/3
2	4 20-30	3	10	57	26	4	7.5YR 6/3	7.5YR 4/6
3	4 35-45	52	7	29	12	<1	10YR 5/8	10YR 4/6
4	4 50-60	45	11	27	14	3	10YR 5/6	10YR 4/6
5	4 65-75	34	11	28	22	5	7.5YR 6/6	7.5YR 5/8



END OF TEST REPORT

Appendix B



Slope Analysis

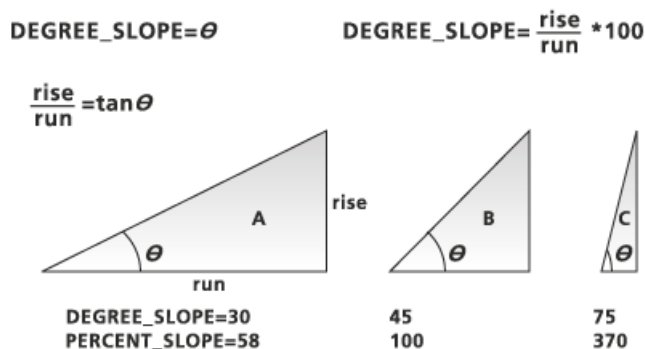
Slope Analysis Methodology

Methodology

1. Acquire appropriate elevation information. In this case, LIDAR data provided by Bulga Coal Complex.
2. Load Contours into ArcMap 10.3
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours
(http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q9000001v000000/)
4. Using 3D Analyst Extension – Run the Surface Slope Tool
(<http://resources.arcgis.com/en/help/main/10.1/index.html#/00q900000076000000/>) using a custom Break File (attached).
5. Using a Spatial Join, correlate the Surface Slope at the Soil Survey coordinates.

The Surface Slope Tool

Surface Slope creates an output polygon feature class containing polygons that classify an input TIN or terrain dataset by slope. The slope is the angle of inclination between the surface and a horizontal plane, which may be analysed in degrees or percent. Slope in degrees is given by calculating the arctangent of the ratio of the change in height (dZ) to the change in horizontal distance (dS), or slope = $\text{Arctan}(dZ/dS)$. Percent slope is equal to the change in height divided by the change in horizontal distance multiplied by 100, or $(dZ/dX) * 100$.



The **{slope_field}** is the name of attribute field used to record the polygon aspect codes. Its default value is SlopeCode.

Each triangle is classified into a slope class. Contiguous triangles belonging to the same class are merged during the formation of output polygons. The **{units}** parameter can be set to use PERCENT or DEGREES. The default is PERCENT. The default percent slope class breaks are 1.00, 2.15, 4.64, 10.00, 21.50, 46.40, 100.00, 1000.00. Optionally, DEGREES may be used to classify slope. The default degree slope class breaks are 0.57, 1.43, 2.66, 5.71, 12.13, 24.89, 45.0, 90.0.

The **{class_breaks_table}** is used to define custom slope classes. The table can be either a TXT or DBF file for a Windows environment, and a DBF file in a UNIX environment. Each record in the table needs to contain two values that are used to represent the slope range of the class and its corresponding class code.

Table example:

```
break, code
```

```
10.0, 11
```

```
25.0, 22
```

```
40.0, 33
```

```
70.0, 44
```

Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When this argument is not specified, the default classification is used.



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