

WATERMARK

COAL PROJECT

ENVIRONMENTAL IMPACT STATEMENT

February 2013

O

Aboriginal Archaeology Impact Assessment





Hansen Bailey
24 October 2012

Watermark Coal Project

Aboriginal Archaeology Impact Assessment
Public Version



Watermark Coal Project

Aboriginal Archaeology Impact Assessment

Public Version

Prepared for

Hansen Bailey

Prepared by

AECOM Australia Pty Ltd

Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia

T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com

ABN 20 093 846 925

24 October 2012

60197485

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Printed on environmentally responsible paper. Made from 100% recycled post consumer waste.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Watermark Coal Project
60197485

Ref p:\s70058 - hansen bailey watermark\5. delivery\5.2 reports
final\aboriginal\60197485_aecom_aboriginal_archaeology_impact_assessment_fn
l_24_10_12.doc

Date 24 October 2012

Prepared by Andrew McLaren

Reviewed by Luke Kirkwood

Revision History

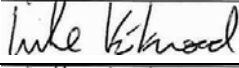
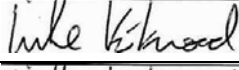
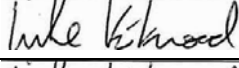
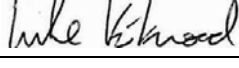
Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	11-05-12	Review of Draft #1	L.Kirkwood	
2	25-06-12	Review of Draft #2	L.Kirkwood	
3	08-08-12	Review of Draft #3	L.Kirkwood	
4	24-10-12	Final	L.Kirkwood	

Table of Contents

Executive Summary	i
1.0 Introduction and Background	1
1.1 Introduction	1
1.2 Investigation Objectives	1
1.3 The Project area	1
1.4 Background	1
1.5 Project Description	3
1.6 Methodology	3
1.7 The Project Team	5
1.8 Director-General's Requirements	5
1.9 Report Structure	5
2.0 Applicable Policy and Legislation	7
2.1 Commonwealth Legislation	7
2.1.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984	7
2.1.2 Environment Protection and Biodiversity Act 1999	7
2.2 State Legislation	8
2.2.1 Environmental Planning and Assessment Act 1979	8
2.2.2 National Parks and Wildlife Act 1974	8
2.3 Local Government	9
2.3.1 Gunnedah Local Environment Plan (LEP) 2012	9
3.0 Aboriginal Community Consultation	10
3.1.1 Stage 1 - Notification and Registration	10
3.1.2 Stage 2 – Presentation of Information about the Project	12
3.1.3 Stage 3 – Gathering Information about Cultural Significance	12
3.1.4 Stage 4 –Review of Draft Cultural Heritage Reports	14
4.0 Landscape Context	16
4.1 Introduction	16
4.2 Climate	16
4.3 Topography	17
4.4 Hydrology	17
4.5 Geology	20
4.6 Soils	24
4.7 Geomorphology	28
4.8 Flora and fauna	30
4.9 European Settlement History	30
4.10 Land Use Impacts	32
4.11 Key Observations	36
5.0 Archaeological Context	37
5.1 Regional Context	37
5.1.1 Regional Chronology	38
5.2 Local Context	39
5.2.1 AHIMS database search	39
5.2.2 Previous Aboriginal archaeological investigations	41
5.2.3 Existing predictive models	43
5.3 Key Observations	44
6.0 Ethnohistoric Context	45
6.1 Introduction	45
6.2 The Kamilaroi	45
7.0 Predictive Model	47
7.1 Introduction	47
7.2 Site Types	47
7.2.1 Sites types likely to occur	47
7.2.2 Sites types with limited potential to occur	48
7.3 Site Distribution, Content and Integrity	49
8.0 Archaeological Survey	51

8.1	Survey Aims and Objectives	51
8.2	Survey strategy	51
8.3	Field Team and Methods	52
8.4	Site Definition	53
8.5	Results	54
8.5.1	Survey Coverage and Effective Coverage	54
8.5.2	Aboriginal Archaeological Sites	57
8.5.3	Artefact Scatters and Isolated Finds	57
8.5.4	Potential Scarred Trees	61
8.5.5	Grinding Groove Sites	61
8.5.6	Spatial Distribution	64
8.5.7	Lithic Assemblage	66
8.5.8	Chronology	71
8.5.9	Reassessment of Predictive Model	72
8.5.10	Archaeological Sensitivity: Subsurface Archaeological Potential	73
8.5.11	Synthesis	74
9.0	Archaeological Significance Assessment	77
9.1	Introduction	77
9.2	Principles of Assessment	77
9.3	Scientific (Archaeological) Significance	78
9.3.1	Research Potential	78
9.3.2	Rarity and Representativeness	78
9.4	Assessment of Scientific Significance	79
10.0	Impact Assessment	89
10.1	Project Construction Details and Impacts	89
10.2	Direct Impacts	89
10.2.1	Open cut mining (including overburden emplacement)	89
10.2.2	Project Infrastructure	91
10.2.3	General Run of Mine Activities	92
10.3	Project Impact Summary	93
10.4	Cumulative Impact Assessment	96
10.4.1	Assessment of Ecologically Sustainable Development (ESD)	96
10.4.2	Intergenerational Equity - Cumulative Impacts of the Project	96
10.4.3	The Precautionary Principle	99
11.0	Management Strategy	100
11.1	Statutory Requirements	100
11.2	Management Strategy	100
11.2.1	Aboriginal Cultural Heritage Offset Areas	100
11.2.2	Archaeological Salvage Program	102
11.2.3	AHIMS Registered Sites 29-1-0155 and 29-1-0157	103
11.2.4	Staged Clearance Process	103
11.2.5	Conservation of Non-Impacted Sites Outside of ACHOAs	104
11.2.6	Annual Monitoring of Conserved Sites	104
11.2.7	Third Party Review of Australian Tree Consultant's Arboricultural Assessment Report	104
11.2.8	AHIMS Site Cards	105
11.2.9	Previously Unrecorded Aboriginal Archaeological Evidence	105
11.2.10	Human Skeletal Remains	105
11.2.11	Aboriginal Site Database	105
11.2.12	Reporting under the ACHMP	105
11.2.13	Continuing Access to Non-Salvaged Sites for Archaeological Research Purposes	106
11.2.14	Periodic Review of ACHMP	106
12.0	References Cited	107

Appendix A	RAP responses to draft field survey methodology	A
Appendix B	Survey Coverage Data	B
Appendix C	Site Descriptions	C
Appendix D	Arboricultural Assessment Report	D
Appendix E	Geomorphological Assessment report	E
Appendix F	Regional review of grinding groove sites	F

List of Figures

Figure 1	Regional Context	2
Figure 2	Project Layout	4
Figure 3	Topography and Hydrology	18
Figure 4	Landform Analysis	19
Figure 5	Geology	21
Figure 6	Soil Landscapes	25
Figure 7	1954 Aerial Imagery of the Project Area	33
Figure 8	2010 Aerial Imagery of the Project Area	34
Figure 9	Disturbance Analysis	35
Figure 10	McCarthy's Eastern Regional Sequence (ERS) (from MacDonald and Davidson 1998: 105, Figure 5.1)	39
Figure 11	AHIMS Registered Sites	40
Figure 12	Survey Transects	55
Figure 13	Aboriginal Archaeological Sites	58
Figure 14	Relative frequency of artefacts/sites (n = 686) by landform (A), slope (B), geological formation (C) and soil landscape (D)	65
Figure 15	Comparison of complete unretouched flake lengths (n = 363) and maximum core scar lengths (n = 83).	70
Figure 16	Archaeological Sensitivity	76
Figure 17	Archaeological Significance	88
Figure 18	Impact Assessment	95
Figure 19	Aboriginal Cultural Heritage Offset Areas	101

List of Tables

Table 1	Director-General's Requirements for Aboriginal cultural heritage	5
Table 2	Registered Aboriginal Parties (RAPs) as at Stage 1	11
Table 3	Summary of Aboriginal cultural heritage consultation post-October 2011	13
Table 4	Detailed RAP comment on Project's draft cultural heritage reports	15
Table 5	Generalised stratigraphy for the spring-fed swamp sites at Lime Springs and Trinkey (after Gorecki <i>et al.</i> 1984; Wright 1986)	17
Table 6	Soil landscape data and key archaeological implications	26
Table 7	Land Disturbance Analysis	32
Table 8	AHIMS search results	39
Table 9	AHIMS registered sites within the Project area	39
Table 10	Previous Aboriginal archaeological investigations	41
Table 11	Existing occupation models for the Watermark-Breeza area	43
Table 12	Key predictions for site distribution, content and integrity	49
Table 13	Breakdown of landforms within the Project area	51
Table 14	Breakdown of landforms within indicative Disturbance Boundary	52
Table 15	Justification of survey strategy by landform	52
Table 16	Archaeological Sensitivity Rating Scheme	54

Table 17	Survey coverage by landform	56
Table 18	Effective coverage by landform and site counts	56
Table 19	Open artefact sites: summary information	59
Table 20	Potential Aboriginal scarred trees: summary information	62
Table 21	Hatchet grinding groove sites: summary information	63
Table 22	Relationship between watercourse distance/stream order and artefact/site counts	64
Table 23	Typological breakdown of recorded survey assemblage	66
Table 24	Raw materials	67
Table 25	Descriptive statistics for the maximum linear dimensions of single, bifacial and multiple cores in survey assemblage	69
Table 26	T-test results for comparisons of mean maximum linear dimensions of single, multiple and bifacial cores in survey assemblage.	69
Table 27	Tool sub-component of survey assemblage	70
Table 28	Evaluation of predictive model	72
Table 29	Values relevant to determining cultural significance, as defined by The Burra Charter (1999).	77
Table 30	Significance Assessment	79
Table 31	Impact Assessment: Open Cut Mining Areas and Overburden Emplacement Areas	89
Table 32	Impact Assessment: Project Infrastructure	92
Table 33	Impact Assessment: Disturbance Boundary (generic)	92
Table 34	Summary of impacts to known Aboriginal sites	93
Table 35	AHIMS search results for study region	96
Table 36	Land use analysis	98
Table 37	List of sites for permanent protective fencing and signage	104

List of Plates

Plate 1: Bands of pebble/cobble conglomerate visible in sandstone cliff face on 'Linavardi'. Note variability in clast size.	22
Plate 2: Surface deposit of loose quartz pebble/cobble conglomerate on 'Hill 60'	23
Plate 3: Blocks of conglomerate found in cleared paddock on 'Watermark'. Note variability in clast size.	23
Plate 4: Surface deposit of loose pebble/conglomerate on 'Lochiel East'	24
Plate 5: Scald on 'Linavardi'. Note excellent surface visibility and presence (albeit limited) of surface gravel.	29
Plate 6: Scald on western proximal drainage plain of Watermark Gully on 'Watermark'. Note salt-tolerant vegetation on edges of scald.	29
Plate 7: WM-IF1-11: chert/tuff flake shatter fragment.	C-1
Plate 8: View across WM-IF1-11, facing northeast	C-1
Plate 9: WM-IF2-11: multiple-platform chert/tuff core.	C-2
Plate 10: View across WM-IF2-11, facing east	C-2
Plate 11: WM-IF3-11: broken chert/tuff flake.	C-3
Plate 12: View across WM-IF3-11, facing east	C-3
Plate 13: WM-IF4-11: broken chert/tuff flake.	C-4
Plate 14: View across WM-IF4-11, facing southwest	C-4
Plate 15: WM-IF5-11: multiple platform chert/tuff core.	C-5
Plate 16: View across WM-IF5-11, facing southwest	C-5
Plate 17: WM-IF6-11: broken chert/tuff flake.	C-6
Plate 18: View across WM-IF6-11, facing southeast	C-6
Plate 19: WM-IF7-11: complete chert/tuff flake.	C-7
Plate 20: View across WM-IF7-11, facing southeast	C-7
Plate 21: WM-IF8-11: complete chert/tuff flake.	C-8
Plate 22: View across WM-IF8-11, facing southeast	C-8
Plate 23: WM-IF9-11: edge-ground hatchet-head.	C-9
Plate 24: View across WM-IF9-11, facing southwest	C-9
Plate 25: WM-IF10-11: chert/tuff scraper.	C-10
Plate 26: View across WM-IF10-11, facing southeast	C-10

Plate 27: WM-IF11-11: multiple platform chert/tuff core.	C-11
Plate 28: View across WM-IF11-11, facing south	C-11
Plate 29: WM-IF12-11: bifacial quartzite core.	C-12
Plate 30: View across WM-IF12-11, facing south	C-12
Plate 31: WM-IF13-11: chert/tuff flake.	C-13
Plate 32: View across WM-IF13-11, facing south	C-13
Plate 33: WM-IF14-11: chert/tuff flake.	C-14
Plate 34: View across WM-IF14-11, facing southeast	C-14
Plate 35: WM-IF15-11: broken quartzite flake.	C-15
Plate 36: View across WM-IF15-11, facing north.	C-15
Plate 37: WM-IF16-11: complete chert/tuff flake.	C-16
Plate 38: View across WM-IF16-11, facing southeast.	C-16
Plate 39: WM-IF17-11: complete chert/tuff flake.	C-17
Plate 40: View across WM-IF17-11, facing southeast.	C-17
Plate 41: WM-IF18-11: broken quartz flake.	C-18
Plate 42: View across WM-IF18-11, facing south.	C-18
Plate 43: WM-IF19-11: single platform chert/tuff core.	C-19
Plate 44: View across WM-IF19-11, facing west.	C-19
Plate 45: WM-IF20-11: chert/tuff scraper.	C-20
Plate 46: WM-IF21-11: hatchet reworking flake (plan)	C-21
Plate 47: WM-IF2-11: hatchet reworking flake (cross-section view)	C-21
Plate 48: WM-IF22-12: complete chert/tuff flake.	C-22
Plate 49: View across WM-IF22-12, facing northwest.	C-22
Plate 50: WM-IF23-12: complete chert/tuff flake.	C-23
Plate 51: View across WM-IF23-12, facing east.	C-23
Plate 52: View across central portion of WM-AS1-11, facing southeast. Scarred tree WM-ST2-11 is located to the immediate left of the vehicle.	C-24
Plate 53: Flagged artefacts on WM-AS1-11. Note poor GSV due to grass cover and drainage depression in background.	C-24
Plate 54: WM-AS1-11: edge-ground hatchet-heads.	C-25
Plate 55: WM-AS1-11: geometric microlith (broken).	C-25
Plate 56: View across WM-AS2-11 on 'Flakenhoe', facing west. Note excellent GSV associated with vehicle track.	C-26
Plate 57: WM-AS2-11: broken chert/tuff Bondi point.	C-26
Plate 58: WM-AS2-11: miscellaneous retouched quartzite flake	C-27
Plate 59: WM-AS2-11: multiple platform chert/tuff core	C-27
Plate 60: View across WM-AS3-11, facing west.	C-28
Plate 61: WM-AS3-11: chert/tuff flakes.	C-28
Plate 62: View across WM-AS4-11, facing southwest.	C-29
Plate 63: WM-AS4-11: broken flake (left) and multiple platform core (right).	C-29
Plate 64: View across WM-AS5-11, facing south.	C-30
Plate 65: WM-AS5-11: broken chert/tuff Bondi point	C-30
Plate 66: WM-AS5-11: quartzite scraper.	C-31
Plate 67: WM-AS5-11: unground bifacially flaked hatchet-head.	C-31
Plate 68: View across WM-AS6-11, facing east.	C-32
Plate 69: WM-AS6-11: bifacial quartz core (left) and chert/tuff flake (right)	C-32
Plate 70: View across northern portion of WM-AS7-11, facing south.	C-33
Plate 71: WM-AS7-11: chert/tuff flakes.	C-33
Plate 72: View across WM-AS8-11, facing south-southwest.	C-34
Plate 73: WM-AS8-11: chert/tuff flakes.	C-34
Plate 74: Concentration of artefacts on deflated bank east of 'The Watermark' homestead complex.	C-35
Plate 75: View across central portion of WM-AS9-11. Note deflated bank on left.	C-35
Plate 76: Scald on proximal drainage plain of Watermark Gully. Note excellent GSV within exposure and presence of salt tolerant vegetation.	C-36
Plate 77: WM-AS9-11: edge-ground hatchet-head.	C-36
Plate 78: WM-AS9-11: chert/tuff tula adze 'slug' (ventral surface)	C-36
Plate 79: WM-AS9-11: chert/tuff backed artefacts.	C-36
Plate 80: View across WM-AS10-11, facing north-northwest.	C-37

Plate 81: WM-AS10-11: multiple platform chert/tuff cores.	C-37
Plate 82: View across WM-AS11-11, facing north.	C-38
Plate 83: WM-AS11-11: hatchet reworking flake (raw material unknown)	C-38
Plate 84: WM-AS11-11: multiple platform chert/tuff core.	C-38
Plate 85: WM-AS11-11: quartzite scraper	C-38
Plate 86: View across WM-AS12-11, facing north-northwest.	C-39
Plate 87: WM-AS12-11: single platform chert/tuff core	C-39
Plate 88: View across WM-AS13-11, facing southwest.	C-40
Plate 89: WM-AS13-11: unground bifacially-flaked hatchet-head.	C-40
Plate 90: View across western portion of WM-AS14-11, facing south. Pin-markers denote artefact locations.	C-41
Plate 91: WM-AS14-11: chert/tuff flake (left) and broken flake (right).	C-41
Plate 92: WM-AS14-11: multiple platform chert/tuff core.	C-41
Plate 93: WM-AS14-11: miscellaneous retouched chert/tuff flake.	C-41
Plate 94: View across WM-AS15-11, facing south.	C-42
Plate 95: WM-AS15-11: chert/tuff flake (left) and quartzite flake (right).	C-42
Plate 96: View across WM-AS16-11, facing south-southwest.	C-43
Plate 97: WM-AS16-11: chert/tuff flakes.	C-43
Plate 98: View across WM-AS17-12, facing northwest.	C-44
Plate 99: WM-AS17-12: Multiple-platform quartz core	C-44
Plate 100: View across Bacon Hill 1 (29-1-0154), facing southeast.	C-45
Plate 101: View across Bacon Hill 2, facing south-southwest.	C-46
Plate 102: Angular sandstone fragments at Bacon Hill 2.	C-46
Plate 103: View across Bacon Hill 3, facing southwest.	C-47
Plate 104: Chert/tuff flake.	C-47
Plate 105: Cloveneden 1: putative sandstone 'muller'.	C-48
Plate 106: Angular sandstone fragments in the vicinity of Cloveneden 1.	C-48
Plate 107: View across Tudgleys Hill 1, facing south-southeast.	C-49
Plate 108: WM-ST1-11, facing southwest.	C-51
Plate 109: WM-ST2-11: potential 'possum hole'.	C-52
Plate 110: Wm-ST2-11: close-up showing steel axe and chainsaw marks.	C-52
Plate 111: WM-ST3-11: scar with potential axe marks.	C-53
Plate 112: Close up of potential hatchet/axe marks near base of scar.	C-53
Plate 113: WM-ST4-11: bark slab removal scar.	C-54
Plate 114: WM-ST5-11	C-55
Plate 115: WM-ST6-11: potential Aboriginal scarred tree	C-56
Plate 116: Scar on WM-ST7-11	C-57
Plates 117 & 118 : Close-ups of steel axe marks on WM-ST7-11.	C-57
Plate 119: WM-ST8-11: scar on eastern fork	C-58
Plate 120: WM-ST8-11: scar on western fork	C-58
Plate 121: WM-GG1-11: view across southern group, facing southwest.	C-59
Plate 122: WM-GG1-11: close-up of grooves in southern group.	C-59
Plate 123: WM-GG1-11: close-up of grooves in southern group.	C-60
Plate 124: WM-GG1-11: view across northern group area, facing north-northeast. Note ephemeral drainage depression in background.	C-60
Plate 125: WM-GG1-11: fractured sandstone bedrock in northern group.	C-60
Plate 126: WM-GG1-11: close-up of grooves in northern group.	C-60
Plate 127: View across WM-GG2-11, facing west-southwest.	C-61
Plate 128: WM-GG2-11: isolated grinding groove.	C-61
Plate 129: View across WM-GG3-12, facing northeast.	C-62
Plate 130: WM-GG3-12: close-up of sandstone bench, facing west.	C-62
Plate 131: WM-GG3-12: close-up of main cluster of grooves within WM-GG3-12.	C-62
Plate 132: WM-GG3-12: close-up of groove located outside of main cluster.	C-62

Executive Summary

AECOM Australia Pty Ltd (AECOM) was commissioned by Hansen Bailey Environmental Consultants (Hansen Bailey), on behalf of Shenhua Watermark Coal Pty Ltd (Shenhua Watermark), to undertake an Aboriginal archaeology impact assessment for the Watermark Coal Project (the Project). This investigation forms part of an Environmental Impact Statement (EIS) being prepared by Hansen Bailey to support Shenhua Watermark's application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period.

This Aboriginal archaeology impact assessment has been undertaken in accordance with the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and with reference to the NSW Office of Environment and Heritage's (OEH) *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a). The former detail the relevant statutory requirements for Aboriginal cultural heritage impact assessments conducted under Division 4.1 of Part 4 of the EP&A Act.

Aboriginal community consultation for the Project has been conducted in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010b) and the superseded draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) by a team from Hansen Bailey, AECOM, Shenhua Watermark and Connect for Effect. Hansen Bailey and AECOM conducted consultation for Stages 1 and 2 from 31 January 2011, and also conducted ongoing Stage 3 and 4 consultation in collaboration with Connect for Effect. Further information regarding consultation undertaken with Registered Aboriginal Parties (RAPs) is provided in Connect for Effect's Aboriginal cultural heritage values assessment report for the Project (Connect for Effect 2012). A detailed correspondence register, including copies of relevant documentation is provided in Connect for Effect (2012).

Archaeological survey of land within the Project Boundary (referred to as the Project area) was undertaken in two blocks between March 2011 and April 2012. The first and primary block of survey was conducted over a period of 25 days between March and May 2011. The second block was conducted over a period of six days between February and March 2012. All survey was completed by a combined field team of two AECOM archaeologists and rostered RAP representatives. For the most part, survey was conducted on foot, with a total of 59 pedestrian transects completed over the course of the survey. A limited number ($n = 17$) of vehicle transects was also completed in response to poor Ground Surface Visibility (GSV) and occupational health and safety considerations. Pedestrian survey involved walking a series of linear transects across the Project area, with individual transect widths dependent on the number of RAPs present each day (range: 3-26) as well as localised topographic conditions.

A search of OEH's Aboriginal Heritage Information Management System (AHIMS) database prior to survey identified six Aboriginal sites within the Project Boundary (29-1-0154, 29-1-0155, 29-1-0156, 29-1-0157, 29-1-0158 and 29-1-0159), all of which were listed as 'Valid'. Three of these sites could not be re-located during the current survey and can be considered 'unverified'. Of the remaining three sites, two (29-1-0155 and 29-1-0157) have been reassessed as natural stone occurrences and one site (29-1-0156) has been confirmed.

In addition to previously recorded sites, a total of 51 new Aboriginal archaeological sites have been identified within, or directly adjacent to, the Project Boundary. These comprise 17 artefact scatters, 23 isolated finds, eight potential Aboriginal scarred trees and three grinding groove sites. Six scar-bearing trees identified during survey but subsequently assessed as being likely non-Aboriginal in origin by a professional arborist are not considered in this report. Unless confirmed as sites by way of an independent third party review, these trees will not be registered on AHIMS nor managed as Aboriginal archaeological sites.

An assessment of the scientific significance of newly and previously recorded Aboriginal sites within and directly adjacent to the Project Boundary has been undertaken. AHIMS registered sites 29-1-0155 (Bacon Hill 2) and 29-1-0157 (Cloveneden 1) have been excluded from assessment on the grounds that both have been re-assessed as natural stone occurrences. Significance assessments for 'unverified' AHIMS registered sites 29-1-0154 (Bacon Hill 1), 29-1-0158 (Tudgelys Hill 1) and 29-1-0159 (The Wilgas 1) are based on the information provided in their respective site cards. High scientific significance has been attributed to eight sites on the basis of their research potential, rarity and representativeness. Moderate scientific significance has been attributed to seven sites and low scientific significance to 40 sites.

An assessment of the potential impacts of the Project on the known Aboriginal archaeological resource of the Project area finds that 43 sites will, or have the potential to, be directly impacted by the Project through open cut

mining activities and/or the construction/maintenance of mine-related infrastructure. These comprise 36 open artefact sites (i.e. artefact scatters and isolates), five potential Aboriginal scarred trees and two grinding groove sites. Seven sites have been assessed as being of high scientific significance, five as being of moderate scientific significance and the remaining 31 as being of low scientific significance. In addition to identified surface sites, it is considered likely that a body of subsurface Aboriginal archaeological material will be impacted by the Project. Management of the Aboriginal archaeological resource of the Project area requires a consideration of this potential resource.

With regards to the potential impacts of the Project on identified Aboriginal archaeological sites, it is noted that Shenhua Watermark are committed to the *in-situ* conservation of 26 of these sites throughout the operational life of the Project. Sites earmarked for conservation include six sites of high scientific significance.

To manage potential impacts to the known and potential Aboriginal archaeological resource of the Project area, it is recommended that a detailed Aboriginal Cultural Heritage Management Plan (ACHMP) be prepared for the Project. The ACHMP should be prepared in consultation with RAPs and OEH, and to the satisfaction of the Department of Planning and Infrastructure (DP&I). The commitment for the development of this ACHMP should be addressed in the EIS.

Key components of the proposed ACHMP for the Project are as follows:

- The establishment of two Aboriginal Cultural Heritage Offset Areas (ACHOAs) on Shenhua-owned land within and directly adjacent to the Project area. Shenhua Watermark is committed to the conservation of the proposed ACHOAs throughout the operational life of the Project, including the eight Aboriginal archaeological sites located within them.
- A comprehensive archaeological salvage program incorporating:
 - a) surface collection of 25 open artefact sites;
 - b) surface collections and archaeological excavations at two open artefact sites;
 - c) the relocation of two grinding groove sites following a comprehensive pre-removal program of works including: topographic mapping, three-dimensional photo documentation, vegetation clearance, archaeological excavations and a geomorphological assessment; and
 - d) a program of archaeological test pitting and open area excavation in selected areas of low and high archaeological sensitivity within the Project's indicative Disturbance Boundary, as determined through consultation with RAPs.
- An independent third-party review of Australian Tree Consultant's (ATC) arboricultural assessment for the Project;
- A staged Aboriginal heritage clearance process for proposed impact areas within the indicative Disturbance Boundary for the Project;
- The *in-situ* conservation of 18 Aboriginal archaeological sites that fall outside the proposed ACHOAs but will not be impacted by Project; and
- Annual monitoring of all non-salvaged Aboriginal archaeological sites within the Project area by a qualified archaeologist and RAP representatives.

1.0 Introduction and Background

1.1 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Hansen Bailey, on behalf of Shenhua Watermark Coal Pty Ltd (Shenhua Watermark), to undertake an Aboriginal archaeology impact assessment for the Watermark Coal Project (the Project). The purpose of this assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Hansen Bailey to support an application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period.

This Aboriginal archaeology impact assessment has been compiled with reference to the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and NSW Office of Environment and Heritage's (OEH) *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a). It is intended that this report be read in conjunction with Connect for Effect's Aboriginal Cultural Heritage Values Assessment (ACHVA) report for the Project (Connect for Effect 2012) and Strata Control Technology's (SCT) geotechnical and geomorphological investigation report for newly identified grinding groove sites WM-GG1-11 and WM-GG3-12 (Strata Control Technology 2012).

A review of relevant environmental, archaeological and ethnohistoric information for the Project area provides a framework for presenting, assessing and discussing the results of a targeted archaeological survey of land within the Project boundary. An assessment of the potential impacts of the Project on the known and potential Aboriginal archaeological resource of the Project area is complemented by the provision of a comprehensive management strategy for this resource.

1.2 Investigation Objectives

The overarching objectives of the archaeological investigation undertaken were as follows:

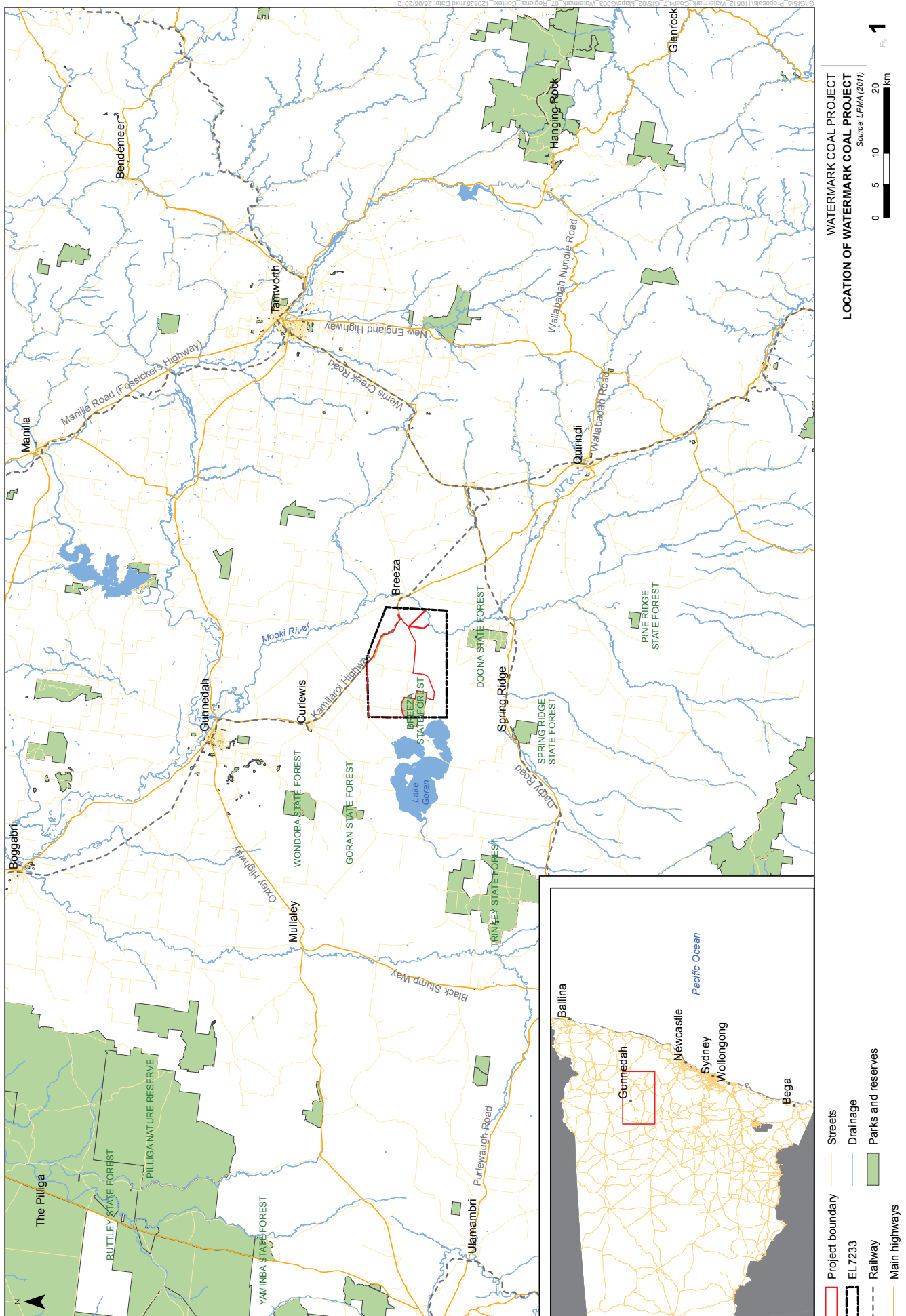
- to identify, through background research and targeted archaeological survey, the Aboriginal archaeological values of the Project area; and
- to provide, on the basis of significance and impact assessments, an appropriate management strategy for the known and potential Aboriginal archaeological resource of the Project area.

1.3 The Project area

The Project area comprises a 9,500 hectare (ha) parcel of land to the immediate west of the village of Breeza in north-western NSW, approximately 25 km south south-east of the township of Gunnedah and 50 km south-west of the city of Tamworth (**Figure 1**). The Kamilaroi Highway and Werris Creek - Moree Railway Line border the Project area to the east whilst Breeza State Forest and the Mooki River abut it to the south-west and south-east respectively. Doona and Spring Ridge State Forests are located to the south of the Project area whilst Goran and Black Jack State Forests lie to the north-west. Trinkey and Wondoba State Conservation Areas, meanwhile, are located to the west south-west and north north-west respectively. The closest National Parks to the Project area are Somerton National Park to the north and Coolah Tops National Park to the south. The Project area falls wholly within the Gunnedah Shire Local Government Area (Gunnedah LGA).

1.4 Background

In October 2008, Shenhua Watermark was granted Exploration Licence (EL) 7223 over an area of 19,500 ha to the immediate west of the village of Breeza (**Figure 1**). Since this time, Shenhua Watermark has undertaken a detailed exploration program within EL 7223 focused on defining the potential open cut coal resource of the non-blacksoil plains component of the site. Exploration undertaken to date has consisted of desktop studies, airphoto and regional airborne geophysical survey analysis, a Light Detection and Ranging Survey (LiDAR) survey, ground geophysical surveys, hydrogeological studies, drilling and geological reconnaissance. Together, these have been used to formulate a comprehensive mine plan for the Project, which will facilitate the extraction of over 290 Million tonnes (Mt) of coal via open cut mining methods for 30 years. EL 7223 expired on 28 February 2011 but has now been renewed until 22 February 2016.



1.5 Project Description

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the EP&A Act for the Project. The Project generally comprises:

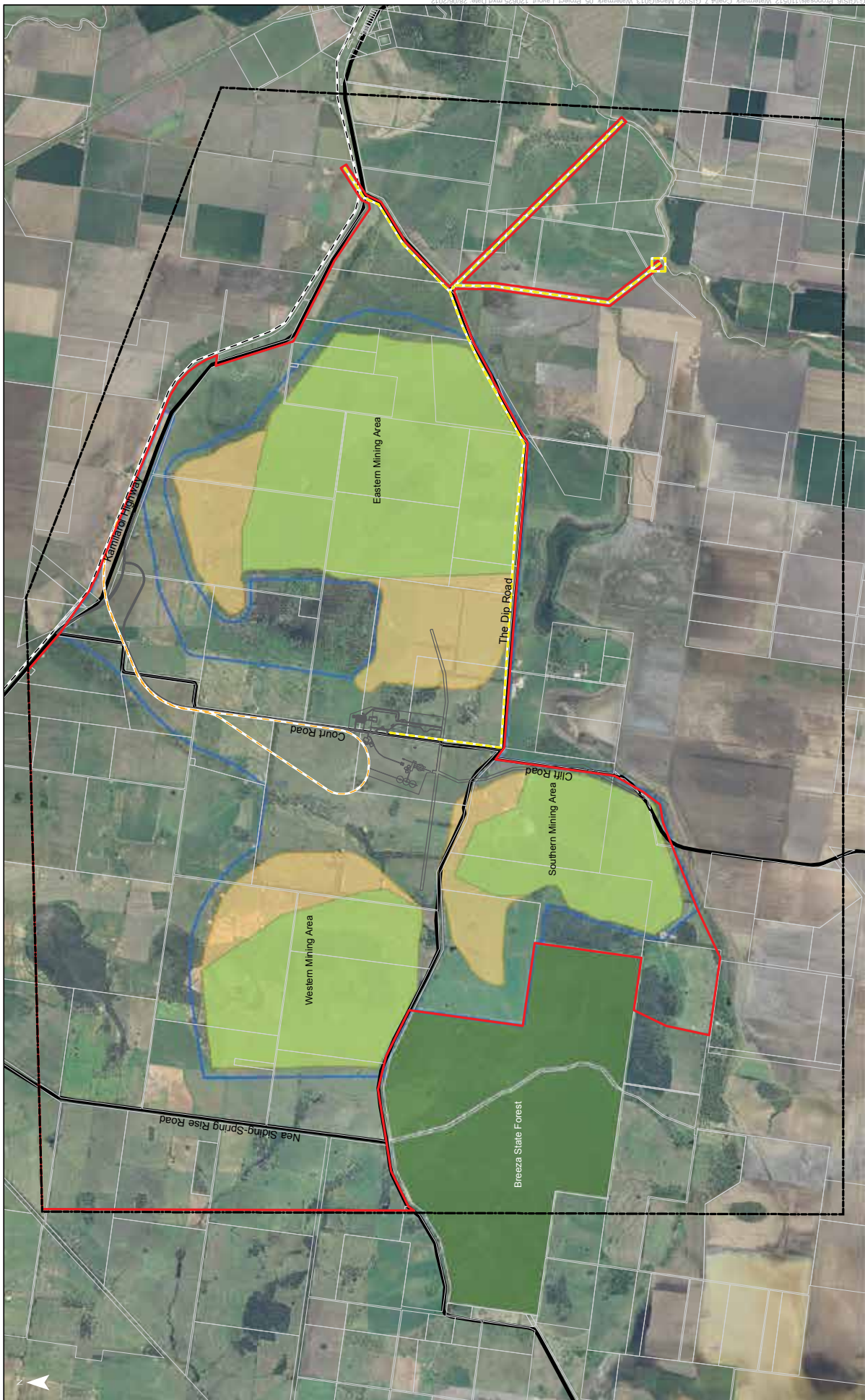
- The construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period;
- An open cut mining fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa ROM coal;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA);
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated load out facility and connection to the Werris Creek - Moree Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of ground and surface water management and reticulation infrastructure including pipelines, pumping stations and associated infrastructure for access to water from groundwater aquifers, the Mooki River and private dams to the north-east of the Project Boundary;
- The installation of communications and electricity reticulation infrastructure; and
- A workforce of up to approximately 600 full-time equivalent employees during construction and up to 600 full-time equivalent employees during the operation of the Project.

The conceptual layout of the Project is shown in **Figure 2**.

1.6 Methodology

This investigation has been undertaken in accordance with the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and with reference to OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a). The former detail the relevant statutory requirements for Aboriginal cultural heritage impact assessments conducted under Division 4.1 of Part 4 of the EP&A Act. Key tasks have been:

- a) To conduct a search of OEH's Aboriginal Heritage Information Management System (AHIMS);
- b) To review the landscape (i.e. environmental) context of the Project area;
- c) To review relevant archaeological and ethnohistoric information for the Project area and environs;
- d) To prepare a predictive model for Aboriginal archaeological sites within the Project area;
- e) To undertake a targeted archaeological survey of the Project area and report on its findings; and
- f) To prepare and finalise an Aboriginal Archaeology Impact Assessment for the Project.



WATERMARK COAL PROJECT
PROJECT LAYOUT



Fig 2

1.7 The Project Team

Dr Andrew McLaren (AECOM archaeologist; BA (Hons); MCultHeritage; PhD) coordinated archaeological survey logistics and was the primary author of this report, with supplementary text provided by Dr Susan Lampard (AECOM Archaeologist; BArchaeology (Hons); PhD), Rochelle Coxon (AECOM Archaeologist; BA (Adv) (Hons), Hansen Bailey and Connect for Effect. Hansen Bailey prepared **Section 3.0** of this report with input from AECOM and Connect for Effect.

Archaeological survey was undertaken by a combined field team of two AECOM archaeologists (Andrew McLaren and Rochelle Coxon) and up to 26 rostered RAP representatives per field day. Luke Kirkwood (AECOM NSW Heritage Team Leader, BSc/BA (Hons)) reviewed this report for Quality Assurance (QA) purposes. Background research services were provided by Sandy Miles (AECOM Information Specialist). Jackie Mandy (AECOM GIS Analyst) created all figures within this report. Jodie Glennan (AECOM IAP Team Secretary) provided administrative support throughout the investigation.

Aboriginal community consultation for the Project's Aboriginal cultural heritage values assessment was undertaken by Hansen Bailey and Connect for Effect in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010b) and the superseded draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and with reference to OEH's *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011) and the principles outlined in the Burra Charter (Australia ICOMOS 1999). Details of the consultation process undertaken and its outcomes are provided in Connect for Effect's (2012) ACHVA report.

1.8 Director-General's Requirements

The Director General of the NSW DP&I issued the Director General's Environmental Assessment Requirements (DGRs) for the Project on 19 April 2012. **Table 1** details the DGRs issued for Aboriginal cultural heritage and indicates where, in the current report, these requirements have been addressed. Attachment 1 (Technical and Policy Guidelines) of the DGRs for the Project lists the draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance) as relevant guidelines for the Aboriginal heritage component of the Project EIS. Both have been utilised in the preparation of this Aboriginal Archaeology Impact Assessment.

Table 1 Director-General's Requirements for Aboriginal cultural heritage

Director General Requirement	
An Aboriginal cultural heritage assessment (including cultural and archaeological significance) which must:	
Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting options and mitigation measures.	Section 3.0
Outline and proposed impact mitigation and management measures (including and evaluation of the effectiveness and reliability of the measures)	Section 11.0

1.9 Report Structure

This report contains 12 sections. This section - **Section 1.0** - has provided background information on the Project and the investigation undertaken. The remainder of the report is structured as follows:

- **Section 2.0** outlines the statutory framework within which this investigation has been undertaken.
- **Section 3.0** provides a summary of Aboriginal community consultation undertaken for the Project.
- **Section 4.0** describes the existing environment of the Project area and its associated archaeological implications.
- **Section 5.0** describes the archaeological context of the Project area on a regional and local scale.
- **Section 6.0** summarises relevant ethnographic information for the Project area.

- **Section 7.0** presents a predictive model for Aboriginal archaeology within the Project area, specifying probable site type occurrence, site type content, site type distribution and site type integrity.
- **Section 8.0** describes the archaeological survey component of AECOM's assessment. Details of the survey undertaken, including objectives, field team members, survey strategy, methods, coverage data and Aboriginal archaeological sites recorded are presented in turn. An evaluation of the predictive model developed for this assessment is also offered.
- **Section 9.0** outlines the scientific (i.e. archaeological) significance of identified Aboriginal archaeological sites within the Project area.
- **Section 10.0** provides an assessment of the potential impacts of the Project on identified sites.
- **Section 11.0** details a comprehensive management strategy for the known and potential Aboriginal archaeological resource of the Project area.
- **Section 12.0** lists the references cited in-text.

2.0 Applicable Policy and Legislation

2.1 Commonwealth Legislation

2.1.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (the ATSIHP Act) provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. The stated purpose of the ATSIHP Act is the “*preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition*” (Part I, Section 4).

Under the Act, ‘*Aboriginal tradition*’ is defined as “*the body of traditions, observances, customs and beliefs of Aboriginals generally or of a particular community or group of Aboriginals, and includes any such traditions, observances, customs or beliefs relating to particular persons, areas, objects or relationships*” (Part I, Section 3). A ‘*significant Aboriginal area*’ is an area of land or water in Australia that is of “*particular significance to Aboriginals in accordance with Aboriginal tradition*” (Part I, Section 3). A ‘*significant Aboriginal object*’, on the other hand, refers to an object (including Aboriginal remains) of like significance.

For the purposes of the Act, an area or object is considered to be injured or desecrated if:

- a) In the case of an area:
 - i. it is used or treated in a manner inconsistent with Aboriginal tradition;
 - ii. the use or significance of the area in accordance with Aboriginal tradition is adversely affected; and
 - iii. passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition
- b) in the case of an object:
 - i. it is used or treated in a manner inconsistent with Aboriginal tradition.

The ATSIHP Act can override state and territory laws in situations where a state or territory has approved an activity, but the Commonwealth Minister prevents the activity from occurring by making a declaration to protect an area or object. However, the Minister can only make a decision after receiving a legally valid application under the ATSIHP Act and, in the case of long term protection, after considering a report on the matter. Before making a declaration to protect an area or object in a state or territory, the Commonwealth Minister must consult the appropriate minister of that state or territory (Part 2, Section 13).

2.1.2 Environment Protection and Biodiversity Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) took effect on 16 July 2000. Under Part 9 of the EPBC Act, any action that is likely to have a significant impact on a matter of National Environmental Significance may only progress with approval of the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (SEWPAC). An action is defined as a project, development, undertaking, activity, series of activities, or alteration. An action will also require approval if:

- It is undertaken on Commonwealth land and will have or is likely to have a significant impact;
- It is undertaken outside Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land; and
- It is undertaken by the Commonwealth and will have or is likely to have a significant impact.

The EPBC Act defines ‘environment’ as incorporating both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). Statutory references to the RNE in the EPBC Act were removed on 19 February 2012. However, the RNE remains an archive of over 13,000 heritage places throughout Australia.

The heritage registers mandated by the EPBC Act have been consulted and there are no Aboriginal heritage items located within the Project area.

2.2 State Legislation

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act requires that consideration be given to environmental impacts as part of the land use planning process. In NSW, environmental impacts are interpreted as including impacts to cultural heritage.

Upon repeal of Part 3A of the EP&A Act on 1 October 2011, the *Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011* inserted a new Division 4.1 into Part 4 of the EP&A Act.

Division 4.1 provides for a new planning assessment and determination regime for State Significant Development (SSD). Section 89C of the EP&A Act stipulates that a development will be considered SSD if it declared to be such by the new *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP SRD).

Under Clause 8(1) of SEPP SRD, a development is declared to be State Significant Development if:

- a) the development on the land concerned is, by the operation of an environmental planning instrument, permissible with development consent under Part 4 of the EP&A Act; and
- b) the development is specified in Schedule 1 or 2 of SEPP SRD.

The Project is SSD as it meets both of these criteria, namely:

- it is permissible with development consent on the land on which it is located; and
- it is development that is specified in Schedule 1 of SEPP SRD.

The Project was declared SSD by the Minister for Planning and Infrastructure on 19 April 2012.

DEC's (now OEH) draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) detail the relevant statutory requirements for Aboriginal cultural heritage impact assessments conducted under Division 4.1 of Part 4 of the EP&A Act.

2.2.2 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act), administered by OEH, is the primary legislation for the protection of Aboriginal cultural heritage in NSW. The NPW Act gives the Director General of OEH responsibility for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places', defined under the Act as follows:

- an *Aboriginal object* is any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation of NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).
- an *Aboriginal place* is a place declared so by the Minister administering the NPW Act because the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects.

Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them. Following amendments introduced in October 2010, the NPW Act includes a 'strict liability offence' for harm to Aboriginal objects and places. A 'strict liability offence' does not require someone to know that it is an Aboriginal object or place they are causing harm to in order to be prosecuted.

Defences against the 'strict liability offence' in the NPW Act include the carrying out of certain 'Low Impact Activities', prescribed in Clause 80B of the *National Parks and Wildlife Amendment Regulation 2010* (NPW Regulation), and the demonstration of due diligence.

An Aboriginal Heritage Impact Permit (AHIP) issued under Section 90 of the NPW Act is required if impacts to Aboriginal objects and/or places cannot be avoided. An AHIP is a defence to a prosecution for harming Aboriginal objects and places if the harm was authorised by the AHIP and the conditions of that AHIP were not contravened. AHIPs are not required for projects approved under Division 4.1 of Part 4 of the EP&A Act (Section 89J(d)). However, Section 89A of the NPW Act requires notification of the location of Aboriginal sites within a reasonable time, with penalties for non-notification. Section 89A is binding in all instances, including Division 4.1 projects.

2.3 Local Government

2.3.1 Gunnedah Local Environment Plan (LEP) 2012

The Project area is located wholly within the Gunnedah Shire LGA, in which the relevant Environmental Planning Instrument (EPI) is the Gunnedah Local Environmental Plan (LEP) 2012. Clause 5.10 of the Gunnedah LEP provides specific provisions for the protection of heritage items and conservation areas within the Gunnedah Shire LGA, defined in the LEP as follows:

- A **heritage item** means a building, work, place, relic, tree, object or archaeological site that location and nature of which is described in Schedule 5 of the LEP.
- A **relic** means any deposit, object or material evidence that:
 - a) use or settlement of the Gunnedah LGA, not being Aboriginal habitation, and
 - b) is of State or local heritage significance.
- A **heritage conservation area** means an area of land of heritage significance:
 - a) shown on the Heritage Map as a heritage conservation area, and
 - b) the location and nature of which is described in Schedule 5, and includes any heritage items situated on or within that area.

Under Clause 5.10 of the LEP, Development consent is required for any of the following:

- a) Demolishing, moving or altering the exterior of any of the following:
 - i. A heritage item,
 - ii. An Aboriginal object, and
 - iii. A building, work, relic or tree within a heritage conservation area.
- b) Altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item,
- c) Disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed
- d) Disturbing or excavating an Aboriginal place of heritage significance;
- e) Erect a building on land:
 - i. on which a heritage item is located or which is within a heritage conservation area, or
 - ii. on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.
- f) Subdividing land:
 - i. on which a heritage item is located or which is within a heritage conservation area, or
 - ii. on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

Schedule 5 of the Gunnedah LEP provides a list of heritage items within the Gunnedah Shire LGA. There are no Aboriginal heritage items listed in the heritage schedule that fall within the Project area.

3.0 Aboriginal Community Consultation

Aboriginal community consultation for the Project has been conducted by Hansen Bailey, AECOM, Shenhua Watermark and Connect for Effect in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (the Guidelines) (DECCW 2010b) and the superseded *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). Hansen Bailey and AECOM conducted consultation for Stages 1 and 2 from 31 January 2011, and also conducted ongoing Stage 3 and 4 consultation in collaboration with Connect for Effect.

Further information regarding consultation undertaken with the RAPs is detailed in the Connect for Effect's (2012) ACHVA report for the Project. A detailed correspondence register, including copies of relevant documentation is provided in Connect for Effect (2012).

3.1.1 Stage 1 - Notification and Registration

In accordance with Section 4 of the Guidelines to identify, notify and register Aboriginal people who hold cultural knowledge relevant to determining the cultural significance the Project, the following organisations were notified of the Project in writing on 31 January 2011:

- DECCW Dubbo;
- Walhallow Local Aboriginal Land Council (WLALC);
- Red Chief Local Aboriginal Land Council (RCLALC);
- National Native Title Tribunal;
- NSW Department of Aboriginal Affairs – Office of the Registrar;
- Native Title Services Corporation Limited (NTSCorp Limited);
- Gunnedah Shire Council (GSC); and
- Namoi Catchment Management Authority (CMA) - Tamworth.

Letters were sent to the agencies requesting the contact details of known Aboriginal stakeholder groups in the locality who may possess cultural knowledge required to determine the cultural significance of Aboriginal objects or places in the area may and desire to be consulted regarding the Project. Following responses from the above agencies, letters were sent to all Aboriginal individuals / groups identified inviting them to register their interest in the Project.

3.1.1.1 Newspaper Advertisement

On 1 and 3 February 2011, a public notice of the Project was published in the Namoi Valley Independent. The notice invited Aboriginal individuals / groups to register their interest in the Project to be consulted with during the preparation of the Aboriginal Heritage Impact Assessment associated with the Project.

3.1.1.2 Notification of Registration to OEH, Walhallow LALC and Red Chief LALC

In accordance with Section 4.1.6 of the Guidelines, a full list of Aboriginal stakeholder individuals / groups who registered within the required timeframe to be consulted for the Project were provided to DECCW (now OEH).

At the close of registration on 15 February 2011, a total of 21 parties had registered their interest in the Project (**Table 2**). In accordance with Section 4.1.5 of the Guidelines, each RAP was provided the opportunity to withhold their information from being provided to DECCW and WLALC and RCLALC. No RAP made this request and as such a comprehensive list was sent to DECCW on 17 March 2011.

A copy of the following documentation was provided to DECCW, WLALC and RCLALC:

- A copy of the public notice advertised in the Namoi Valley Independent on 1 and 3 February 2011;
- A copy of the letter issues to all identified Aboriginal groups providing notification of the assessment for the Project; and
- A record of Registered Aboriginal Parties that expressed an interest in the Project (**Table 2**).

Table 2 Registered Aboriginal Parties (RAPs) as at Stage 1

Aboriginal Organisation	Contact
Aboriginal Native Title Consultants	John and Margaret Mathews
Bawurra Consultants	Kevin Sampson
Bigundi Biame Traditional People	Wayne Griffiths
Bullen Bullen Consultants	Lloyd Matthews
Cacatua Cultural Consultants	George Sampson
Carrawonga Consultants	Justin Matthews
Cryil Sampson	Cyril Sampson
Giwiirr Consultants	Rodney Matthews
Gunida Gunyah Aboriginal Corporation	Jane Bender
Hunter Valley Culture Consultants	Christine Archbold
Mingga Consultants	Clifford Matthews
Min Min Aboriginal Corporation	Gwen Griffen
Mooki River Consultants	Wayne Matthews
Muswellbrook Culture Consultants	Brian Horton
Neville Sampson	Neville Sampson
Nungaroo Local Aboriginal Land Council	Shane Allan
Red Chief Local Aboriginal Land Council	Robert Horne
Robert Miller Cultural Consultant	Robert Miller
Simon Taylor	Simon Taylor
Upper Hunter Heritage and Culture Consultants	Darrell Matthews
Walhallow Local Aboriginal Land Council	Jason Allan

3.1.1.3 Additional Registrations

Since the close of registrations on 15 February 2011, an additional 108 Aboriginal parties registered an interest in the Project during the course of the assessment process. This subsequently resulted in registrant numbers rising to 54 RAPs by November 2011 and to 145 RAPs by January 2012. The increased interest in the Project by Aboriginal community members related to a number of factors, which included:

- Gathering of Aboriginal people for the purposes of a regional Native Title claim resulting in sharing of projects and proposed projects in the region by RAPs;
- Distribution of Project information through community newsletters and Project information provided to Aboriginal parties already registered;
- Connect for Effect's cultural consultation approach; and
- Location of the Project.

As a result of additional RAPs registering their interest in the Project after the close of registrations on 15 February 2011, letters were sent to OEH, Walhallow and Red Chief LALCs on 11 April, 2 May and 7 June 2011 advising of the additional registered parties.

3.1.2 Stage 2 – Presentation of Information about the Project

The aim of Stage 2 of the consultation process is to *‘Provide registered Aboriginal parties with information about the scope of the proposed project and the proposed cultural heritage assessment process’*.

3.1.2.1 Planning Meeting

In accordance with Section 4.2.1 of the Guidelines, a letter was provided on 21 February 2011 by Hansen Bailey inviting all RAPs to attend a Planning Meeting to discuss the various aspects of the Project. The Planning Meeting was held at the Mackellar Motel on Thursday, 10 March 2011. In total, 19 Aboriginal stakeholders representing 18 of the 21 registered organisations attended the Planning Meeting. The Aboriginal consultation program, draft field survey methodology and associated field survey involvement were covered during the meeting which was followed by a site visit. A copy of the presentation provided during the Planning Meeting was sent to all registered Aboriginal stakeholder groups on 16 March 2011.

3.1.3 Stage 3 – Gathering Information about Cultural Significance

3.1.3.1 Archaeological Field Assessment Methodology

In accordance with Section 4.3.1 and 4.3.2 of the Guidelines, on 21 February 2011 all RAPs were sent a copy of the draft Aboriginal archaeology field survey methodology. All RAPs were encouraged to provide comment on the draft methodology.

Comments on the proposed survey methodology and field work were received at the planning meeting held on 10 March 2011, and both verbally and in writing until 23 March 2011.

On 16 March 2011, a letter was sent from Hansen Bailey to all 21 registered groups confirming the dates for the upcoming field work, providing a copy of the presentation given at the planning meeting, a Project layout figure and a request for the provision of the relevant insurances in order to participate in the field survey (Stage 3).

3.1.3.2 Summary of Responses to Field Survey Methodology

Five written responses to, and 12 written acceptances of, the draft Aboriginal archaeology field survey methodology were received from RAPs (**Appendix A**). Key concerns cited by RAPs in written responses related to survey coverage, stone artefact recording, archaeological predictions, scar tree recording, sharing of information regarding findings, the consultation approach and acknowledgement of the significant Aboriginal history and presence in the area. It was noted that the AHIMS results reflect the lack of surveys completed in the region, rather than the lack of Aboriginal places or objects of significance. Concerns relating to the consultation approach, social and cultural values assessment and cultural heritage information exchange were also noted.

All concerns were acknowledged and where practicable incorporated into the revised field survey methodology. A revised survey methodology meeting was held on 24 March 2011 in Gunnedah in which all comments received were addressed. At the completion of the meeting, no RAPs registered at the time cited concerns associated with the revised field survey methodology.

3.1.3.3 Archaeological Field Assessment

All RAPs registered at the time were provided the opportunity to participate in the archaeological field assessment. A total of 21 RAPs indicated they would like to participate in the archaeological field survey.

Following the receipt of relevant insurances, each RAP group was incorporated into a rotating roster for the field work. Two RAPs requested no involvement in the field work - Mooki River Consultants and Simon Taylor - due to work commitments and conflicts of interest. Both RAP groups indicated they would like to continue to be consulted in relation to the Project. In total, 22 Aboriginal RAPs provided a representative for scheduled field survey.

The field survey was scheduled to be completed over the 18 working days from 28 March to 20 April 2011. Each RAP was scheduled six days of survey. Group 1 had six RAP representatives present for the first week commencing 28 March and finishing 1 April 2011. Group 2 had seven RAP representatives present for the second week commencing 4 April to 8 April 2011. Group 3 commenced field survey on 11 April and ended 15 April 2011. Group 3 had six RAP representatives present Monday and Tuesday and seven RAP representatives on Wednesday through to Friday. From 18 April to 20 April each group completed one additional day of survey. Survey was completed via primarily pedestrian transects combined with vehicular transects in areas of lower visibility.

On Friday 8 April 2011 a meeting was held at Curlewis with all RAPs where a presentation of the sites found in the first two weeks was given.

On 15 April 2011, an invitation was provided to all RAPs to attend a post survey meeting to be held 21 April 2011 to discuss the results of the surveys undertaken. At this meeting a presentation of the findings of the field work was given.

As a result of discussion at the meeting, a final week of field survey was agreed to in response to RAP concerns over potential cultural sensitive areas such as creeklines and mountains. The fifth and final week of field survey was conducted between Monday 2 May and Friday 6 May 2011 with each of the 22 RAPs completing one day of survey work.

As a result of consultation with all RAPs following the completion of field survey, it was agreed to complete a second round of survey with the Senior Elders and Elders group formed in January 2012. This survey was conducted from 27 February 2012 to 2 March 2012 via limited pedestrian transects and vehicle transects.

3.1.3.4 Cultural Values Consultation

In accordance with Sections 4.3.3, 4.3.4 and 4.3.5 of the Guidelines, cultural heritage information was sought from the RAPs. This process commenced on 20 May 2011 when letters were sent to all RAPs offering to hold culture and heritage information exchange meetings with Hansen Bailey. A total of 5 culture and heritage meetings were held with 7 RAPs between 21 April and 9 June 2011. Additional cultural heritage meetings were undertaken by Connect for Effect from October 2011 and are detailed in Connect for Effect's ACHVA report for the Project (see Connect for Effect 2012).

3.1.3.5 Cultural Heritage Consultation

In October 2011, Connect for Effect were engaged by Hansen Bailey on behalf of Shenhua Watermark to conduct an Aboriginal cultural heritage values assessment. Key consultation activities are provided in **Table 3**. The consultation approach undertaken by Connect for Effect included workshop discussions, archival investigation, Senior Elders and Elders Walks on Country and RAP self-assessment of cultural, historic, scientific and aesthetic values. Further detail is provided in Connect for Effect's (2012) ACHVA report for the Project.

Table 3 Summary of Aboriginal cultural heritage consultation post-October 2011

2011	Activity
26-Oct-11	Letter to all RAPs: Invitation to attend workshops scheduled 31 October, 16, 17 November.
31-Oct-11	Workshop 1: Cancelled due to Sorry Business. 16 & 17 November Workshops postponed also.
14-Nov-11	Letter to all RAPs: Briefing Session to be held 21 November, Gunnedah.
21-Nov-11	Meeting: Briefing Session held at Gunnedah, 9am.
30-Nov-11	Registrations of Interest rose to 54 by the end of November.
7-Dec-11	Meeting: With DP&I to discuss ACHA methodology. Sydney, 1pm.
7-Dec-11	Letter to all RAPs: Invitation to attend workshops scheduled 19, 20, 21 December.
19-Dec-11	Meeting: Workshop 1, Gunnedah Town Hall, 9am.
20-Dec-11	Meeting: Workshop 2, Curlewis Hall and Walk on Country (Project Boundary), 10am.
21-Dec-11	Meeting: Workshop 3, Gunnedah Town Hall - SIA focus.
2012	Activity
17-Jan-12	Email: Update to DP&I on consultations undertaken to date.
25-Jan-12	Meeting: Senior Elders and Elders Group. Gunnedah, 10am.
31-Jan-11	Registrations of Interest in the Project rose to 132 RAPs.
14-Feb-12	Meeting: WLALC SIA & permission to speak on Country.
21-Feb-12	Walk on Country & Scar Tree Assessment: Senior Elders and Elders Group.

27-Feb-12	Field Survey II: Senior Elders & Elders Group.
2-Mar-12	Meeting: Senior Elders and Elders Group. Field survey close out meeting. Curlewis, 12pm
12-Mar-12	Letter to all RAPs: distribution of November Briefing session, December 19, 20, 21 2011 Workshop minutes.
11-Apr-12	Letter to all RAPs: 3 new sites identified via Due Diligence. Includes WM-GG3-12. Notification that Senior Elders and Elders will inspect the sites.
23-Apr-12	Site Inspection: 3 new sites identified from Due Diligence assessment. Inspection undertaken with Senior Elders and Elders Group.
21-May-12	Letter & Report sent to all RAPs: Senior Elders & Elders' inspection of 3 new sites. Report included photos.
14-Jun-12	Letter sent to all RAPs: Notification of grinding groove geotechnical investigation (WM-GG1-11 and WM-GG3-12).
18 June -20-June-12	Observation of Works: Grinding groove geotechnical investigation with Senior Elders & Elders Group.
4-Jul-11	Letter to OEH: Response to email RE: Watermark Axe Grinding Groove Site (WM-GG3-12).
5-Jul-12	Letter to all RAPs: Grinding groove geotechnical investigation methodology letter.
3-Aug-12	Letter to all RAPs: Delay in ACHA DRAFT Report distribution explained.

3.1.4 Stage 4 –Review of Draft Cultural Heritage Reports

In accordance with Section 4.4 of the Guidelines, draft copies of AECOM's Aboriginal archaeology impact assessment, Connect for Effect's ACHVA report and Strata Control Technology's geotechnical and geomorphological Investigation report for grinding groove sites WM-GG1-11 and WM-GG3-12 were sent out to all RAPs for review on 15 August 2012. Reports were provided to RAPs in Compact Disc (CD) format due to the combined size of the documents. Printed copies of all reports were also made available to RAPs upon request.

An initial total of 28 days was provided for RAP review and comment, with responses requested by 15 September 2012. RAPs requested that additional time for report review be provided to all RAPs in order to provide more time to be able to read all assessment reports and provide detailed feedback to inform the final reports and recommended management measures. Shenhua Watermark provided an additional 18 days to all RAPs for draft public comment for all three reports, with comments on the report required by 3 October 2012.

Subsequent to the provision of the reports via mail and hand delivery, a series of discussion and mitigation workshops were held in Gunnedah and Walhallow Village from 29 to 31 August 2012, to which all RAPs were invited to attend. The purpose of these discussion sessions was to provide an open forum for RAPs to raise and discuss any concerns regarding the contents of AECOM's, Strata Control Technology's and Connect for Effect's reports, including all technical appendices. All registered Aboriginal parties concerns expressed during the draft review and mitigation sessions were captured by Hansen Bailey through the taking of minutes. A group meeting was held on 31 August 2012 for all RAPs to attend and understand the issues raised throughout all of the draft review and mitigation discussion sessions.

In response to RAP requests, Shenhua Watermark also provided a further opportunity for RAPs to offer feedback on the reports in the form of site visits on 10 and 11 September 2012, to which all RAPs were invited to attend. The primary purpose of these visits was to provide an opportunity for all RAPs to visit the proposed Mooki River and Watermark Gully Aboriginal Cultural Heritage Offset Areas (ACHOAs) as well as newly recorded grinding groove sites WM-GG1-11 and WM-GG3-12. All concerns raised by RAPs during site visits were captured by Hansen Bailey through the taking of minutes.

Further discussion opportunities for RAPs to comment on the draft reports were provided by way of a Senior Elders and Elders consultation session on Tuesday 25 September 2012 and three day consultation sessions to all RAPs on 26 and 27 September 2012 and 3 October 2012. Shenhua Watermark also provided all RAPs with the opportunity to discuss the draft reports via appointment during the extended draft public notice period. On 12 September 2012, a draft consolidated list of RAP concerns and comments regarding the Project's cultural heritage assessment reports, including a draft of this report, was compiled at a RAP meeting held in Gunnedah.

Comments received through other means (i.e., formal letter responses to the draft reports) were also incorporated into this list.

Table 4 presents the consolidated list of RAP comments on the Project's cultural heritage assessment reports. These comments reflect both the letters of comment provided on the draft reports, and also the input provided by RAPs during the September and October 2012 discussion sessions. Responses drafted by AECOM and Connect for Effect in consultation with Shenhua Watermark and Hansen Bailey are provided for all comments.

Table 4 Detailed RAP comment on Project's draft cultural heritage reports
(Non-disclosed RAP comments not available for public review)

4.0 Landscape Context

4.1 Introduction

The nature and distribution of Aboriginal archaeological sites are closely connected to the environments in which they occur. As mobile hunter-gatherers, environmental variables such as topography, geology, hydrology and vegetation will have played a critical role in influencing how Aboriginal people moved within, and utilised, their respective Country. Amongst other things, these variables affected the availability of suitable campsites, potable water, edible and otherwise useful plant and animal resources, and raw materials for the production of stone and organic implements. Accordingly, any attempt to predict or interpret the character and distribution of Aboriginal sites in a given landscape must take such environmental factors into account. At the same time, an assessment of historic and current land use practises allows predictions to be made concerning the likely presence or absence of sites and, where appropriate, their archaeological integrity.

4.2 Climate

The present-day climate of the Project area can be characterised as dry sub-humid. Temperatures are generally warm to hot in summer, mild in autumn and spring and cool with occasional frosts in winter (Broughton 1994: 3). The average summer maximum is 32.5°C and the average winter minimum 2.3°C (Bureau of Metrology 2011). Winds are predominantly from the southeast. The long term average annual rainfall for the Watermark area is 640 mm. This average is influenced by several factors including passage of moist upper atmospheric low pressure cells from the north, passage of inland tropical cyclones and low pressure systems, passage of cold fronts across NSW and localised convection storms (Hansen Bailey 2011).

As in other parts of the state and country (e.g., Attenbrow 2010; Hall 1999; Hiscock 1999), the long-term climatic history of the greater Watermark-Breeza area is of particular relevance to debates concerning the antiquity and nature of Aboriginal occupation within it. As indicated in **Section 5.1**, available archaeological data indicate that Aboriginal people have occupied this area for at least 25,000 years (Gorecki *et al.* 1984; Wright 1985, 1986), a period of time that will have witnessed significant changes to the prevailing climate and associated vegetation regimes of the area. Some idea of these changes is provided by Gorecki *et al.*'s (1984) and Wright's (1985, 1986) archaeological excavations at the spring-fed swamp sites of Lime Springs and Trinkey, located between Spring Ridge and Premer, approximately 30 km south-west of the Project area. Of relevance here is Wright's (1985, 1986) interpretation of the stratigraphy of these sites (**Table 5**), which spans from the terminal Pleistocene around 26,000 BP to the 20th century AD. It has, for example, been suggested that the aeolian dusts present at Trinkey and Lime Springs likely represent localised arid retreats from high groundwater phases (Wright 1985: 2). The Grey Silt, Wright (1986: 7) has hypothesised, was likely blown off fluvial sediments bordering the Darling River and subsequently trapped by dense vegetation growing within the swamps. The Black Swamp, in contrast, has been interpreted as representing a period of sustained high groundwater that collapsed around 6,000 BP with the introduction of the Grey Silt. Unfortunately, more detailed reconstructions of the palaeoecology and associated climate of the area surrounding the Lime Springs and Trinkey swamps was not possible due to a complete lack of pollen from the Black Swamp unit at both sites, a phenomenon Wright (1986: 8) has attributed to the drying-out of both swamps around 6,000 BP.

Further afield, Dodson and Wright's (1989) analysis and interpretation of excavated pollen deposits from Ulungra Springs, approximately 100 km southwest of Lime Springs and Trinkey, is also of relevance to the current assessment. The pollen sequence obtained from this site, which was found to contain light-grey and buff clays equivalent to the aeolian dusts observed at Trinkey and Lime Springs¹, provides a vegetation history extending from the Late Pleistocene at c.30,000 BP to the late Holocene (0-3,000 BP). The pattern of terrestrial vegetation change at this site has been interpreted as one of subhumid forest, changing, around 25,000 BP, to semi-arid shrubland and returning, at the beginning of the Holocene around 10,000 BP, to subhumid forest (Dodson and Wright 1989: 190). Pollen data for the period between c.25,000 BP and 10,000 BP indicate a treeless open shrub-steppe formation dominated by chenopods but also including heath taxa such as *Hibbertia*, *Bossiaea*, *Lomandra/Xanthorrhoea*, and *Gonocarpus*. In contrast, data for the oldest part of the record (*pre*-25,000 BP) and that of the Holocene (0-10,000 BP) indicate a vegetation regime remarkably similar to that of the present day (i.e. open forest or woodland dominated by ironbark eucalypts such as *E.creba* and *E.sideroxylon* and white cypress pine (*C. columellaris*), and an understory dominated by sclerophyllous-leaved shrubs). The pollen sequence

¹ Unlike Trinkey and Lime Springs, no archaeological deposits were identified at Ulungra Springs.

preserved at Ulungra Springs thus provides evidence for an eastward late Pleistocene expansion of the arid zone in Australia (Dodson and Wright 1989: 182).

Table 5 Generalised stratigraphy for the spring-fed swamp sites at Lime Springs and Trinkey (after Gorecki *et al.* 1984; Wright 1986)

Stratigraphic Layer	Associated Date(s)	Sediment Type
European Dump	20 th century AD	Black sandy clay
Grey Silt	6,000 BP	Grey aeolian dust
Black Swamp	22,000 to 6,000 BP	Organic rich sandy-clay
Buff Silt	26,000 BP	Weathered aeolian dust
Basal Clay	-	Clay

4.3 Topography

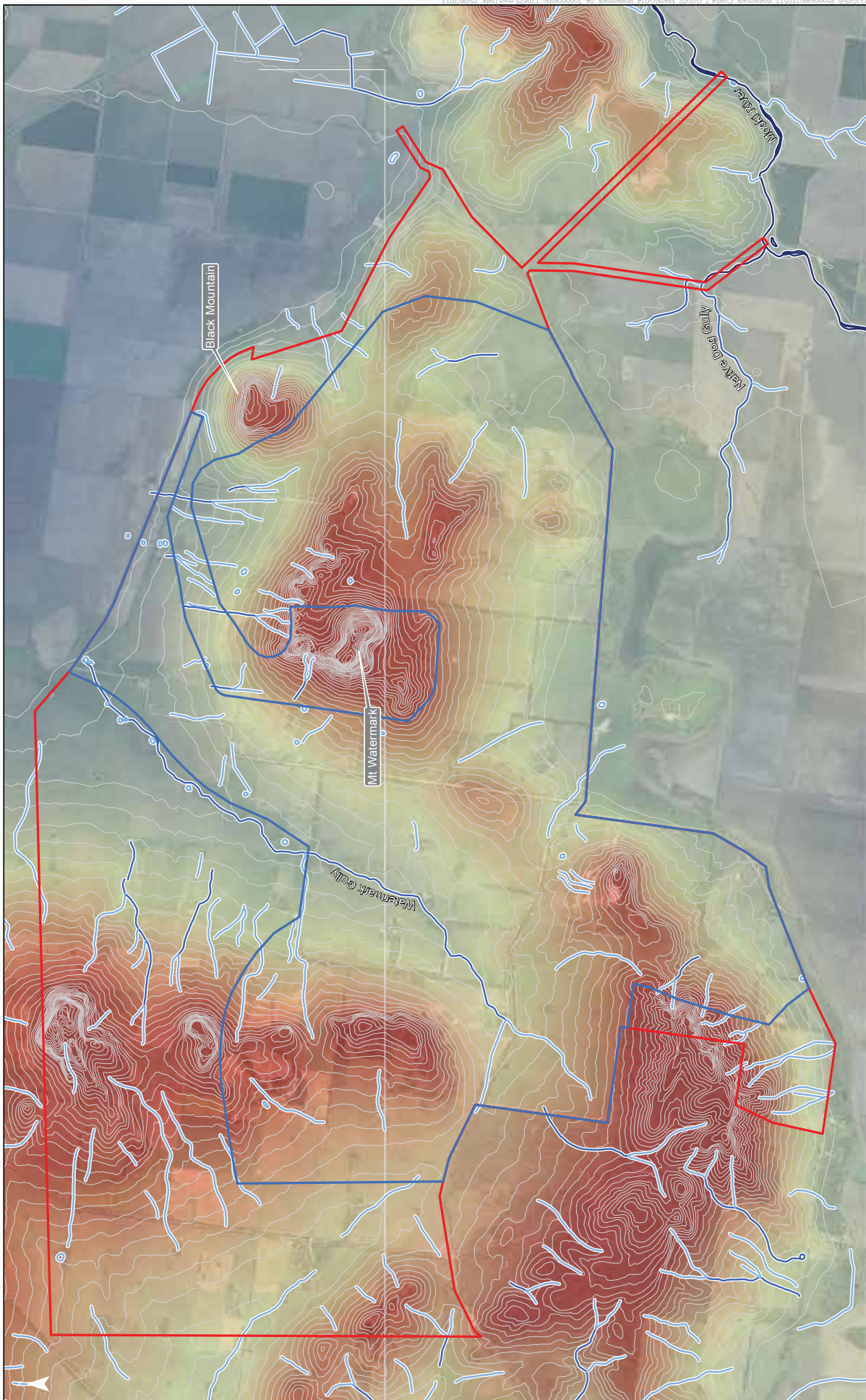
The Project area is characterised by variable topography (**Figure 3**). Level to gently inclined drainage plains are well represented, as are extremely long pediment foot slopes and undulating to rolling hills and rises with very gently to moderately inclined side slopes. Broad level floodplains are restricted to the south-western and north-central portions of the Project area in association with the Mooki River, Native Dog Gully and Watermark Gully. Named peaks within the Project area include Mount Watermark at 512 m AHD and Black Mountain at 393 m AHD. Colluvial slopes associated with these and other unnamed peaks within the Project area range from gently to very steeply inclined. Elevations within the Project area range from 512 m to 290 m AHD, providing a total local relief of 222 m. **Figure 4** presents a simplified landform analysis of the Project area, with landforms types based on the topographic descriptions of Banks (1995).

In topographic terms, it would appear that the majority of the Project area would have been suitable for occupation by Aboriginal people. This said, outside of rockshelters, which may conceivably have been occupied repeatedly over a long period of time, it can be suggested that the most intensive Aboriginal occupation is likely to have occurred on low gradient land surfaces (i.e., level to gently inclined surfaces), a reflection of factors such as ease of access and comfort. Level to gently inclined/undulating river/creek terraces and proximal flood/drainage plains, in particular, are likely to have been the focus of repeated activity through time, offering ready access to potable water and other water-dependent resources. In contrast, it is highly unlikely that Aboriginal people will have spent any significant amount of time on the steep colluvial slopes that fall away from the sandstone cliff formations of the Project area. Archaeological evidence for Aboriginal activity in these areas is likely to reflect artefact discard in the context of 'short-stay' episodes (e.g., a retooling event during hunting). Assuming they exist, access to rockshelters along the base of sandstone cliff formations could have been achieved from above or below, with individual access points dependent on localised topographic conditions.

4.4 Hydrology

The Project area is located within the Mooki River catchment and, as shown on **Figure 3**, is drained by numerous watercourses, almost all of which are ephemeral and unnamed. The Mooki River, which rises in the Liverpool Ranges to the south of the Project area, flows through the south-eastern corner of the Project Boundary in a northeasterly direction. At present, the Mooki is the only permanent source of water in the vicinity of the Project area. The river drains an area of 7,648 km² before joining the Namoi River near Gunnedah. Major tributaries flow from the Liverpool and Melville Ranges and include Quirindi, Werris, Warrah and Big Jacks Creeks, as well as Native Dog Gully (Broughton 1994: 5). North of Pine Ridge, the Mooki meanders across wide, flood-prone alluvial plains that have, and continue to be subject to intensive cultivation.

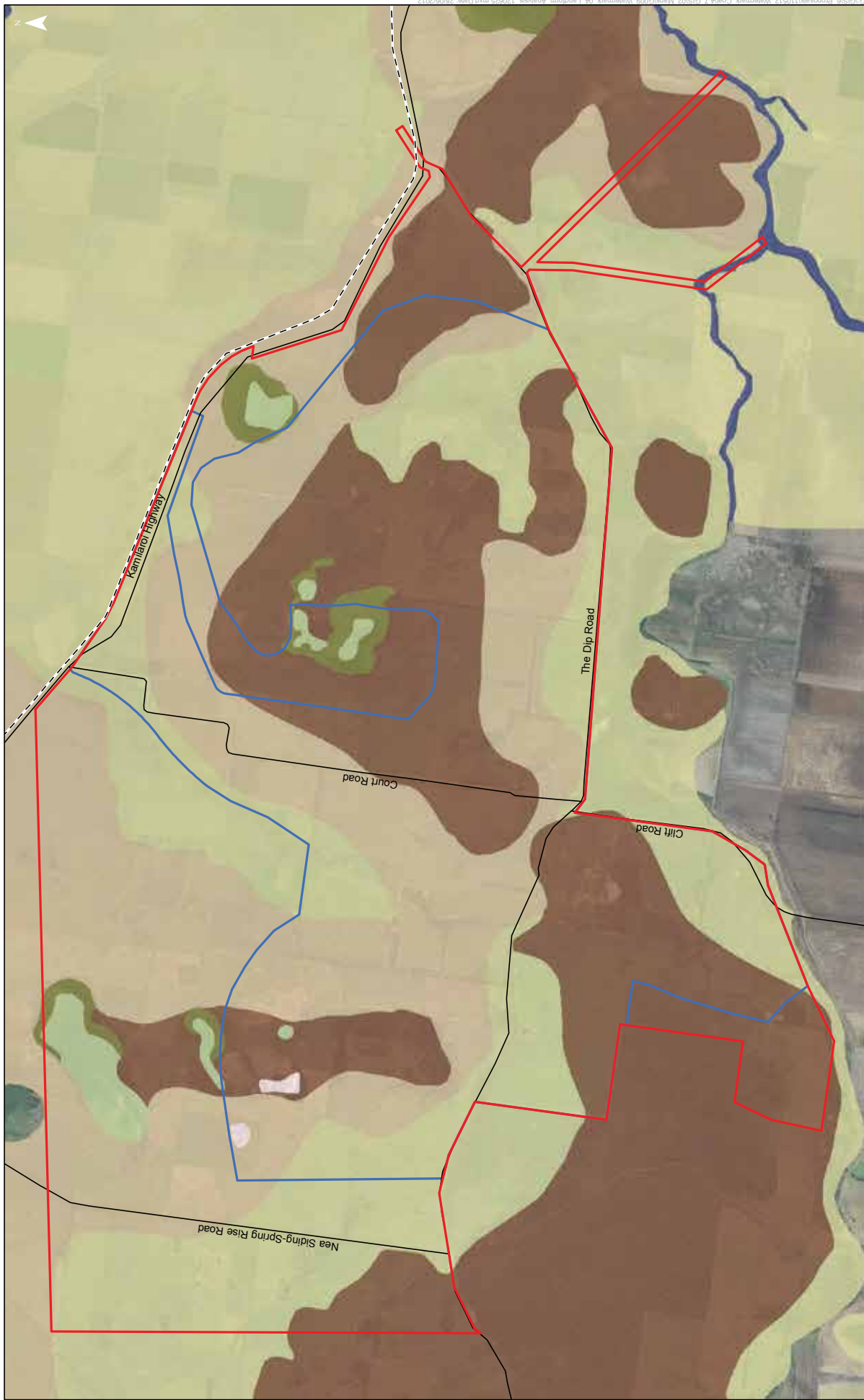
Other named watercourses within the Project area include Native Dog and Watermark Gullies, both of which have been heavily modified through historic land use practises. The former flows directly into the Mooki River in the south-eastern corner of the Project area and is currently a 2nd to 3rd order stream. The creek originates from a large, unmapped ephemeral wetland on the property 'The Dip' and is now heavily channelised. North of The Dip Road, Watermark Gully comprises the Project area's principal drainage line, flowing in a northeasterly direction through the wide alluvial valley that comprises the central portion of the site. Natural flows along Watermark Gully, which currently comprises a 1st to 2nd order stream, have been seriously disrupted by the construction of numerous farm dams. For much of its length, these dams provide the only indication of water flow.



WATERMARK COAL PROJECT
TOPOGRAPHY AND HYDROLOGY

0 0.5 1 2 km
Fig 3

AECOM



WATERMARK COAL PROJECT
LANDFORM ANALYSIS



- | | | |
|---|--|---|
| <ul style="list-style-type: none"> Project Boundary Disturbance Boundary (Indicative) Roads Railway | <ul style="list-style-type: none"> Landform Disturbed Gently inclined footslopes Level to gently undulating / inclined flood / drainage plains | <ul style="list-style-type: none"> Level to undulating hills on plateau surfaces Moderately to steeply inclined hillslopes Undulating to rolling hills River banks below floodplain level |
|---|--|---|

AECOM

Lake Goran, a naturally occurring ephemeral lake, is located to the immediate west of the Project area. During times of flooding, the lake drains eastward, into the Mooki River, via Native Dog Gully. The lake dries within two and a half years if no run-in events occur (Broughton 1994: 5). Examination of available topographic mapping for the Watermark area shows the eastern boundary of Lake Goran as falling approximately 4 km west of the southwestern corner of the Project area (Breeze 8935-II-N, 1:25,000). However, a mapped wetland adjacent to 'Doona' homestead may represent an eastern continuation of the lake. Flooding within the Project area is limited to areas of low-lying terrain south of the Dip Road and east of the Kamilaroi Highway.

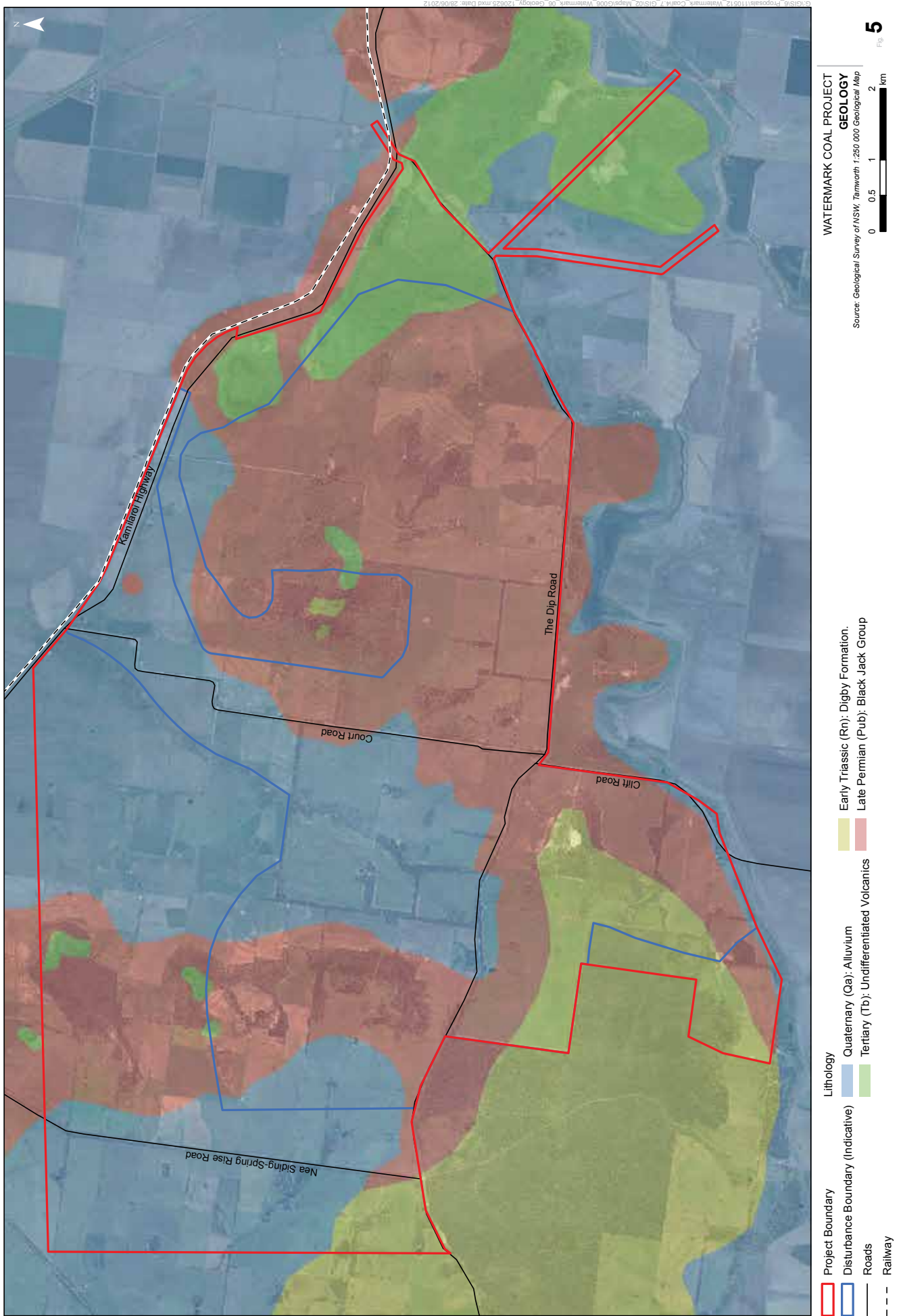
In common with other parts of the state and country, the nature and distribution of potable water sources within the Project area is of particular relevance to an assessment of its Aboriginal archaeological potential. Whilst recognising the fact that the Project area's current hydrological scheme is, to a significant extent, a product of historic European land use practises within it, with many changes in drainage patterns and flow rates since the early European settlement of the area, the results of previous archaeological investigations on a local (e.g., Gorecki 1980; JMcD CHM 1998; Wilson and McAdam 2000) and regional (e.g., McBryde 1974) scale do allow some basic predictions to be made concerning the character of Aboriginal archaeological assemblages within the Project Boundary (i.e., as they relate to surface water).

It is, for example, highly likely that the permanency of potable water sources in the Project area, expressed, in the case of rivers and creeks in terms of Strahler's (1952) stream order system, will have played an important role in influencing both the nature and duration of Aboriginal occupation in their vicinity. Aboriginal archaeological sites associated with small, ephemeral creeklines are unlikely to yield the same quantity or diversity of archaeological materials as their more permanent (i.e., higher order) counterparts, which have the potential to contain large, complex archaeological assemblages (e.g., White and McDonald 2010), often in subsurface contexts. Although the presence of significant archaeological deposits in association with 1st and 2nd order creeklines cannot be ruled out, not least because of changes in drainage patterns and flows rates over time, it can be confidently asserted that higher order streams (e.g., Mooki River, Native Dog and Watermark Gullies) will, as a general rule, produce larger and more complex archaeological assemblages than their ephemeral counterparts. They are, for example, likely to contain higher overall artefact counts and densities as well as a broader range of raw material and artefact types. Differences in the nature and extent of core reduction and tool production may also be apparent, themselves tied to factors such as site function and duration of occupation.

4.5 Geology

The Project area falls wholly within the Gunnedah Basin of northeastern New South Wales, a major geological province covering an area of approximately 15,000 km². The Gunnedah Basin comprises a molassic foreland basin, with a complex Permian-Triassic sequence unconformably overlying deformed and metamorphosed Ordovician to Devonian Lachlan Fold Belt strata in the west and Devonian to Carboniferous New England Fold Belt strata in the east (Broughton 1994:14). A large reverse fault known as the Hunter-Mooki Thrust Fault separates the Gunnedah Basin from the Tamworth Fold Belt to the east (Broughton 1994:14). This fault extends from Murrurundi to Carroll and strikes north-northwest into the Cenozoic volcanics of Nandewar Mountain. The boundary between the Gunnedah and Bowen Basins is more-or-less arbitrary, defined on the basis of a structural high north of Narrabri. The boundary between the Gunnedah and Sydney Basins, in contrast, is defined by the Mount Coricudgy Anticline (Broughton 1994:14).

Examination of available geological mapping for the Project area indicates that rocks of the Late Permian Black Jack Group (Pub), specifically, sandstone, shale, chert, conglomerate, coal and limestone, dominate its surface geology (**Figure 5**). However, Quaternary alluvium (Qa), comprising clay, silt, sand and gravel, and undifferentiated volcanics of Tertiary age are also well represented. The latter are concentrated in the eastern half of the Project area, with limited though widely distributed occurrences in the west. Dominant lithologies include basalt and dolerite. Conglomerate-rich sandstone strata belonging to the Triassic Digby Formation are largely restricted to the south of the Dip Road in the southwestern portion of the Project area but are also represented by the prominent sandstone cliff formations of Mount Watermark and unnamed peaks to the west of Court Road. The Digby Formation is divided into two units, the lower Digby Conglomerate and upper Ulinda Sandstone. The former unconformably overlies coal-bearing strata of the Black Jack Group and consists principally of thickly bedded, polymictic pebble/ cobble conglomerate, with minor, finely to medium bedded lithic sandstone beds present towards the top of the unit. Permian and Triassic strata within the Project area have an approximate thickness of 700 m. Coal resources within the Project area are associated exclusively with the Late Permian Black Jack Group. Target seams include the Hoskissons and Melville seams.



Like surface water, the underlying geology of the Project area is of particular relevance to an assessment of its Aboriginal archaeological potential. Rockshelters, for example, are a common feature of the sandstone cliffs and outliers of the Triassic and Permian Periods, having been formed over time by a combination of wind and water erosion. Local and regional archaeological evidence (e.g., Balme 1986; Gaynor 1996, 1997; McBryde 1974; Wilson and McAdam 2000) indicates the widespread, and in some cases, repeated use of such shelters by Aboriginal people in the past. Material cultural assemblages recovered from the excavation of rockshelter floor deposits in the region attest to the carrying out of a range of activities within them, including food preparation and consumption, stone tool manufacture and maintenance and the production of rock art. The presence of engraved and/or pigment images on the walls of some shelters suggests that they may, on occasion, have been sites of spiritual or religious activities such as male initiation ceremonies (see also Attenbrow 2010 for a discussion on sandstone images as possible indicators of linguistic boundaries).

Sandstone outcrops also offered surfaces on which stone hatchet-heads and wooden spears could be shaped or resharpened, with flat, low outcrops of fine-grained sandstone near water favoured for this task. In addition to food preparation (i.e., seed grinding), smaller, portable sandstone blocks may also have been used in this capacity.

Significantly, stone suitable for the production of chipped stone artefacts is available in abundance in the Project area in the form of widely distributed surface deposits of loose pebble/cobble conglomerate (**Plates 1-4**). Most of these deposits are likely Triassic in age and belong to the lower Digby Conglomerate unit. However, in addition to chert/tuff strata, formations of the Late Permian Black Jack Group are known to contain pebble/cobble conglomerate. Knappable rock types observed in the conglomerate deposits of the Project area include chalcedony, quartz (milky, rose and crystal), quartzite, jasper, chert/tuff and petrified wood (A.McLaren, *pers. obs.*, March-May 2012). Clast size in these deposits is highly variable. However, clasts exceeding 64 mm in maximum linear dimension (i.e., cobbles, after Wentworth 1922) are well represented. The implications of this observation for Aboriginal chipped stone technology in the Project area will be returned to in **Section 8.5.7.3**.



Plate 1: Bands of pebble/cobble conglomerate visible in sandstone cliff face on 'Linavardi'. Note variability in clast size.



Plate 2: Surface deposit of loose quartz pebble/cobble conglomerate on 'Hill 60'



Plate 3: Blocks of conglomerate found in cleared paddock on 'Watermark'. Note variability in clast size.



Plate 4: Surface deposit of loose pebble/conglomerate on 'Lochiel East'

Outside of the Project area, gravel bars associated with the Mooki and Namoi Rivers are known to contain rocks suitable for the production of chipped and groundstone implements (see also Wilson and McAdam 2000 for the Peel and Cockburn Rivers). Further afield, the contact metamorphism of the andesitic greywacke to the north of the Peel River in Tamworth is also worthy of mention here. As highlighted by Wilson and McAdam (2000: 26), this metamorphism was responsible for producing, in a limited area on Mount Daruka at Moore Creek, a stone that was highly valued by Aboriginal groups living in the greater Tamworth-Gunnedah region for the production of edge-ground hatchet-heads (Binns and McBryde 1972; Wilson 1994). Previous archaeological investigations (e.g. McBryde 1991; McCarthy 1941) at Mount Daruka indicate intensive Aboriginal quarrying of the distinctive grey-green andesitic greywacke that outcrops along the crest of the steep saddle-backed ridge to the west of 'Daruka' homestead. The on-site production of unifacially and bifacially flaked hatchet-heads is also well attested, with significant quantities of hatchet manufacturing debris having been recorded in association with quarried exposures. More broadly, available archaeological data attest to the importance of the Mount Daruka hatchet quarry in both local and regional exchange networks (see Binns and McBryde 1972; Wilson 1994).

4.6 Soils

Soils within the Project area are closely related to the geological units that underlie them, with soils of the Watermark (wa), Fullwoods Road (fr), Booloocooroo (bo), Carinya (cr), Stafford Gap (sg) soil landscapes dominating and largely conforming to the distribution of associated Quaternary (bo & fr), Tertiary (cr & sg) and Permian (wa) formations (**Figure 6**). **Table 6** summarises the key characteristics of the soils associated with these dominant soil landscapes. Key archaeological implications for each are also provided. Other soil landscapes represented within the Project area include Pit Hill (ph), Black Jack (bj), Long Mountain (lm), Conadilly (cd), East Lynne (el), Goscombes Road (go), Disturbed (xx) and Mooki River (mo) (Banks 1995).

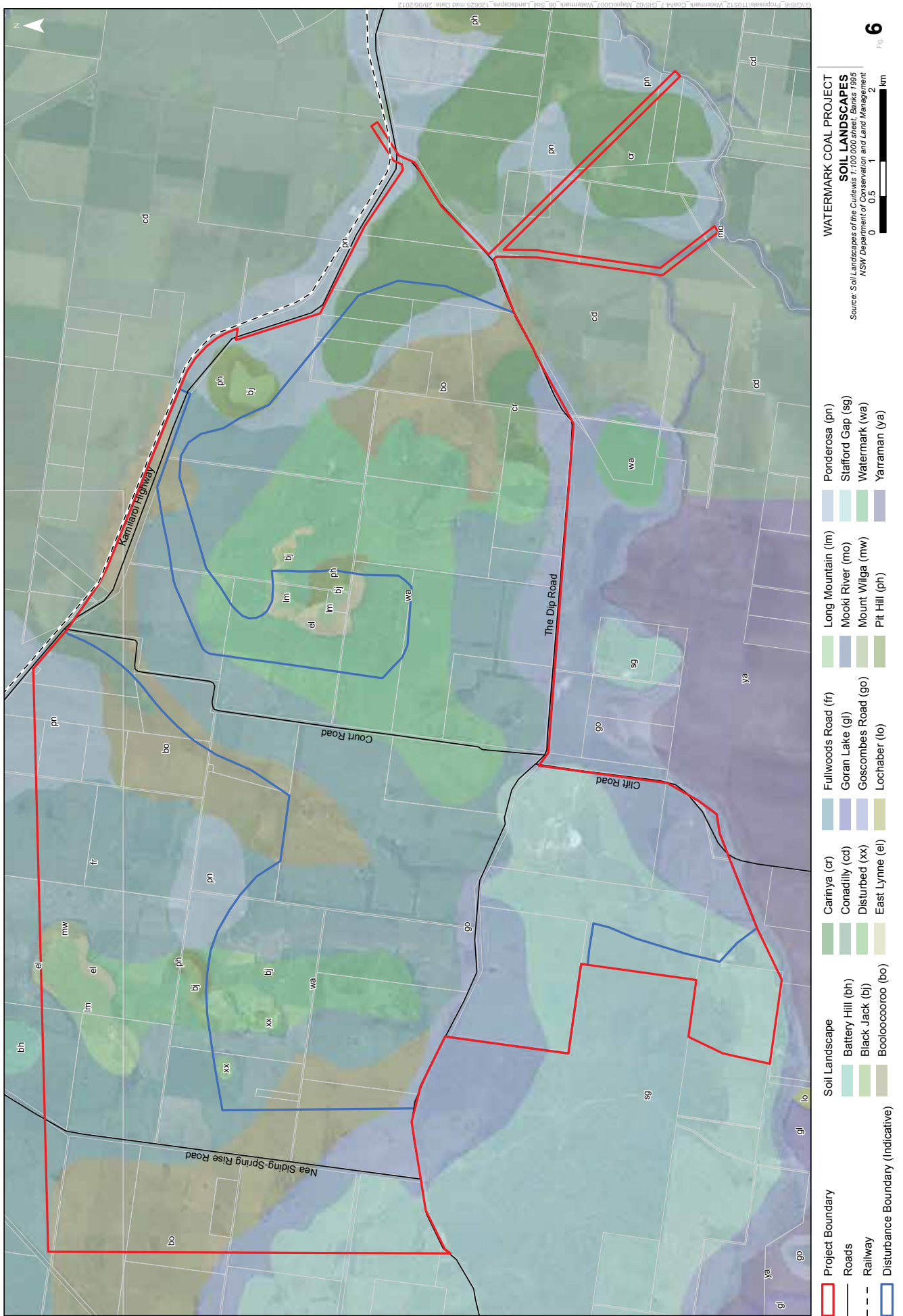


Table 6 Soil landscape data and key archaeological implications

Soil Landscape	Dominant soils	Soil pH		Erosion hazard*	Permeability	Archaeological implications
		A horizon	B/C horizon			
Watermark (wa)	wa1 - Single-grained brownish black sandy loam	5.5-6.5	na	Non-Con: G: low C: mod-high LC: high Con: G: mod-high C: high LC: moderate	High	1. Exposure of subsurface archaeological materials in anthropogenically-modified areas likely due to erosion hazard ('A' horizons); 2. Exposed archaeological deposits less likely to retain high spatial integrity due to erosion hazard; 3. Low potential for substantial intact soil units containing archaeological deposits; and 4. Preservation of bone in acidic soils unlikely.
	wa2 - Single-grained dull yellowish brown clayey coarse sand	4.5	na		High	
	wa3 - Loose dark reddish brown silty clay loam	6.5-7.0	na		Moderate	
	wa4 - Weakly pedal reddish brown light medium clay	na	7.0-8.5		Moderate	
	wa5 - Gravelly pedal greyish brown light medium clay	na	8.0-8.5		Moderate	
Fullwoods Road (fr)	fr1 - Hardsetting dark clay loam fine sandy	6.5-7.0	na	Non-Con: G: low C: moderate LC: moderate Con: G: moderate C: high LC: high	Moderate	1. Exposure of subsurface archaeological materials in anthropogenically-modified areas more likely due to erosion hazard ('A' horizons); 2. Exposed archaeological deposits less likely to retain high spatial integrity due to erosion hazard; 3. High run-on may be reflected archaeologically. 4. Moderate to high potential for substantial intact soil units containing archaeological deposits; and 5. Preservation of bone in acidic soils unlikely.
	fr2 - Hardsetting dark brown silty clay loam	6.0-6.5	na		Slow	
	fr3 - Bleached fine sandy clay loam	6.0-9.0	na		Moderate	
	fr4 - Strongly structured reddish brown medium clay	na	7.0-10.0		Slow	
	fr5 - Brown medium clay with calcareous segregations	na	8.0-10.0		Slow	
	fr6 - Brown earthy sandy clay	na	6.5-9.0		Moderate	
	fr7 - Bright yellowish brown mottled medium heavy clay	na	7.5-8.0		Very slow	
Booloocooroo (bo)	bo1 - Hardsetting dark brown clay loam fine sandy	5.5-6.5	na	Non-Con: G: low C: low LC: low	Moderate	1. Exposure of subsurface archaeological materials in anthropogenically-
	bo2 - Sub-angular reddish brown silty	7.5	Na		Moderate	

Soil Landscape	Dominant soils	Soil pH		Erosion hazard*	Permeability	Archaeological implications
		A horizon	B/C horizon			
	clay loam			Con: G: low C: high LC: moderate		modified areas more likely due to erosion hazard ('A' horizons); 2. Exposed archaeological deposits unlikely to retain high spatial integrity due to erosion hazard; 3. High run-on may be reflected archaeologically; 4. Moderate to high potential for substantial intact soil units containing archaeological deposits; and 5. Preservation of bone in acidic soils unlikely.
	bo3 - Self mulching dark brown medium heavy clay	7.0	na		Low	
	bo4 - Massive bright brown silty clay	na	8.0-9.0		Moderate	
	bo5 - Blocky reddish brown medium heavy clay with segregations	na	7.0-9.0		Low	
	bo6 - Earthy brown alkaline clay loam	9.0	na		High	
	bo7 - Reddish brown acid sandy clay loam	5.0	na		High	
	bo8 - Dark brown silty clay	na	8.0-8.5		Slow	
	bo9 - Dark reddish brown acid sandy clay	na	5.0		Moderate	
	bo10 - Bright gypseous clay	na	10		High	
Carinya (cr)	cr1 - Hardsetting dark reddish brown clay loam	6.0	na	Non-Con: G: low C: low-mod	Moderate	1. Exposure of subsurface archaeological materials in anthropogenically-modified areas more likely due to high erosion hazard; 2. Exposed archaeological deposits unlikely to retain high spatial integrity due to erosion hazard; 3. Moderate to low potential for substantial intact soil units containing archaeological deposits; and 4. Preservation of bone in acidic soils unlikely.
	cr2 - Brownish black silty medium clay	6.5-7.0	na		Slow	
	cr3 - Brownish black heavy clay	na	7.0	Con: G: low C: high	Slow	
	cr4 - Dark reddish brown medium clay	na	6.5-8.5		Slow	
	cr5 - Carbonate-rich silty clay	na	9.0		High	
Stafford Gap (sg)	sg1 - Loose dark reddish brown sandy loam	6.0-7.5	na	Non-Con: G: low-mod C: mod-high LC: mod-high	High	1. Exposure of subsurface archaeological materials in anthropogenically-modified areas more likely due to erosion hazard; 2. Exposed archaeological
	sg2 - Hardsetting dark brown fine sandy loam	5.5-7.0	na		Mod-High	
	sg3 - Hardsetting dark brown weakly structured fine sandy clay loam	6.5-7.0	na	Con: G: mod-high C: high LC: high	Mod-High	
	sg4 - Reddish brown	na	5.0-8.5		Mod-High	

Soil Landscape	Dominant soils	Soil pH		Erosion hazard*	Permeability	Archaeological implications
		A horizon	B/C horizon			
	earthy fine sandy clay loam					deposits unlikely to retain high spatial integrity due to erosion hazard; 3. Low potential for substantial intact soil units containing archaeological deposits; and 4. Preservation of bone in acidic soils unlikely.
	sg5 - Earthy dull yellowish brown clayey sandy and sandy loam	na	6.0-8.5		Mod-High	
	sg6 - Dark reddish brown earthy sandy clay	7.0	na		Mod-High	
	sg7 - Bleached fine sandy clay loam	5.5-6.5	na		High	
	sg8 - Yellow orange gravelly sandy clay	na	5.5-8.5		Moderate	
	sg9 - Bright brown moderately pedal medium clay	na	6.0		Slow	

*Non-con: non-concentrated flow; Con: concentrated flow; G: grazing; C: cultivation; and LC: land clearing

4.7 Geomorphology

As highlighted in Fanning's (2012) geomorphological assessment for the Project (**Appendix E**), a review of existing historic reference materials for the Project area (e.g., local histories, aerial photographs) indicates that the majority of land within the Project Boundary has been more or less continuously cropped and/or grazed since the late 19th century. The result, in sum, of this long history of agricultural and pastoral land use has been severe land degradation, with soil erosion, structural decline and a general rise in saline watertables key geomorphological outcomes (Fanning 2012: 8). The quantity, in particular, of contour banks visible in historic aerial photographs for the Project area indicates that soil erosion has, at certain times in the history of the Project area (e.g., the 1950s and 60s), been a major problem for local landholders.

Today, the Project area appears to have largely returned to a state of relative stability, with conservation farming and grazing practices regarded as the most likely catalyst for change (Fanning 2012: 18). Nonetheless, scalds, a legacy of severe sheet erosion and dryland salinity in the past, are common and widespread (**Plates 5 & 6**). Archaeologically, scalds are of particular significance given the excellent surface visibility they provide, affording the greatest potential for the identification of archaeological features such as stone artefacts and hearths. Following Fanning *et al.* (2007, 2008, 2009) and others (e.g., Shiner 2008), deflated surface artefact distributions on scalds are best conceived of as time-averaged palimpsests, with the majority representing the accumulation of materials from multiple behavioural episodes occurring over long periods of discontinuous time.

Fanning (2012: 18) notes that, whilst limited, areas of sediment deposition within the Project area afford the greatest likelihood for the preservation of subsurface archaeological materials. Terraces associated with the Mooki River, in particular, have been identified as having the highest potential due to the fact that, as remnants of the river's former floodplains, sediment deposition is likely to have been the dominant geomorphic process operating on these landform elements. Footslopes and drainage plains have likewise been identified as having "moderate to high potential for the preservation of subsurface archaeological materials because of the likelihood of burial by sediment deposition" (Fanning 2012: 18).



Plate 5: Scald on 'Linavardi'. Note excellent surface visibility and presence (albeit limited) of surface gravel.



Plate 6: Scald on western proximal drainage plain of Watermark Gully on 'Watermark'. Note salt-tolerant vegetation on edges of scald.

4.8 Flora and fauna

Native vegetation within the Project area has been extensively modified as a result of agricultural and pastoral activities, with the majority cleared historically for cropping and/or cattle grazing. Vegetation in cleared areas ranges from severely modified cropland to derived native grassland with scattered mature paddock trees. Remaining native vegetation comprises a mixture of fragmented strips of woodland along boundary fences and road verges, remnant open forest or woodland on mountains and steeper slopes, and isolated patches of remnant or regrowth woodland (Cumberland Ecology 2011).

Box Woodlands are well represented in the Project area, with White Box Grassy Woodland the most extensive wooded vegetation community within the Project Boundary. Remnant native vegetation within the Project area is generally intact and in good condition with only minor degradation from weeds and other disturbances. Archaeologically, areas of remnant vegetation are of particular importance for they have the potential to contain mature native trees with Aboriginal scars or carvings.

Compared with other Aboriginal language groups in southeastern Australia (e.g., Attenbrow 2010), available ethnohistoric records for the Kamilaroi people of the Central and North West Slopes and Plains of NSW indicate the exploitation, for food, of a comparatively limited array of plant species (Gamilaraay: *yuul* or *manhdha*, meaning 'vegetable food') (see O'Rourke 1997, 2005 for references). Although these records must be treated with caution for a variety of reasons, not least the suggestion that the use of vegetable foods was systematically under-reported by early observers, taken at face value, they suggest that Kamilaroi speaking peoples preferred animal foods, known in Gamilaraay as '*yuri*' ('meat foods') (O'Rourke 1997: 151). Particularly favoured, O'Rourke (1997: 151) notes, "were possum meat and aquatic animals such as crayfish ("yabbies"), freshwater mussels and fish". However, the hunting and/or consumption of kangaroos, wallabies, bandicoots, emus, bustards, lizards and snakes are also reported in the writings of early observers.

Of the limited number of plant foods cited in available ethnohistoric records, grass-seed appears to have been particularly important to Kamilaroi speaking peoples, especially in late summer and early spring. O'Rourke (1997: 153) refers to grass-seed cakes as "distinctive and prized food of the inland" and notes that the main grasses used belong to the genera *Panicum* and *Sporobolus*. The Kamilaroi, he reports, called the grass '*ganali*', the seed '*gula*' and the bread itself '*dhuwarr*' (O'Rourke 1997: 153).

Recorded vegetation communities will have provided suitable habitat for a range of fauna types including amphibians, reptiles, birds and mammals, both terrestrial and arboreal. Water bodies within and surrounding the Project area will likewise have supported a diverse range of aquatic fauna (e.g., fish, molluscs and crustacea). Some of the faunal resources that may have been exploited by Aboriginal people passing through, or camping within the Project area, include freshwater fish, eels, mussels and yabbies, snakes, bats, lizards, goannas, possums, gliders, turtles, koalas, emus, kangaroos, wallabies, birds, insects and their larvae (e.g. ants, cicadas, termites, moths) and frogs. Honey derived from the hives of native bees is also known to have been exploited.

4.9 European Settlement History

John Oxley was the first official European explorer to pass through the greater Watermark-Breeza area. In August 1818, Oxley and his party travelled eastward on a line that took them through the present-day township of Curlewis, approximately 15 km northwest of the Project area (Whitehead 2004:237). Settlement soon followed, with two of the most influential early pastoral runs in the area being 'Doona' and 'Breeza'. 'Breeza' was set up by Donald McLaughlin on behalf of Thomas Potter Macqueen in 1832. McLaughlin drove some bullocks to the current location of Breeza Station and built a stockyard and hut. 'Doona' was established in 1837 by Samuel Clift, although he may have selected the land as early as 1835. The township of Breeza originated with the establishment of an accommodation house near the Mooki River in 1845. The accommodation was run by William Conroy, who also had eight horses and 80 cattle on 160 acres of land. This was within 'Breeza' and when Clift purchased the property he disputed Conroy's claim to the land. The Crown Lands Commissioner, however, ordered a reserve of one square mile.

From 1861, with the introduction of the Robertson Land Act, squatters had the option to purchase parts of their runs, but also to relinquish parts of their lease back to the Crown for sale. Samuel Clift died in 1862 and his runs (Breeza, Weia Weia Creek, Wallala East and West and Mooki River) were transferred to his sons William, Joseph, James, Samuel and George. James sold his portion and was bought out by the remaining brothers. Each brother received around 32,000 acres each. The Project area, for the most part, became the property of William Clift, with the western portion been given to George. All the Clift brothers tried to have the entirety of their leaseholds converted to freehold. They appear to have been largely successful until the new Crown Lands Act of

1884. At this point squatters had to divide their leases into an area of lease and an area to be resumed. The resumed area could be leased by the squatter until it was selected (Durrant & Roworth 1973:88).

Initial surveys for a railway line between Werris Creek and Gunnedah were undertaken in 1873. There was political wrangling over the location of the line and delays caused by high temperatures and various other factors so that the line was not officially proclaimed until 14 June 1877. Work on the line began soon thereafter. The line was finished and officially opened in Gunnedah on 11 September 1879. The line, however, did not make a profit and it was soon realised that to do so would require an extension to Narrabri. This was achieved by October 1882. The railway line improved local farmers ability to transport and sell local livestock.

William Clift died in 1889 and his land was divided amongst his four sons, with his daughters being given a dowry (Durrant & Roworth 1973:98). Each son received 8,000 acres, although it is not clear how the land was divided and who inherited the portion of the Project area still in Clift ownership. When William's brother George died in 1912 his property was also subdivided between his seven children. Within the Project area the land to the west of Nea Siding Spring Rise Road was inherited by George Percival Clift. On his death his land was split between his four children with George Percival junior inheriting the portion in the Project area, which he divided into Lochiel, which he operated, Lochiel East, which was managed by his son Don, and two other properties, Birrawa and Urubula outside the Project area being managed by other sons (Durrant & Roworth 1973:102).

One of the earliest Settlement Leases was taken up by Walter Court in 1896. His lease of 1600 acres was converted to a Conditional Purchase in 1913. Walter had been a tutor on a squatters run in southern New South Wales, where he acquired a taste for country life. The property was named Flakenhoe, a variation on his father's middle name of Flecknoe (Durrant & Roworth 1973:90). Lilyfield was another early selection, taken by John Gaynor on 14 February 1899. This was followed by a number of other selections within and adjacent to the Project area. These include The Dip, selected by John Branxton Clift, which was later augmented by land from one of the other Clift estates. John A. Clift had Brownes Corner, on the corner of the Kamilaroi Highway and The Dip Road. The Clifts also owned The Watermark until it passed on to the Bailey family. The Bailey family also owned Watermark, a separate property on the corner of the Kamilaroi Highway and Court Road. This was selected by Joseph Bailey in 1902. In the same year Vine Cottage (now Demeter) was purchased by the McIntosh's, who passed it on to David Williams (Durrant & Roworth 1973:90-91). One of the worst droughts recorded in the area occurred in 1902, so neither Bailey or McIntosh had a good start.

In 1905, the property of Joe Pateman, Black Mountain, was sold to John Perry, who renamed it 'The Wilgas'. John Perry was a member of the NSW Legislative Assembly from 1904 to 1907 and again in 1911 (Durrant & Roworth 1973:102). Perry was involved in establishing the Wilga Coal and Coke Company in 1914 with a group of Quirindi businessmen. The mine was located just off the Kamilaroi Highway, about one kilometre south of The Wilgas homestead. The quality of coal was never good and once the Company lost the tender to supply coal to the local railway, together with World War I, the mine was forced to close in 1916.

Perry sold the property to the Hethringtons. The Wilgas was purchased by the Roworth family in 1938. Sometime before 1906, Barwo was purchased by Jack Devlin, which was then passed on to Mrs J. Farley. Inverness had been settled by Hugh Cameron, but was bought by Thomas Colley in 1906 and during the 1970s was owned by J. Colley (Durrant & Roworth 1973:90-91).

Following World War I, some of the land to the north of The Dip Road, formerly part of 'Bumble' owned by B. Durham, was resumed for soldier settlement. Three parcels of land were given to W. Hale, N. Hirst and a Maclean in 1920. Maclean did not stay long and sold his property to Lance Tudgey in 1924 (Durrant & Roworth 1973:91-92). This is believed to be the Hill 60 property. Hale also sold, dividing the land between Hirst and Hale. It is assumed that W. Hale's property is Cloveneden, although this requires clarification. Post World War II, there was another round of land resumption for soldier settlement blocks, although this seems to have mainly occurred on Piallaway Station to the north and east of the Project area. More generally, the post-war period was a time of agricultural (as opposed to pastoral) expansion, with an increased population and new farming techniques driving increased production (Durrant & Roworth 1973:107).

4.10 Land Use Impacts

The Project area has been subject to a range of historic and recent land use impacts. These include:

- Extensive native vegetation clearance, a progressive phenomenon readily apparent in historic aerial photographs for the Project area. A comparison, for example, of the earliest historic aerials for the Project area (1954, **Figure 7**) with the most recent, flown in January 2010 (**Figure 8**), indicates a significant *overall* decrease in vegetation cover since the mid-1950s. Particularly notable between aerial sets is the reduction in native vegetation cover in paddocks to the south of Mount Watermark and to the east of the Breeza State Forest.
- Pastoral activities such as cattle grazing, fencing and the excavation of farm dams;
- The widespread creation of contour banks for erosion control;
- Ploughing;
- Sheet, gully and rill erosion, particularly along creeklines and on cleared hillslopes;
- The construction of essential services such as telephone/power lines and roads;
- The construction of farm houses and associated buildings;
- Limited historic coal mining activity;
- Limited quarrying; and
- Exploratory drilling activities.

To varying degrees, all are relevant to the survival, integrity and identification of Aboriginal archaeological evidence within the Project area. Key archaeological implications include:

- The destruction, in areas of grossly modified terrain, of pre-existing sites and deposit(s);
- The disturbance of pre-existing sites and deposit(s) through both direct (e.g., ploughing) and indirect (e.g., erosion) means, resulting in a loss of archaeological integrity;
- The removal of culturally scarred trees; and
- An increase, in areas affected by erosion, of archaeological site visibility.

Figure 9 presents AECOM's assessment of levels of land disturbance within the Project area (see also **Table 7**). As shown, the majority (76.1%) of land within the Project area has been assessed as 'moderately disturbed'. Moderately disturbed land is defined here as fully to near-fully cleared agricultural/grazing land. It is predicted that Aboriginal archaeological materials present within moderately disturbed areas will exhibit low spatial integrity.

Undisturbed / minimally disturbed land is also reasonably well represented in the Project area, accounting for 22.3% of the total. This category includes all areas of remnant vegetation as well as minimally cleared land that does not appear to have been ploughed. In contrast to moderately disturbed terrain, Aboriginal archaeological materials located within undisturbed / minimally disturbed areas have the potential to retain high spatial integrity. Remaining land within the Project area has been classified as 'highly disturbed'. Highly disturbed land comprises that which is deemed, on the basis of aerial interpretation and/or in-field observations, to have been grossly modified by European land use practices. Aboriginal archaeological materials are unlikely to survive in highly disturbed areas.

Table 7 Land Disturbance Analysis

Disturbance Category	Area (ha)	%
Moderately disturbed land	7,225.8	76.1
Undisturbed / minimally disturbed land	2,113.9	22.3
Highly disturbed land	160.4	1.7
Total	9,500	100

AECOM



WATERMARK COAL PROJECT
1954 AERIAL IMAGERY OF THE PROJECT AREA



Fig 7

Project Boundary



AECOM

AECOM

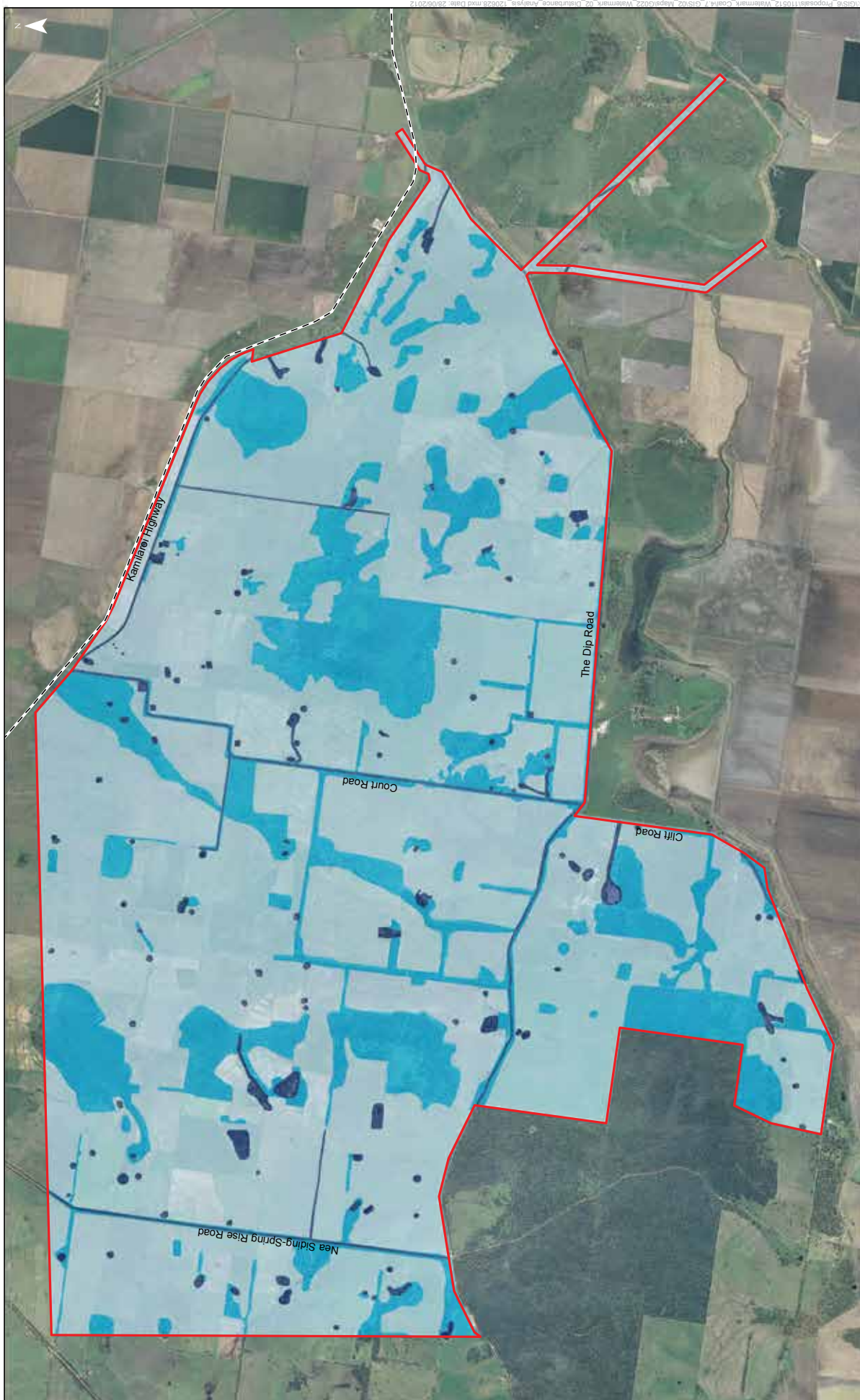


WATERMARK COAL PROJECT
2010 AERIAL IMAGERY OF THE PROJECT AREA

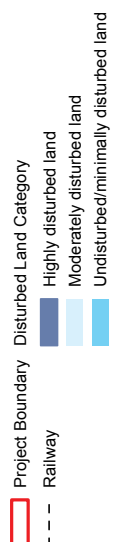
0 0.5 1 2 km
Fig 8

Project Boundary

AECOM



WATERMARK COAL PROJECT
DISTURBANCE ANALYSIS



AECOM

4.11 Key Observations

Key observations to be drawn from a review of the existing environment of the Project area are as follows:

- Prior to European occupation, the permanency of potable water sources within the Project area is likely to have played an important role influencing the nature and duration of Aboriginal activity in their vicinity. More permanent watercourses (i.e., the Mooki River, Native Dog and Watermark Gullies) are likely to have attracted more intensive or longer-term occupation activity;
- In topographic terms, the majority of the Project area can be characterised as being suitable for occupation by Aboriginal people. This said, landforms most suited to repeated or intensive occupation activity include level to gently undulating / inclined flood / drainage plains and gently inclined footslopes (i.e. low gradient land surfaces);
- Stone suitable for the production of chipped and ground implements is available in abundance in the Project area in the form of widely distributed surface deposits of pebble / cobble conglomerate;
- Outcropping sandstone within the Project area has the potential to house rockshelters that may have used by Aboriginal people for shelter and other activities. Hatchet and spear grinding grooves may also occur, particularly along watercourses;
- Native vegetation within the Project area has been extensively modified as a result of European land use practices. Nonetheless, areas of remnant woodland have the potential to contain trees with cultural scarring. Scattered mature paddock trees may likewise exhibit scars;
- Prior to European occupation, the floral and faunal resources of the Project area will have been sufficient to facilitate intensive and/or repeated occupation by Aboriginal people; and
- Sheet erosion is the most common and widespread form of erosion in the Project area. Other, less common forms include gully and rill erosion. All result from increased run-off precipitated by European land use practices (e.g., native vegetation clearance, (over)grazing and agriculture). Archaeological site visibility will be highest in eroded areas.

5.0 Archaeological Context

5.1 Regional Context

Available archaeological data indicate that Aboriginal people have occupied the Central and North West Slopes and Plains of NSW for at least 25,000 years (Wright 1985, 1986). As in other parts of the state (e.g., Attenbrow 2007, 2010), evidence for Pleistocene occupation is limited, with terminal Pleistocene dates and associated archaeological assemblages obtained from just three sites: Crazyman Rockshelter near Coonabarabran (Gaynor 1997) and the spring-fed swamp sites of Trinkey (Wright 1985, 1986) and Lime Springs (Gorecki *et al.* 1984), located between Spring Ridge and Premer, southwest of Gunnedah.

Crazyman Rockshelter is a medium-sized rockshelter located at the base of a conglomerate-bearing sandstone cliff formation approximately 10 km southwest of Coonabarabran. The shelter is situated approximately 80 m east of Deringulla Creek and 200 m south of a creek-fed swamp. Excavation of floor deposits within the shelter was undertaken in 1989 and revealed a stratified cultural sequence extending from the terminal Pleistocene to the contact period. Radiocarbon dates ($n = 8$) for prehistoric deposits at the site range from 20,310 BP at 1.3 m (Spit T) to 1380 BP at 27 mm (Spit 2) (Gaynor 1997: 8). Material evidence for terminal Pleistocene/early Holocene occupation of Crazyman Rockshelter was limited to chipped stone artefacts, with no plant or animal materials (charcoal excluded) recovered from deposits predating 8,000 BP. Analysis of the chipped stone assemblage associated with this period (i.e., c.20,000 to 8,000 BP) has indicated that quartz was the preferred material for stone artefact production, a preference that appears to have persisted until the mid Holocene period around 5,000 BP, with a marked increase in the exploitation of ultra fine-grained stones such as chert, jasper and chalcedony. The source of these finer-grained materials is unknown and it has been suggested that they may have been introduced to the site by way of existing trade networks (Gaynor 1997: 10).

Stone artefact discard rates for Crazyman Rockshelter suggest that the period of greatest Aboriginal activity at the shelter occurred between 8,000 and 5,000 BP, a finding consistent with the results of Gaynor's (1996) technological analysis of chipped stone artefacts from the site. Amongst other things, these attest to a marked increase in the intensity of core reduction during this period (Gaynor 1997: 9). Backed artefact production at Crazyman Rockshelter appears to have been restricted to the period between 5,000 and 1,000 BP, an observation more-or-less consistent with the results of other rockshelter excavations in the region (McBryde 1974). Backed artefacts at the shelter were manufactured out of quartz as well as chert and chalcedony.

The spring-fed swamp sites of Trinkey and Lime Springs are located approximately 30 km south-west of the current Project area between Spring Ridge and Premer. Excavated in the early-to-mid 1980s, these sites produced near-identical stratified sequences of Aboriginal chipped stone artefacts in association with animal tooth and bone fragments from both extinct and extant genera and species, including megafauna. At Lime Springs, the richer of the two sites in terms of the quantity of cultural material recovered during excavation, a seven metre long trench on the western side of the swamp revealed three discrete depositional units (Gorecki *et al.* 1984: 117). The earliest of these, Unit 3, comprised a layer of black sandy clays referred to as the 'Black Swamp' (Wright 1985; 1986). An organic-rich band in the middle of this unit produced a radiocarbon date of 19,300±500 BP. Radiocarbon dates for the same unit at Trinkey, which overlay a weathered aeolian dust not present at Lime Springs², range from 22,000 BP to around 6,000 BP. As at Trinkey, the Black Swamp unit at Lime Springs was capped in places by a layer of yellow aeolian fine sands termed the 'Grey Silt' (Unit 2). Wright (1985: 3) reports a radiocarbon determination of 6,000 BP for charred bone recovered from the top of this unit. Overlying the Grey Silt at Lime Springs was a 0.6 m thick layer of black sandy clays (Unit 1) containing modern (i.e., 20th century AD) European artefacts. A similar layer was identified at Trinkey.

As alluded to above, the Lime Springs excavation produced relatively large assemblages of flaked stone and animal tooth/ bone fragments. A total of 1,988 stone artefacts greater than 1cm in maximum dimension was recovered from the excavation, with the excavators arguing for the existence of two distinct stone tool industries at the site. Confined to the lower two thirds of the Black Swamp unit, the earlier of these is reported to have been characterised by the "patternless flaking" of a variety of siliceous rock types and contained "no clear types" (Gorecki *et al.* 1984: 118). The later industry, in contrast, was assigned to Tindale's (1937) 'Kartan culture' on the grounds that it was characterised by "the flaking of large horeshoof cores and scrapers" (Gorecki *et al.* 1984:198). A preference for the use of "quarried tabular tuff" in this industry was also noted. Chipped stone artefacts collected

² Associated with a thermoluminescence (TL) date of 26,000 BP, this dust was termed the 'Buff Silt'.

from the surface of a ploughed field adjacent to the swamp were likewise considered to be 'Kartan' in date (*sensu* Tindale 1937). Faunal remains from the site comprised 5218 individual fragments of bone and tooth, 36.7% (n = 1917) of which were burnt. Represented amongst these were five extinct species of megafauna including *Diprotodon*, *Macropus titan*, *Protemnodon*, *Procoptodon* and *Sthenurus*. Megafaunal remains were distributed throughout the Grey Silt and Black Swamp units. Interestingly, Gorecki *et al.* (1984: 118-9, Table 1-4) note the presence of numerous megafaunal remains in the upper part of the Black Swamp unit, a pattern replicated at Trinkey and one suggestive of the survival, well into the Holocene, of megafauna in this part of the Liverpool Plains (but see Flood 1999:187-89 for a different interpretation).

Compared with the late Pleistocene/early Holocene, archaeological evidence for mid-to-late Holocene Aboriginal occupation of the Central and North West Slopes and Plains of NSW abounds. Excavated sites with confirmed and/or probable mid-to-late Holocene deposit(s), for example, include: Kawambarai Cave near Coonabarabran (Beck *et al.* nd; Gaynor 1996, 1997), Crazyman Shelter (Gaynor 1996, 1997), Billy's Cave, near Tambar Springs (White *et al.* 1980), Camp Pincham, an open site within Warrumbungle National Park (Gaynor 1996, 1997), 'Malloka' homestead, adjacent to Lake Goran (Gorecki *et al.* 1980), the Ukerbarley Hayshed Site north of Coonabarabran (Gaynor 1996, 1997), Trinkey and Lime Springs (Gorecki *et al.* 1984, Wright 1985, 1986), the Bendemeer I and II rockshelters on the northern side of the Moonbi Range (McBryde 1974), the Moore Creek 4 and 6 rockshelters north of Tamworth (Binns and McBryde 1972; McBryde 1977) and the Graman GB1 and GB4 rockshelters (McBryde 1974) in the valley of Ottley Creek near Graman. At the same time, typological and technological affinities with excavated chipped stone assemblages suggest that the majority of open surface scatters identified within these regions likely date to this period.

In keeping with broader Australian developments (e.g., Allen and O'Connell 1995; Attenbrow 2007, 2009; Beaton 1985; Brumm and Moore 2005; Lourandos 1997; Lourandos and Ross 1994), the social and economic systems of Aboriginal groups living in the study region during the mid-to-late Holocene appear to have become increasingly complex. Available archaeological data, for example, suggest a marked increase in site usage and population density over time, as well as a concomitant growth in the size and complexity of social aggregation. Long-distance exchange networks are also attested archaeologically (e.g., Binns and McBryde 1972; McBryde 1974; 1991; Wilson 1994) as are significant developments in artistic activities (McBryde 1974). A marked increase in the complexity of stone technology during this period is also apparent, a phenomenon that may, as suggested by Hiscock (1994, 2006, 2008), have been linked to increased foraging risk associated with greater climatic variability as well as other variables such as landscape colonisation, redefinition of social space, reduction of resources and greater mobility (see also Attenbrow *et al.* 2009).

5.1.1 Regional Chronology

With some modification, McCarthy's (1967) *Eastern Regional Sequence* (ESR) of stone artefact assemblages remains the dominant chronological framework for Aboriginal prehistory in the region. The ESR hypothesises a three phase sequence of 'Capertian' (earliest), 'Bondaian' and 'Eloueran' (most recent) assemblages and was developed on the basis of McCarthy's (1948, 1964) pioneering analyses of stratified chipped stone assemblages from Lapstone Creek rockshelter (McCarthy 1948), on the lower slopes of the Blue Mountains eastern escarpment, and Capertee 3 rockshelter (McCarthy 1964), in the Capertee Valley north of Lithgow. McCarthy's ESR is now routinely characterised as a four-phase sequence, with the term Capertian retained and 'Bondaian' subdivided into three phases: Early Bondaian, Middle Bondaian and Late Bondaian³ (Figure 10). The tripartite division of the Bondaian is based principally on the introduction and subsequent decline of backed artefact manufacture. However, other factors, such as changes in the abundance of bipolar and quartz artefacts, and the presence/absence of edge-ground hatchet-heads and other organic implements (e.g., bone points and shell fishhooks) are also relevant.

Stone artefact assemblages belonging to McCarthy's Capertian phase are described by archaeologists as belonging to the 'Large Core and Scraper Tool Tradition', a term first used by Bowler *et al.* (1970) to describe the Pleistocene assemblages recovered from Lake Mungo in western New South Wales. Bowler *et al.* (1970) saw the main components of these assemblages - core tools, steep-edged scrapers and flat scrapers - as characteristic of early Australian Aboriginal assemblages and as being of a distinctly different character to those appearing in the mid-Holocene around 6,000 BP and persisting into the contact period (i.e., the last 200 years). In south-eastern Australia, these later assemblages are often referred to as 'Bondaian' assemblages. However, they also form part of what is known as the 'Australian Small Tool Tradition', a term coined by Gould (1969) to signal the appearance, during the mid-to-late Holocene, of a new suite of chipped stone tool forms in the Aboriginal archaeological record

³ The Late Bondaian is equivalent to McCarthy's Eloueran phase.

of Australia, including Bondi points, geometric microliths, tula adzes and points, both unifacially and bifacially flaked. Tools of the Small Tool Tradition, it has been suggested, formed part of a portable, standardised and multifunctional tool kit aimed specifically at risk reduction (Hiscock 1994, 2006).

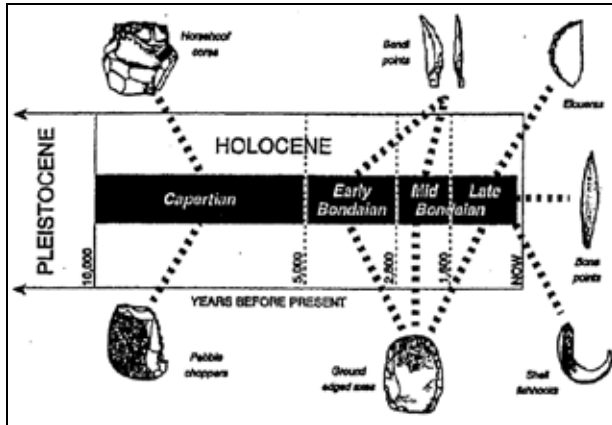


Figure 10 McCarthy's Eastern Regional Sequence (ERS) (from MacDonald and Davidson 1998: 105, Figure 5.1)

5.2 Local Context

5.2.1 AHIMS database search

The AHIMS database, administered by OEH, contains records of all Aboriginal objects reported to the Director General of the Department of Premier and Cabinet in accordance with Section 89A of the NPW Act. It also contains information about Aboriginal places which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

A search of the AHIMS database in February 2011 for a 225 km² area (15 x 15 km) centred on the Project area (AHIMS search area) identified 46 registered Aboriginal sites, six of which are located within the Project Boundary (**Figure 11**). A breakdown of obtained AHIMS records by site type is provided in **Table 8**, with some additional information on AHIMS registered sites within the Project area provided in **Table 9**. As indicated, scarred trees dominate the Aboriginal archaeological record of the AHIMS search area, accounting for 67.4% (n = 31) of the total. Remaining site types include open artefact scatters (19.6%, n = 9), isolated finds (6.5%, n = 3) and grinding grooves (6.5%, n = 3). AHIMS registered sites (n = 6) within the Project area consist exclusively of open artefact sites (i.e., artefact scatters and isolated finds).

Table 8 AHIMS search results

Site type	Count	%
Open artefact scatter	9	19.6
Isolated find	3	6.5
Scarred tree	31	67.4
Grinding groove(s)	3	6.5
Total	46	100

Table 9 AHIMS registered sites within the Project area

AHIMS ID	Site Name	MGA E	MGA N	Site Type	Recorder(s)	Reference(s)
29-1-0154	Bacon Hill 1	246971	6537159	Artefact scatter	P.Gaynor	None available
29-1-0155	Bacon Hill 2	246150	6538276	Artefact scatter	P.Gaynor	None available
29-1-0156	Bacon Hill 3	245993	6538195	Artefact scatter	P.Gaynor	None available
29-1-0157	Cloveneden 1	251069	6538705	Isolated find	P.Gaynor	None available
29-1-0158	Tudgeys Hill 1	250638	6540077	Artefact scatter	P.Gaynor	None available
29-1-0159	The Wilgas 1	251517	6541051	Artefact scatter	P.Gaynor	None available



5.2.2 Previous Aboriginal archaeological investigations

A search of the AHIMS database indicates that relatively few Aboriginal archaeological investigations have taken place in the greater Watermark-Breeza area, with previous consultancy-based work concentrated in areas to the north of Gunnedah. Research-based investigations are similarly poorly represented. As for the Project area itself, to date, assessment has been limited to a series of targeted field inspections carried out as part of a due diligence assessment for exploratory drilling activities within EL 7223. These inspections, conducted by local archaeologist Patrick Gorecki in association with Walhallow Local Aboriginal Land Council (WLALC) field representatives, are known to have resulted in the identification of six putative Aboriginal archaeological sites within the Project area (see **Table 8** above). However, as far as AECOM is aware, no associated reporting is available for these inspections. This lack of reporting notwithstanding, **Table 10** summarises the results of these inspections alongside those of several other Aboriginal archaeological investigations from the surrounding area.

Table 10 Previous Aboriginal archaeological investigations

Company/ Researcher(s)	Year	Investigation type	Project/Area	Results
P.Gorecki & others	1980	Survey and test excavation (research-based)	Vicinity of Tambar Springs	Numerous open artefact scatters identified, most in close proximity to reliable water sources. Other site types included shell middens (n = 2) and grinding grooves (n = 10). All grinding groove sites were found in close proximity to water. Test excavations undertaken at three sites: Killawarra Shelter, Billy's Cave and Malloka Beach (see below).
P.Gorecki, D.Gojak, P.Greenwood, C.Haughton-James & K.Pratt	1980	Test excavation (research-based)	'Malloka' homestead, Lake Goran.	Three 1m ² pits excavated on the shore of the lake. Pits distributed along former beach line. Three distinct stratigraphic units identified: 1) topsoil/grey sand; 2) white sand; and 3) calcium carbonate/green hard sand (basal). Majority of finds recovered from top 30 cm of each pit. These comprised chipped stone artefacts, animal teeth/bone fragments and ochre. No archaeological material located on the surface of the 30,000 year-old basal green sand unit. Dominant raw material for chipped stone artefact production was chert. Quartz also used but comparatively poorly represented. Formal tools limited to two backed artefacts (one geometric microlith and one Bondi point).
P.Gorecki & others	1980	Test excavation (research-based)	Killawarra Shelter, Killawarra Valley, near Tambar Springs.	Single augur hole sunk c.4 m north of small shelter created by detached sandstone boulder. Augur hole taken to 80 cm, with bedrock not reached. Two distinct stratigraphic layers inferred: 1) loose sand containing charcoal and stone artefacts; and 2) sterile hard compact sand. Single chert flake recovered between 25 and 35 cm.
P.Gorecki & others	1980	Surface collection (research-based)	Scully 1189, near Tambar Springs	Surface collection of stone materials on saddle between two low hills. Ten 1m ² sample squares laid out at 50 m intervals across saddle. All stone visible on the surface of each square collected. Raw materials comprised basalt (38.5 kg), chert (2.8 kg) and crystal/agate (0.4 kg). Definitive artefacts few in number and restricted to chert. "Occasional human activity" proposed (Gorecki 1980: 2). Finest grained chert observed nearest to outcropping basalt,

Company/ Researcher(s)	Year	Investigation type	Project/Area	Results
J.P.White, T.Konecyi, R. Lennon & J.Webster	1980	Test excavation (research-based)	Billy's Cave, McPherson's Creek, near Tambar Springs.	Shelter (9x4 m) located at foot of sandstone scarp c. 400 m downstream of major waterfall and 80 m west of "main secondary arm" of McPherson's Creek. Artefacts observed on shelter floor and associated talus slope. Four 50 cm ² pits excavated: one in the shelter (Test Pit 1) and three (Test Pits 2-4) down the talus. Artefacts recovered from TPs 2 and 3, excavated to 110 cm and 74 cm respectively. Artefacts in Test Pit 2 concentrated in top 30 cm of excavated deposit. Concentration in TP3 encountered "slightly deeper". Total of 191 artefacts recovered during excavation. Quartz dominant raw material (n = 119, 62.3%), Other, less common materials included chert, quartzite and indurated siltstone. Three backed blades (two broken), four "edge-retouched pieces" and four cores (inc. 2 bipolar examples) identified.
R.V.S.Wright & others	1981-4	Excavation (research-based)	Lime Springs, near Spring Ridge.	See Section 4.1 above
R.V.S.Wright & others	1981-4	Excavation (research-based)	Trinkey, near Spring Ridge.	See Section 4.1 above
Gaynor and Wilson Archaeological consultants	1995	Survey (consultancy)	Proposed andesite quarry, Currabubula	Three open artefact scatters identified and designated as 'Carrabobblia 1, 2 and 3'. All located within close proximity to reliable water sources. Recorded artefact types included cores, flakes, flaked pieces and retouched flakes. No formal implement types. Raw materials represented included chert, tuff, chalcedony, cherty argillite and ignimbrite, with chert and tuff dominating.
"Goorie" Aboriginal Heritage Consultancy	1995	Survey (consultancy)	Proposed optic fibre cable route from Spring Ridge to Red Bobs Exchange	No Aboriginal sites identified.
JMcD CHM	1998	Survey (consultancy)	Natural gas pipeline between Dubbo and Tamworth	Ninety-eight Aboriginal archaeological sites identified including scarred trees (n = 36), open artefact scatters (n = 40), isolated artefacts (n = 17), rockshelters with deposit (n = 4) and a single grinding groove site. Greatest number of sites found in the vicinity of rivers (e.g. Talbragar, Coolaburragundy and Mooki). Majority of open artefact scatters and scarred trees found in association with major (4 th order+) water courses. No pattern between assemblage size and stream order evident.
S.R.Hudson Consulting	1997	Survey (consultancy)	Lochaber Irrigation Development, "Lochaber", Spring ridge Road, Caroona	Eight isolated chipped stone artefacts identified on flat ground surrounding the banks of Lake Goran. Raw materials comprised chert and quartz. Quartz artefacts indicative of bipolar technology.

Company/ Researcher(s)	Year	Investigation type	Project/Area	Results
Central West Archaeological and Heritage Services	1998	Survey (consultancy)	Piallaway optic fibre cable route, near Gunnedah.	One potential Aboriginal scarred tree identified (Bimble box) along the northern edge of Robinsons Road. Scar shape suggestive of 'coolamon' or shield removal.
Archaeological Surveys and reports Pty Ltd	2004	Survey (consultancy)	Werris Creek Coal Mine	Single grinding groove site - "Narrawolga" - recorded on southwesterly-facing slope approximately 30 to 50 m from ephemeral drainage line. 25+ grooves recorded, with most aligned north/south.
Umwelt	2008	Due diligence inspection(s) (consultancy)	Caroona Coal Project (EL 6505)	Three isolated artefacts recorded: Caroona 1, 2 and 3. Caroona 1 and 2 located in road reserves on/above Mooki River floodplain. Caroona 3 located beside a vehicle track providing access to a cultivated field on a floodplain associated with Quirindi Creek.
P.Gaynor & WLALC representatives	2009	Due diligence inspection(s) (consultancy)	Watermark Coal Project	Six putative Aboriginal archaeological sites identified, including five artefact scatters and one isolated find.

5.2.3 Existing predictive models

Existing predictive models for Aboriginal occupation of the greater Watermark-Breeza area are limited to those developed by Umwelt (2008) and Nexus Archaeology (2009) as part of their respective desktop assessments for the Caroona and Watermark Coal Projects. These models, neither of which has been tested through field investigation, are summarised in **Table 11** below.

Table 11 Existing occupation models for the Watermark-Breeza area

Researcher(s)	Location	Summary of model
Umwelt	Caroona EL 6505	Doona State Forest likely to contain additional scarred trees; Bimble box (<i>Eucalyptus populnea</i>) and white box (<i>E. albens</i>) will likely be the most commonly scarred trees. Grinding grooves may occur in locations where suitable sandstones are exposed or were exposed in the past; Stone arrangements may be located within Doona State Forest and Nicholas Ridge as these areas have largely escaped European disturbance; Rock engravings may occur in locations where suitable sandstones are exposed or were exposed in the past. Conglomerate-bearing outcrops unlikely to exhibit engravings; Doona Point unlikely to contain rockshelters. However, suitable rock overhangs and cliffs faces are present on Nicholas Ridge. Isolated finds and open artefacts scatters may be located anywhere within Caroona EL 6505; The majority of isolated finds and open artefact scatters will occur within 50 m of a watercourse; The frequency and size of open artefact scatters will likely decrease concomitantly with stream order; Floodplains are more likely to contain highly disturbed archaeological deposit within the 'cultivation zone' (upper 30 cm approx). However, significant, intact deposit may occur below this level.

Researcher(s)	Location	Summary of model
Nexus Archaeology and Heritage	Watermark EL 7223	Breeza State Forest and areas of remnant vegetation may contain additional scarred trees; Grinding grooves may be present in locations where suitable sandstone is or was exposed and water is readily available; Stone arrangements may be located anywhere within non-cleared/non-disturbed areas; Rock art/rock engravings may occur in locations where suitable sandstones are exposed or were exposed in the past; Rockshelters with archaeological deposit may be present; Burials may be present within any landform; Artefact scatters and/or isolated finds may be present anywhere, especially along reliable watercourses; and Ceremonial sites may be present within non-cleared/non-disturbed areas.

5.3 Key Observations

Key observations to be drawn from a review of available archaeological data for the Project area and environs are as follows:

- Available radiocarbon determinations indicate that Aboriginal people have occupied the Central and North West Slopes and Plains of NSW for at least 25,000 years, with Late Pleistocene dates and associated archaeological assemblages recovered from three sites: Crazyman Rockshelter near Coonabarabran and the spring-fed swamp sites of Trinkey and Lime Springs, located between Spring Ridge and Premer, southwest of Gunnedah;
- Compared with that available for the Late Pleistocene and early Holocene, evidence for middle to late Holocene Aboriginal occupation of the study region abounds;
- Compared with areas to the north of Gunnedah, very few archaeological investigations have been undertaken in the greater Watermark-Breeza area. Consequently, current understanding of Aboriginal site patterning on a local scale is very limited;
- Existing predictive models for Aboriginal occupation of the greater Watermark-Breeza area have yet to be tested through detailed field investigation;
- Although few in number, the results of previous archaeological investigations in the local area suggest that the site types most likely to be identified within the Project area are stone artefact scatters and isolates, scarred trees, rockshelters and grinding grooves;
- Utilised rockshelters have the potential to retain stratified cultural sequences of considerable antiquity;
- Most sites will occur in close proximity to watercourses, with larger, more complex artefact assemblages associated with higher order streams;
- Local stone artefact assemblages are invariably dominated by flake and flake-non flake debitage. Tools, where identified, typically comprise scrapers and/or backed artefacts. Edge-ground hatchet-heads also occur; and
- Local archaeological data attest to the use of wide range of raw materials for stone artefact production. However, chert/tuff appears to have been the favoured raw material.

6.0 Ethnohistoric Context

6.1 Introduction

Information regarding the ways in which Aboriginal people likely used pre-contact landscapes is available to archaeologists through two primary sources: archaeological (i.e., survey and excavation) data and historical records. **Section 4.0** has summarised the archaeological context of the Project area on both a regional and local scale. This section builds on this foundation by summarising relevant ethnohistoric information for the Project area and environs. As in other parts of Australia, Europeans living in the Central and North West Slopes and Plains of NSW began to document Aboriginal culture from first contact, with explorers, missionaries, settlers and the like recording their encounters with, and observations of, Aboriginal people and their material culture in letters, journals and official reports. Most of these accounts are overtly Eurocentric in tone and content and the veracity of some is, at best, questionable. Nonetheless, taken together, they form an important source of information on Aboriginal lifeways at the time of British colonisation and can, in conjunction with available archaeological data, be used to generate working predictive models of prehistoric Aboriginal land use practices.

6.2 The Kamilaroi

The Project area falls within the traditional country of the Kamilaroi (also spelt Gamilaraay or Kamilaraay) language group (also known as the 'Kamilaroi nation'). Kamilaroi territory extended from near Singleton in the Hunter Valley through to the Warrumbungle Mountains in the west and up through the townships of Quirindi, Tamworth, Narrabri, Walgett, Moree and Mungindi in northern New South Wales, to Nindigully in southwest Queensland. Key published sources for the Kamilaroi language and people include: Austin (1992, 2011), Austin *et al.* (1980), Fison and Howitt (1880), O'Rourke (1995, 1995, 2005), Roworth (2000), Ridley (1866, 1875), Woodgate (1995) and Matthews (1903, 1917). A summary of some key aspects of Kamilaroi society is provided below as a basis for informing the predictive model outlined in **Section 7.0**. Further detail on the post-contact history of the Kamilaroi people of the Central and North West Slopes and Plains is presented in Connect for Effect's (2012) ACHVA report for the Project.

Although difficult to determine with any accuracy, a pre-contact population of c.10, 000 Kamilaroi speakers has been suggested, with a large though unquantified number of dialectal sub-groups (O'Rourke 1997: 126; see also Austin 2011, Austin *et al.* 1980). Aboriginal people of the Mooki, Peel, and Namoi River valleys were all Kamilaroi speakers. The variant of Kamilaroi spoken at Gunnedah and on the western (Coonabarabran) side of the Namoi River is reported to have been known as *Koinbere* (*Guyinbaraay*). O'Rourke (1997: 70) notes that this dialect was not distinguished from Kamilaroi until fairly late, having been first recorded by William Ridley in 1871. Quinn, writing in 1958, claimed that the Gunnedah dialect was called *Wilbraberray*. However, there are no other accounts to corroborate this claim.

Social organisation amongst the Kamilaroi was based on complex system of kinship involving, in descending order: 'moieties', 'sections' and 'clans'. The Kamilaroi 'moieties' were Dhillbay ('dilbi') and Gubadhin ('kupathin') and, as highlighted by O'Rourke (1997: 159), "a human being or any other living thing belonged to one moiety or the other, never to both". Each moiety contained two 'sections' which took masculine forms for men and boys and feminine forms for women and girls (for details see O'Rourke 1997: 160). Membership of a section was derived or inherited from an individual's maternal grandmother. 'Clans' were notional matrilineal descent lines, with representatives spread throughout Kamilaroi territory. Each clan took its name and identity from a totem, typically an animal or plant species. Large numbers of clans are known to have existed. Matthews (1895, 1897), for example, noted 68 different matri-clans among the northern Kamilaroi.

According to O'Rourke (1997), the smallest residential unit within Kamilaroi society was the 'hearth-group', which consisted of up to ten people, typically a man, his wife (or wives) and their dependent children. Larger residential groupings (i.e. 40-60 individuals) termed 'bands' were formed through the regular though temporary aggregation of several 'hearth-groups'. Annual seasonal aggregations of 'bands' resulted in 'communities' of 200 or more people (O'Rourke 1997: 130). Individual communities are estimated to have occupied territories of more than 2,500 km². The presence of up to eight communities at irregular ceremonial events such as Bora (buurra) assemblies has also been noted (O'Rourke 1997: 130).

O'Rourke (1997: 148) has speculated that "summer villages with semi-permanent huts were a common feature of Aboriginal life on the plains of New South Wales". The observations of early explorers such as Cunningham (1825) and Mitchell (1831-32) provide some support this claim. Cunningham, for example, noted 14 huts with bark

floors and conical roofs scattered through thick woodland to the west of Cox's Creek near Boggabri (O'Rourke 1997: 148). Some of the huts were apparently large enough to accommodate up to six people and appeared to have been designed to resist months of inclement weather. Major Mitchell's (1839 cited in O'Rourke 1997) description of the huts in a 'native village' to the south of Moree near the Gwydir River paints a similar picture. According to Mitchell (1839: 76-7, cited in O'Rourke 1997), "[e]ach hut was semi-circular, or circular, the roof conical, and from side a flat roof stood forward like a portico, supported by two sticks". Moreover, "[t]he interior of each looked clean, and to us, passing in the rain, gave some idea, not only of shelter, but even of comfort and happiness" (*ibid*).

The annual subsistence and occupation cycle of Kamilaroi-speaking peoples appears to have been one of summers spent along rivers exploiting a range of terrestrial, avian and aquatic food resources and winters spent in areas away from rivers hunting and/or trapping (predominantly) terrestrial game. Animals known to have been exploited for food include freshwater fish, yabbies, mussels, turtles, 'grubs', possums, kangaroos, wallabies, echidnas, quolls, emus, bustards, plains turkey, water fowl, goannas, frogs, lizards and snakes. Various plant foods were also exploited for food and medicine. Grass-seed, in particular, was a major food source for the Kamilaroi, with seeds ground and cooked in the form of small loaves or cakes (see Mitchell 1848 and Gardner 1846 in O'Rourke 1997: 153-4).

Available ethnohistoric records attest to the manufacture and use of a diverse range of hunting and gathering equipment by Kamilaroi-speaking peoples. Equipment used by both Kamilaroi men and women, O'Rourke (2005: 108) reports, included 'water gourds' made from sewn animal skins and possum skin robes. Yam sticks (used variously as digging sticks, staffs and weapons), seed-grinding mills, needles and plaited bags (both small and large) comprised key items of women's 'gear'. The latter were used for carrying items such as felled game, needles (made from fish, kangaroo and emu bones), tinder, animal sinews, stone knives, and wetted clay balls (used for dressing wounds) (O'Rourke 2005: 109). Key items of men's gear, meanwhile, included wooden spears, shields, boomerangs, waddies and nulla-nullas, as well as stone and metal hatchets, the latter in use as early as 1832 (see Mitchell 1839: 63). Kamilaroi men are reported to have worn wide girdles woven from animal hair.

Spiritual authority in Kamilaroi society was vested in a number of supernatural beings, chief amongst which was Baiame or Baayama, the 'Great Shaper' or 'Thunder-God', variously imagined as a half-human, half-crystal being and/or as a giant in human form (Ridley 1875: 135). For the Kamilaroi, Baiame was the creator and preserver of all things. His subordinate deity - *Turramulan* - acted as a mediator between him and humans. It was *Turramulan*, for example, who presided over the *bora*, which Ridley (1875: 153) defined as "the rite of initiation into the duties and privileges of manhood". Bora grounds generally consisted of two circles, one large and one small, which were surrounded by banks of soil and joined by a pathway. Surrounding trees were carved with representations of animals, men, or Baiame. Figures and designs were drawn in the soil as well (Wilson and McAdam 2000: 14). Used as teaching props for initiates, these figures and representations were not to be viewed by women, children, or uninitiated men. Kamilaroi initiation, Berndt and Berndt (1988: 173-76) note, did not involve circumcision or subincision. However, in some Kamilaroi groups, the front tooth of the initiate was knocked out, and some were subjected to cicatrization, where cuts denoting their totem were made on the body (Greenway 1910b: 217-218). Kamilaroi women had their own ceremonies. However, little is known of these as the earliest recorders of Aboriginal culture were predominantly men who were not allowed to access the women's ceremonies (Bell 1983).

As in other parts of the state and country, the post-contact history of the Kamilaroi of the Central and North West Slopes and Plains is primarily one of dispossession and loss, with traditional hunting and camping grounds rapidly claimed and settled by Europeans, populations decimated by introduced diseases such as tuberculosis and small pox, and state-run missions and reserves established in several areas (O'Rourke 1997: 200-216). However, active resistance and peaceful co-existence are also attested in available records (see O'Rourke 1997).

7.0 Predictive Model

7.1 Introduction

This section provides a working predictive model for the Aboriginal archaeological record of the Project area. Predictions are made concerning the type of sites likely to occur within the Project area, as well as their likely content, distribution and integrity. The validity of all predictions made will be assessed against the results of the archaeological survey conducted.

7.2 Site Types

7.2.1 Sites types likely to occur

A review of the existing environment and archaeological context of the Project area suggests that the following Aboriginal archaeological site types are likely to occur within it:

Isolated Finds

The term 'Isolated find' refers to a single Aboriginal object in a surface context. These typically comprise non-ground chipped stone artefacts. However, the term applies equally to isolated groundstone implements (i.e., hatchet-heads and grindstones), hammerstones and other categories of find (e.g., modified and non-modified pieces of bone and shell).

Artefact Scatters

Artefact scatters are surface manifestations of past Aboriginal activity at a given location. Chipped stone artefacts dominate archaeological assemblages from this site type. However, materials such as complete and fragmentary groundstone implements, charcoal, animal bone, shell and ochre may also occur, as may hearths. Artefact scatters are invariably located in eroded areas and, as such, their presence is often indicative of associated subsurface materials. Although no set correlation exists, the size and complexity of subsurface archaeological assemblages will often match or exceed that found on the ground surface.

Scarred Trees

Scarred trees are trees that have scars present on their trunk that are associated with the production of cultural implements such as coolamons, shields and canoes. Aboriginal scars can, in theory, be distinguished from those created by natural processes (e.g., branch fall, fire damage, lightning, insect activity) on the basis of the following characteristics:

- Aboriginal scars will be more-or-less regular in shape, often with parallel sides and slightly pointed or rounded ends;
- Aboriginal scars will typically terminate above ground level;
- Exposed sapwood on Aboriginal scars will be free of knots or evidence of branches;
- Aboriginal scars may exhibit stone or metal axe marks;
- Aboriginal scars will only occur on native Australian tree species; and
- Aboriginal scars will only occur on trees that are at least 100 years old.

However, natural processes can and frequently do produce scars consistent with one or more of these characteristics, precluding definitive identifications. Determining which scars are likely to be Aboriginal in origin requires the systematic application of the above mentioned set of criteria. The advice of a professional arborist may also help to provide clarity.

An additional complication is posed by European scarred trees. As highlighted by Long (2005), early European settlers frequently used bark as a construction material (i.e., building cladding) and as a raw material for manufacturing processes such as tanning. As with those created by natural processes, distinguishing scars of European origin from Aboriginal scars is not always straightforward, particularly in areas where Aboriginal people are known to have been in possession of metal axes prior to European settlement. Nonetheless, Long (2005) suggests that the following features should help to distinguish European scars:

- European scars will be limited to bark removal scars and resource extraction holes;

- European scars occur on a selected range of tree species (i.e. Stringybark, messmate and box); 3) European bark removal scars are limited to rectangular panels (1-3 m in length);
- Large scars will sometimes be separated by a line of tool marks produced during the splitting of sheets;
- European scars will invariably be located at the base of the tree in question and terminate within 0.5 m of the ground surface;
- Where present, axe marks will typically reflect the use of full size woodman's axe (10-15 cm); and
- The presence of cross-diagonal axe marks, especially at the top of the scar.

Rockshelters with Deposit and/or Art or Potential Archaeological Deposit (PAD)

Rockshelters are a common feature of the elevated sandstone terrain of the Central and North West Slopes and Plains of NSW, having been formed by a combination of wind and water erosion. Rockshelters were often used by Aboriginal people in past, both for shelter and ceremonial activities. Material culture assemblages recovered from the excavation of rockshelter floor deposits in the region attest to the carrying out of a range of activities within them, including food preparation and consumption, stone tool manufacture and maintenance and the production of rock art. The presence of engraved and/or pigment images in some shelters suggests that they may, on occasion, have been sites of spiritual or religious activities such as male initiation ceremonies.

Grinding Grooves

Grinding grooves are oval-shaped depressions found on sandstone outcrops and blocks created via the shaping, sharpening and re-sharpening of stone hatchet-heads and wooden spears. Grinding grooves are most frequently found on flat, low outcrops of fine-grained sandstone in close proximity to water. However, portable sandstone blocks were also used for this task.

7.2.2 Sites types with limited potential to occur

Sites with limited potential to occur within the Project area include:

Stone Arrangements

Stone arrangements are sites created by Aboriginal people through the deliberate placement of stones to achieve a desired shape and/or pattern. Stone arrangements are routinely interpreted as ceremonial sites.

Rock engravings

Aboriginal rock engravings are outlines or filled-in figures created on rock surfaces by pecking, hammering or scraping. Common motif types include animals (including tracks), people, anthropomorphs, weapons and tools.

Stone Quarries

Stone quarries are stone outcrops or deposits that have been exploited by Aboriginal people for the purposes of procuring stone suitable for chipped and/or groundstone manufacture. Quarries will typically exhibit evidence of extraction and/or stone working.

Burials

Aboriginal burials typically consist of concentrations of human bone or teeth in disturbed sub-surface contexts. Surrounding soil matrixes may be stained with charcoal or ochre. Grave goods may also be present. Burials tend to be found in soft soils and sand. However, they are also known to occur in rockshelters and caves.

Post-contact camps

Aboriginal post-contact camps can be defined archaeologically as places in the landscape that retain evidence of Aboriginal occupation or activity post-dating European occupation of the Australian continent. Byrne and Nugent (2004: 56) identify four broad types of Aboriginal post-contact camps:

- *Autonomous camps*: campsites selected primarily on the basis of "the needs and desires of Aboriginal people" (Byrne and Nugent 2004: 56). Camps of this type may, in some instances at least, have been established as means of avoiding white interference and/or surveillance.
- *Farm camps*: camps located on or adjacent to white farms and pastoral stations. Camps of this type, Byrne and Nugent (2004: 56) note, "reflect interdependence between Aboriginal and white people".

- *Pocket camps*: camps independent of any specific white farm or pastoral station. Locations determined by availability of 'pockets' of vacant land within existing mosaic of white settlement (Byrne and Nugent 2004: 56).
- *Fringe camps*: camps located on the edges of, or occasionally inside, white settlements. Typically located on land reserved for other purposes (e.g., water reserves, town commons).

Although difficult to detect archaeologically, due principally to the fact that most of the material culture employed by Aboriginal people within historic post-contact camps was also used by white people, Byrne and Nugent (2004: 62-3) provide a useful list of the various forms of physical evidence that have been identified at such sites. Flaked bottle glass, in particular, has been isolated as a strong diagnostic trait, and it is worth noting that considerable analytical and interpretive attention has been directed towards this material within Australia (e.g., Allen and Jones 1980; Cooper and Bowdler 1998; Harrison 1996, 2000; Niemoller and Guse 1999; Paterson 1999; Ulm et al. 1999).

7.3 Site Distribution, Content and Integrity

Section 6.2 has outlined the types of Aboriginal archaeological sites that have the potential to occur within the Project area. A division has been made between sites that are *likely* to occur and sites that have limited potential to occur on the basis of the data summarised in Sections 4.0, 5.0 and 6.0. Table 12 provides a series of basic predictions concerning the likely distribution, content and integrity of the former within the Project area. These predictions will be evaluated against the results of the archaeological survey detailed in Section 8.0.

Table 12 Key predictions for site distribution, content and integrity

Site type	Distribution	Content	Integrity
Isolated finds	The majority of isolated finds will occur within 200 m of a creekline (1a) The majority of isolated finds will be located on one of two landforms: gently inclined footslopes and level to gently undulating/inclined flood/drainage plains (1b) The majority of isolated finds will occur on low to very low gradient land surfaces (1c)	The majority of isolated finds will comprise chipped stone artefacts. Ground-edge hatchet-heads and grindstones may also occur (2a).	The majority of isolated finds will exhibit fair to poor integrity due to past and/or present land uses (3a)
Open artefact scatters	The majority of scatters will occur within 200 m of a creekline (4a) The majority of scatters will be located on one of two landforms: gently inclined footslopes and level to gently undulating/inclined flood/drainage plains (4b) The majority of isolated finds will occur on low to very low gradient land surfaces (4c)	Chipped stone artefacts will be the most common form of artefact present within identified scatters. Edge-ground hatchet-heads made from local/non-local raw materials may also occur (5a). The majority of scatters will contain less than 15 artefacts. (5b) Scatters with more than 50 artefacts will be rare (5c) Chert/tuff will be the dominant raw material for chipped stone artefact manufacture (5d)	The majority of scatters will exhibit fair to poor integrity due to past and/or present land uses (6a)

Site type	Distribution	Content	Integrity
		Most, if not all of the raw materials utilised for chipped stone artefact manufacture will have been sourced from locally occurring conglomerate deposits (5e) Flake debitage (<i>sensu</i> Andrefsky 2006) will dominate the survey assemblage (5f) Chronologically diagnostic tool types will be restricted to backed artefacts and edge-ground hatchet-heads (5g) Sites found in association with higher order creeklines ($\geq 2^{\text{nd}}$ order) will contain a higher number of artefact types than those found in association with 1st order streams (5h).	
Scarred trees	The majority of scarred trees will occur within 200 m of a creekline (7a) The majority of scarred trees will occur within 200 m of other site types (7b)	The majority of scars will occur on box species (8a) 'Curved' scars (after Long 2005) will be the most common scar form identified. Other forms will be rare (8b)	The majority of scarred trees will exhibit fair to good integrity (9a)
Rockshelter with deposit and/or art or PAD	The majority of rockshelters will be located at the base of sandstone cliff formations (10a) Most rockshelter sites will be located within 200 m of a source of potable water (10b)	Rockshelters with PAD will be most the common form of rockshelter site identified (11a)	The majority of rockshelter sites will exhibit fair to good integrity (12a)
Grinding groove sites	Most grinding groove sites will occur in direct association with established creeklines (13a)	Most grinding groove sites will exhibit more than one groove (14a)	The majority of grinding groove sites will exhibit fair to good integrity (15a)

8.0 Archaeological Survey

8.1 Survey Aims and Objectives

The overarching aim of the survey undertaken was to identify, record and map Aboriginal archaeological materials within the Project area. More specific survey objectives were as follows:

- To relocate and reassess all previously identified AHIMS registered sites within the Project area;
- To sample - by way of targeted pedestrian transects - all landform types within the Project area;
- To achieve a survey coverage that adequately reflects the variable archaeological potential of differing landform types within the Project area;
- To identify areas that, irrespective of the presence or absence of surface archaeology, are likely to contain archaeological deposit; and
- To provide sufficient data to facilitate the development of appropriate management strategy for the known and potential Aboriginal archaeological resource of the Project area.

8.2 Survey strategy

Prior to survey, three key influences on the survey strategy to be adopted were identified. These comprised:

- The demonstrably large size of the Project area at 9,500 ha, precluding a full coverage survey;
- The need to sample all landform types that will potentially be impacted by the Project; and
- The need to concentrate survey on landform types deemed to have higher archaeological potential on the basis of a review of existing archaeological and environmental data.

Accordingly, prior to entering the field, it was decided that a targeted survey strategy involving the division of the Project area into its constituent landform types and a proportional field emphasis on those considered to have higher archaeological potential (i.e., level-to-gently undulating/inclined flood/drainage plains, gently inclined footslopes and level to gently-undulating hills on plateau surfaces) would be adopted. At the same time, in recognition of Ground Surface Visibility (GSV) and access issues, it was decided that decisions concerning the exact number, placement and length of individual transects would be made in the field. Landforms earmarked for more intensive survey as part of the current survey account for 65% of land within the Project area and 61.3% of land within the indicative Disturbance Boundary for the Project (**Table 13 and Table 14**). Justifications for the selection of each targeted landform are summarised in **Table 15**.

Table 13 Breakdown of landforms within the Project area

Landform type	Area (ha)	%
Gently inclined footslopes	3425.5	36.1
Undulating to rolling hills	3124.3	32.9
Level to gently undulating/inclined flood drainage plains	2558.3	26.9
Level to undulating hills on plateau surfaces (inc. sandstone cliff formations)	189.8	2
Moderately to steeply inclined hillslopes	177.6	1.9
Disturbed terrain	17.6	0.2
River banks below floodplain level	6.9	0.1
Total	9,500	100

Table 14 Breakdown of landforms within indicative Disturbance Boundary

Landform type	Area (ha)	%
Undulating to rolling hills	2136	37.9
Gently inclined footslopes	1966.2	34.9
Level to gently undulating flood / drainage plains	1473.6	26.2
Moderately to steeply inclined hillslopes	27.8	0.5
Disturbed terrain	17.6	0.3
Level to undulating hills on plateau surfaces (inc. sandstone cliff formations)	8.9	0.2
Total	5,630	100

Table 15 Justification of survey strategy by landform

Landform type	Justification
Level to gently undulating / inclined flood / drainage plains	Landform includes the proximal flood/drainage plains of Watermark and Native Dog Gullies, landform elements considered to have high Aboriginal archaeological potential. Terrain suitable for sustained/repeated occupation is well-represented. Landform includes parts of Native Dog and Watermark Gullies, both of which are likely to have focal landscape features for Aboriginal people camping within, or passing through, the Project area. Swamp-like terrain associated with Native Dog Gully evident in aerial photographs to the south The Dip Road. Together with the creek itself, this area may have been a focal resource area. Artefact scatters in this landform are predicted to contain substantially higher artefact counts and densities than those located in other landform units. A greater range of raw material and artefact types is also predicted.
Gently inclined footslopes	Landform includes parts of the proximal drainage plain of Watermark Gully and a terrace of the Mooki River, landform elements considered to have high archaeological potential. Terrain suitable for sustained/repeated occupation is well represented. Landform includes parts of Watermark Gully and two other unnamed 2nd order streams. With the probable exception of level to gently undulating/inclined flood/drainage plains, scatter sites in this landform are predicted to contain substantially higher artefact counts and densities than those located in other landform units. A greater range of raw material and artefact types is also predicted.
Level to undulating hills on plateau surfaces (inc. sandstone cliff formations)	Landform incorporates sandstone cliff formations that may contain rockshelters suitable for occupation. Note that these formations occur at the interface between this landform and that designated as 'moderately to steeply inclined hillslopes'.

8.3 Field Team and Methods

Archaeological survey of the Project area was undertaken in two blocks between March 2011 and April 2012. The first and primary block of survey was conducted over a period of 25 days between March and May 2011. The second block was conducted over a period of six days between March and April 2012. All survey was completed by a combined field team of two AECOM archaeologists (Andrew McLaren and Rochelle Coxon) and rostered RAP representatives. For the most part, survey was conducted on foot, with a total of 59 pedestrian transects completed over the course of the survey. A limited number (n = 17) of vehicle transects was also completed in

response to poor GSV and occupational health and safety considerations. Pedestrian survey involved walking a series of linear transects across the Project area, with individual transect widths dependent on the number of Aboriginal stakeholder representatives present each day (range: 3-26) as well as localised topographic conditions.

The location of each transect completed during survey was recorded using a handheld differential GPS. Additional transect data (e.g., GSV, integrity, soils and vegetation) was recorded separately in the form of descriptive notes and photographs. All Aboriginal archaeological sites identified during survey were recorded to a standard comparable to that required by the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010a). For each site located or re-visited, individual artefact locations were captured by differential GPS. Associated site data (e.g., location, type and content) was documented using AECOM's standard open site recording form. Attribute data recorded for identified chipped and groundstone artefacts varied by technological type, with additional attributes recorded for complete flakes, cores and implements. However, as a minimum, recorded attributes comprised raw material, technological type and maximum linear dimension. Photographic records of each site were also taken.

8.4 Site Definition

The definition, in spatial terms, of Aboriginal archaeological sites is a topic of considerable importance to modern cultural heritage management and one that has generated significant discussion in Australian archaeology (e.g., Doleman 2008; Holdaway 1993; Holdaway *et al.* 2000a, 2000b; MacDonald and Davidson 1998; McNiven 1992; Robins 1997; Shiner 2008). Aboriginal archaeological sites, of course, can be broadly defined as places in the landscape that retain physical evidence of past Aboriginal activity. Naturally, such evidence can assume a range of forms, depending on the nature of the activity or activities that produced it, and can vary dramatically in quantity and extent. Some Aboriginal archaeological sites are, by their very nature, easy to define in spatial terms. Scarred trees and rockshelters, for example, can be readily delineated from their surrounding landscapes. Difficulties arise, however, for sites whose present-day physical extent is, more often than not, a product of natural geomorphic processes, as opposed to the actions of Aboriginal people in the past.

Although relevant to a variety of site types, geomorphic processes such as soil erosion and deposition are of particular relevance to identification and definition of surface scatters of stone artefacts, commonly referred to as 'artefact scatters'. It is, for example, now widely accepted that the visibility and preservation of such sites are, to a significant extent, products of contemporary, historic and prehistoric geomorphic processes which have, and continue to act variously to exposure, obscure and destroy them (Dean Jones and Mitchell 1993; Fanning and Holdaway 2004; Fanning *et al.* 2009; Holdaway *et al.* 2000). As demonstrated by countless large-scale excavations projects in southeastern Australia, surface artefacts almost invariably represent only a fraction of the total number of artefacts present within these sites, with the majority occurring in subsurface contexts. Artefact exposure, unsurprisingly, is highest on erosional surfaces and lowest on depositional ones. At the same time, in many areas, surface artefacts have been shown to form part of more-or-less continuous subsurface distributions of artefacts, albeit with highly variable artefact densities linked to environmental variables such as stream order, landform, slope and distance to water (e.g., White and McDonald 2011).

Such evidence poses a significant analytical and interpretive dilemma. Defining sites on the basis of surface artefacts alone is clearly problematic, with modern site boundaries invariably reflecting the size and distribution of surface exposures as opposed to the actions of Aboriginal people in the past. Nonetheless, for pragmatic reasons, this is the most commonly used approach, with 'distance' and 'density-based' definitions dominating. In NSW, two of the most commonly employed distance-definitions are '*two artefacts within 50m of each other*' and '*two artefacts within 100 m of each other*'. Neither definition is derived from a particular theoretical approach or body of empirical research - they are simply pragmatic devices for site definition. Definitions based on artefact density also vary in their particulars. However, one of most commonly used definitions is that which isolates, within an arbitrarily defined 'background scatter' of one artefact per 100 m², higher density clusters that are subsequently defined as 'sites'.

Non-site archaeology offers an alternative approach to distance and density-based site definitions (Ebert 1992; Foley 1981), with individual artefacts, not sites, treated as the basic units of analysis (for published Australian examples see Holdaway *et al.* 2000a; McNiven 1992; Robins 1997; Shiner 2008). Whilst recognising the major interpretive potential of non-site approaches with respect to data analysis and discussion, their implementation in the context of cultural heritage management studies is difficult (but see MacDonald and Davidson 1998; Kuskie 2000 for successful examples of this approach). Here, the identification of 'sites' is required for reasons of recording (i.e., their entry into site databases such as AHIMS) as well as ease of relocation, protection, and

ongoing management. The identification of spatially-discrete 'sites', therefore, offers the most pragmatic approach to Aboriginal heritage management in impact assessment contexts.

Surface site definition in the current investigation has been based on the 100 m convention cited above. Subsurface archaeological potential, meanwhile, is addressed by the concept of 'archaeological sensitivity', with three levels of sensitivity recognised: nil, low and high (**Table 16**). Akin to the concept of Potential Archaeological Deposit (PAD), archaeologically sensitive areas can be *broadly* defined as those that retain potential for subsurface archaeological deposit. For the current investigation, levels of archaeological sensitivity across the Project area have been assessed on the basis of observed archaeology (i.e., its distribution and character), levels of past land disturbance and the predicted complexity of deposits within each category.

Table 16 Archaeological Sensitivity Rating Scheme

Rating	Definition
Nil	Land with no potential for subsurface archaeological deposit(s) due to past ground disturbance(s).
Low	Subsurface archaeological deposit(s) may be present. Relative to areas of high sensitivity, lower artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.
High	Subsurface archaeological deposit(s) may be present. Relative to areas of low sensitivity, higher artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.

8.5 Results

8.5.1 Survey Coverage and Effective Coverage

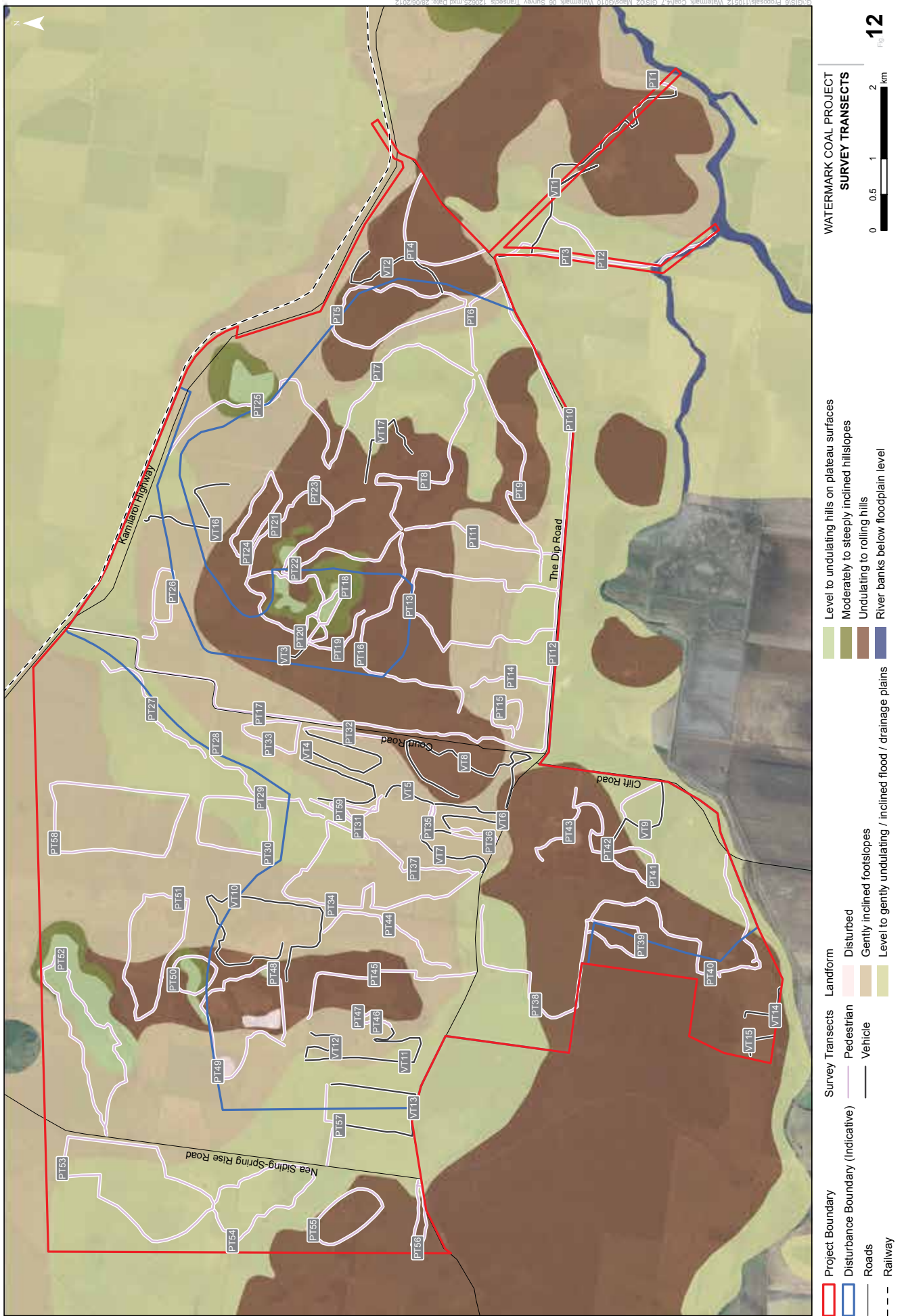
This section describes, as a basis for assessing its effectiveness, coverage data for the survey undertaken. A distinction is drawn between total survey coverage and effective coverage, with calculations for both variables based on *pedestrian transect data only*. Coverage data generated in the course of vehicle transects are not, as stipulated in the *Code of Practice*, deemed suitable for survey effectiveness calculations.

As shown on **Figure 12**, a total of 59 pedestrian transects were completed over the course of the survey, with individual transects ranging from 0.3 to 7.7 km in length (mean = 2.8 km). Employing, for the purposes of this analysis, a standard 80 m transect width⁴, it can be stated that a *total survey coverage* of approximately 1304 ha was achieved. Excluding those portions of transects falling outside of the Project area provides a revised *total survey coverage* of 1232.6 ha, representing around 12.9% of the Project area. A breakdown of Project area survey coverage by landform (**Table 17**) shows that all landforms present within the Project area were subject to survey. However, as per the survey strategy developed for the Project (see **Section 8.2** above), emphasis was placed on landforms deemed to have higher archaeological potential (i.e., level-to-gently undulating / inclined flood / drainage plains, gently inclined footslopes and level to gently-undulating hills on plateau surfaces). Coverage of these landforms equates to 60.6% of the total estimated survey coverage achieved during survey⁵.

Effective coverage is an estimate of the area in which archaeological materials are 'detectable'. Calculation of the *total effective coverage* obtained for the current survey indicates that approximately 101.4 ha of land within the Project area was effectively surveyed for Aboriginal archaeological materials. This equates to around 1.1% of the total Project area, 1.8% of land within the Project's indicative Disturbance Boundary and 8.2% of the total survey coverage achieved within the Project area. Tabulated estimates of the effective coverage achieved for each of the 59 pedestrian transects completed during survey are provided in **Table B1** in **Appendix B**. As indicated, levels of effective coverage during survey were generally very low, with the majority (n = 45, 76.2%) of transects exhibiting values under 10% (range: 0-81%). Visibility along most transects was very poor due to dense vegetation cover, with areas of higher visibility restricted to exposures associated with fluvial erosion (primarily sheet but also rill and gully), stock movement, cultivation and the construction of features such as contour banks, dams, vehicle tracks and farm buildings.

⁴ All but one transect incorporated a minimum of eight individuals.

⁵ It should be stressed that this is a *minimum value only* given the exclusion of vehicle transects from coverage calculations.



Consideration of levels of effective survey coverage by landform type (**Table 18**) indicates that effective coverage was highest on gently inclined footslopes (37.9 ha, 37.4%) followed closely by level to gently undulating/inclined flood/drainage plains (37.7 ha, 37.2%) and then undulating to rolling hills (23.3 ha, 23%), level to undulating hills on plateau surfaces (1 ha, 1%), riverbanks below floodplain level (0.8 ha, 0.8%), moderately to steeply inclined hillslopes (0.7 ha, 0.7%) and disturbed areas (0.1 ha, 0.1%). Landform-based site counts are consistent with these data.

Effective coverage data for the current survey suggest that limited surface visibility was a constraint in assessing the surface Aboriginal archaeological record of the Project area. Nonetheless, observations made during survey suggest that the survey did result in a reasonably high sample of exposed ground within the Project area. Combined with the fact that poor GSV is of less relevance to the identification of 'obtrusive' site types such as rockshelters, grinding grooves and scarred trees, this observation provides support for the suggestion that the results of the current survey offer a satisfactory basis from which to assess the known and potential Aboriginal archaeological resource of the Project area, determine likely impacts and formulate appropriate management and mitigation options.

Table 17 Survey coverage by landform

Landform type	Area (ha)	%
Undulating to rolling hills	452	36.7
Gently inclined footslopes	383.1	31.1
Level to gently undulating / inclined flood / drainage plains	324.5	26.3
Level to undulating hills on plateau surfaces (inc. sandstone cliff formations)	39.4	3.2
Moderately to steeply inclined hillslopes	28.4	2.3
River banks below floodplain level	3.3	0.3
Disturbed	1.9	0.2
Total	1232.6	100

Table 18 Effective coverage by landform and site counts

Landform type	Area (ha)	%	Number of sites	%
Gently inclined footslopes	37.9	37.4	19 ⁶	36.5
Level to gently undulating / inclined flood / drainage plains	37.7	37.2	19 ⁷	36.5
Undulating to rolling hills	23.3	23	13	25
Level to undulating hills on plateau surfaces (inc. sandstone cliff formations)	1	1	1	1.9
River banks below floodplain level	0.8	0.8	0	0
Moderately to steeply inclined hillslopes	0.7	0.7	0	0
Disturbed terrain	0.1	0.1	0	0
Total	101.4	100	52⁸	100

⁶ Includes WM-AS5-11 which cross-cuts gently inclined footslopes and undulating to rolling hills.

⁷ Includes WM-AS9-11 which cross-cuts level to gently undulating/inclined flood / drainage plains and gently inclined footslopes.

⁸ Excluded from this total are AHIMS registered artefact scatters 29-1-0154, 29-1-0155, 29-1-0157, 29-1-0158 and 29-1-0159. Scatters 29-1-0155 and 29-1-0157 have been re-assessed as natural stone occurrences. The remaining three scatters could not be re-located during survey.

8.5.2 Aboriginal Archaeological Sites

A total of 52 Aboriginal archaeological sites, comprising 18 artefact scatters, 23 isolated finds, three grinding groove sites and eight potential Aboriginal scarred trees were recorded during the current survey. All but one of these sites (i.e., AHIMS registered open artefact scatter 29-1-0156) are new sites and will be registered on AHIMS.

Excluded from the total cited above are five out of six AHIMS registered sites within the Project area (29-1-0154, 29-1-0155, 29-1-0157, 29-1-0158 and 29-1-0159). Three of these sites (29-1-0154, 29-1-0158 and 29-1-0159) could not be relocated during survey. The remaining two sites (29-1-0157 and 29-1-0155) were re-assessed in the field as natural stone occurrences (i.e., non-cultural sites). Scar bearing trees (n = 6) identified during survey but subsequently assessed as being likely non-Aboriginal in origin by a professional arborist are likewise excluded from further discussion here (but see **Appendix D** for descriptions).

Site descriptions for all previously and newly identified Aboriginal sites within and directly adjacent to the Project area (n = 57) are provided in **Appendix C**. Summary information on recorded open artefact sites (i.e., artefact scatters and isolated finds), scarred trees and grinding groove sites is presented in **Table 19, Table 20 and Table 21** below. Site locations are marked on **Figure 13**. As shown, all but one site (WM-ST2-11) is located within the Project area. WM-ST2-11 is located within 70 m of the Project Boundary.

8.5.3 Artefact Scatters and Isolated Finds

A total of 41 open artefact sites (i.e., artefact scatters and isolated finds) were recorded during the current survey, all but one of which are new sites and will be registered on AHIMS (**Table 19**). Together, these sites contained a total of 675 stone artefacts.

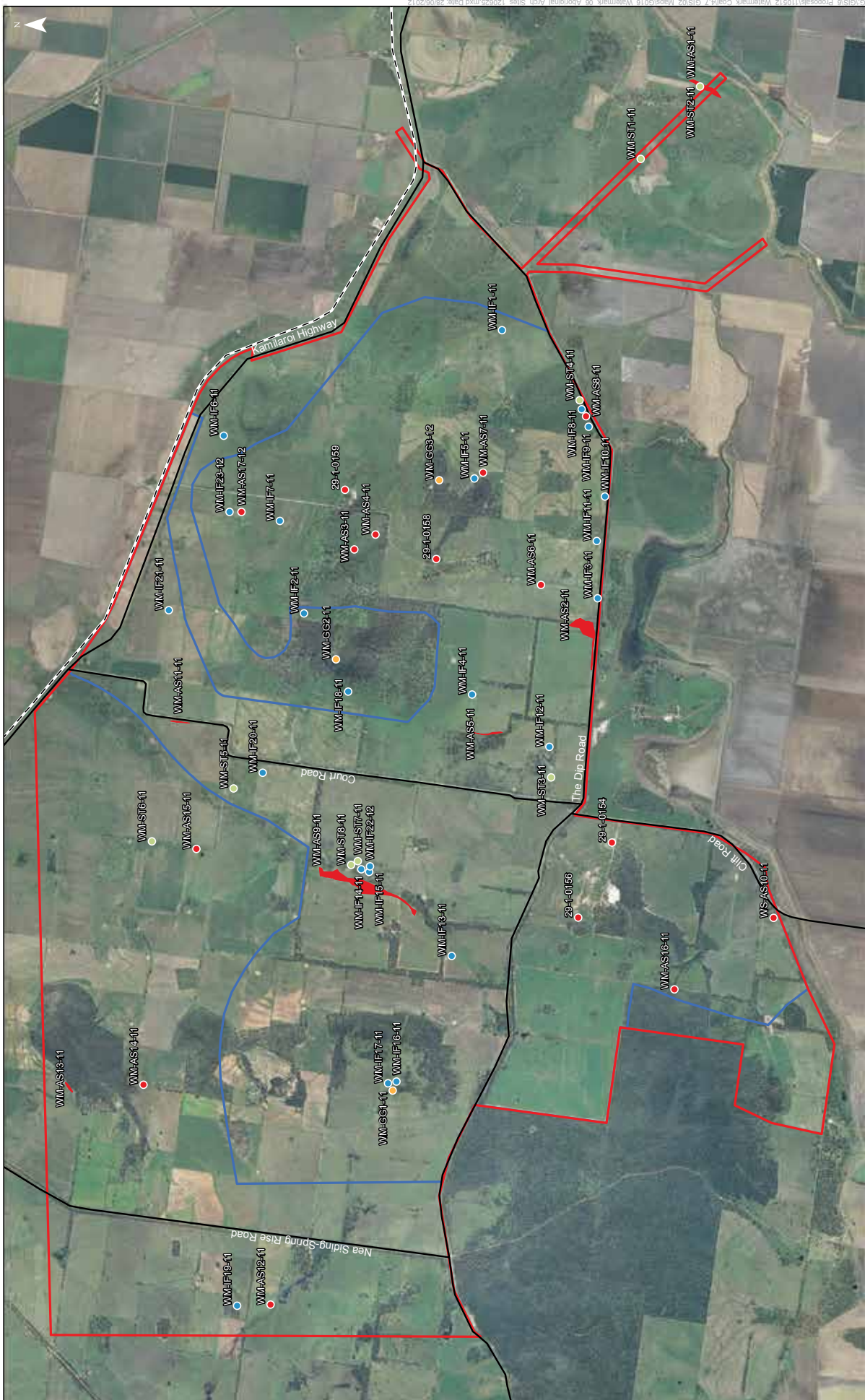
Of the six previously recorded open artefact sites within the Project area, three (29-1-0155, 29-1-0156, 29-1-0157) were re-located during survey. The first comprised artefact scatter 'Bacon Hill 3' (29-1-0156). The site card for the 29-1-0156 reports two 'rotated' quartz cores within a 5 m² erosion scald. Neither core could be re-located during the current survey. However, a previously unrecorded chert/tuff flake was identified within the fenced boundary of the site. The remaining two sites (29-1-0155 and 29-1-0157) were re-assessed in the field as natural stone occurrences (but see **Appendix C** for site descriptions). None of the stones identified within these sites as artefacts exhibit definitive or probable evidence of human manufacture / use. Accordingly, neither is considered to be an Aboriginal archaeological site.

Scatters (n = 18) and isolated artefacts (n = 23) are more-or-less equally represented within the Project area, accounting for 43.9% and 56.1% of the total respectively. Artefact counts for confirmed scatter sites (n = 18) range from two to 358, with a mean count of 36.3. Most (n = 12, 70.6%) scatters contain less than ten artefacts. Scatters containing more than 100 artefacts are rare, with only two examples (WM-AS1-11 and WM-AS9-11) identified during survey. As indicated in **Table 19**, the maximum number of artefacts recorded within any one scatter was 358 at WM-AS9-11. Mean artefact densities range from 0.001 to 2 artefacts per m², with an *overall* mean density of 0.09 artefacts per m². The maximum density of artefacts recorded during survey was five artefacts per m² at WM-AS9-11.

Open artefact sites identified during the current survey occupy a total surface area of approximately 183,456 m², representing around 0.2% of the total Project area. Scatter areas range from one to 98,163 m² (mean = 10,190 m²; Stdev = 25,182 m²). All isolated finds have been assigned a nominal site area of 1m².

As in other contexts (e.g., Kuskie 2000; White and McDonald 2010), recorded open artefact sites within the Project area are best conceived of as opportunistic surface manifestations of a more-or-less continuous subsurface distribution of artefacts across it, albeit with highly variable densities linked to environmental factors such as landform, distance to water, stream order and slope. Sites are widely distributed across the Project area (**Figure 13**) and occur exclusively in contexts consistent with their exposure from subsurface contexts (e.g., erosion scalds, contour banks, dam banks and vehicle tracks). Importantly, recorded artefacts likely represent only a fraction of the total stone artefact resource present within the Project area, with most artefacts currently obscured by vegetation and/or soil.

Further discussion on the composition of the stone artefact assemblage (n = 675) recorded during survey is provided in **Section 8.5.7** below



WATERMARK COAL PROJECT
ABORIGINAL ARCHAEOLOGICAL SITES

0 0.5 1 2 km

13

Table 19 Open artefact sites: summary information

Site name	Type	Coordinates (MGA)		Site area (m²)	#Artefacts	Density (mean, m²)	Density (max, m²)	Environmental Context				
		Easting	Northing					Landform	Surface Geology	Distance to Water (m)	Slope (%)	Vegetation community
WM-IF1-11	Isolated find	253690	6539199	1	1	1	1	1	Pub	345	1-3	1
WM-IF2-11	Isolated find	249976	6541792	1	1	1	1	3	Pub	125	3-10	1
WM-IF3-11	Isolated find	250177	6537945	1	1	1	1	2	Pub	1,380	<1	1
WM-IF4-11	Isolated find	248916	6539590	1	1	1	1	3	Pub	690	3-10	1
WM-IF5-11	Isolated find	251746	6539560	1	1	1	1	3	Pub	215	3-10	1
WM-IF6-11	Isolated find	252304	6542845	1	1	1	1	4	Pub	180	10-32	1
WM-IF7-11	Isolated find	251191	6542108	1	1	1	1	3	Pub	245	3-10	1
WM-IF8-11	Isolated find	252654	6538154	1	1	1	1	2	Qa	905	<1	1
WM-IF9-11	Isolated find	252425	6538061	1	1	1	1	2	Qa	905	<1	1
WM-IF10-11	Isolated find	251509	6537848	1	1	1	1	2	Pub	1,050	1-3	1
WM-IF11-11	Isolated find	250928	6537956	1	1	1	1	2	Pub	1,120	3-10	1
WM-IF12-11	Isolated find	248229	6538576	1	1	1	1	1	Pub	325	1-3	1
WM-IF13-11	Isolated find	245488	6539856	1	1	1	1	1	Qa	8	<1	1
WM-IF14-11	Isolated find	246623	6541043	1	1	1	1	2	Qa	95	1-3	1
WM-IF15-11	Isolated find	246591	6540937	1	1	1	1	2	Qa	95	1-3	1
WM-IF16-11	Isolated find	243843	6540580	1	1	1	1	1	Pub	240	3-10	2
WM-IF17-11	Isolated find	243822	6540693	1	1	1	1	1	Pub	125	1-3	2
WM-IF18-11	Isolated find	248953	6541212	1	1	1	1	3	Pub	405	10-32	1
WM-IF19-11	Isolated find	240905	6542669	1	1	1	1	2	Qa	270	1-3	1
WM-IF20-11	Isolated find	247891	6542332	1	1	1	1	1	Qa	285	1-3	1
WM-IF21-11	Isolated find	250018	6543563	1	1	1	1	1	Qa	200	1-3	1
WM-IF22-12	Isolated find	246662	6540929	1	1	1	1	1	Qa	165	1-3	1
WM-IF23-12	Isolated find	251307	6542767	1	1	1	1	1	Qa	20	1-3	1
WM-AS1-11	Scatter	256859	6536525	20,795	105	0.005	3	1	Qa	115	1-10	1

Site name	Type	Coordinates (MGA)		Site area (m ²)	#Artefacts	Density (mean, m ²)	Density (max, m ²)	Landform	Environmental Context			
		Easting	Northing						Surface Geology	Distance to Water (m)	Slope (%)	Vegetation community
WM-AS2-11	Scatter	249752	6538102	50,344	70	0.001	2	2	Pub	455	<1-3	1
WM-AS3-11	Scatter	250817	6541132	1	2	2	2	3	Pub	310	3-10	1
WM-AS4-11	Scatter	251011	6540853	42	2	0.048	1	3	Pub	380	3-10	1
WM-AS5-11	Scatter	248403	6539344	3,707	60	0.016	3	1 & 3	Pub	60	1-10	1
WM-AS6-11	Scatter	250349	6538686	95	2	0.021	1	1	Pub	1,150	1-3	1
WM-AS7-11	Scatter	251823	6539447	155	5	0.032	2	2	Pub	235	3-10	1
WM-AS8-11	Scatter	252559	6538098	133	2	0.015	1	2	Qa	905	<1	1
WM-AS9-11	Scatter	246353	6540893	98,163	358	0.003	5	1 & 2	Qa	10	<1	1
WM-AS10-11	Scatter	245987	6535638	194	11	0.057	2	2	Qa	840	1-3	1
WM-AS11-11	Scatter	248554	6543437	1,645	13	0.008	1	1	Qa	50	1-3	1
WM-AS12-11	Scatter	240919	6542229	118	3	0.025	1	2	Qa	50	<1	1
WM-AS13-11	Scatter	243766	6544874	3,254	4	0.001	1	1	Pub	15	10-32	1
WM-AS14-11	Scatter	243800	6543896	267	4	0.015	1	3	Pub	90	3-10	1
WM-AS15-11	Scatter	246891	6543204	10	2	0.2	1	2	Qa	95	1-3	1
WM-AS16-11	Scatter	245053	6536937	17	2	0.116	1	3	Rn	20	10-32	2
WM-AS17-12	Scatter	251307	6542612	4,483	6	0.001	1	1	Qa	0	1-3	1
Bacon Hill 3 (29-1-0156)	Scatter	245993	6538200	5	3 reported. 1 relocated.	0.6	na	3	Rn	330	3-10	1

Table 19 Key:

Landform: 1: Gently inclined footslopes; 2: Level to gently undulating/inclined flood/drainage plains; 3: Undulating to rolling hills; 4: Moderately to steeply inclined hillslope

Vegetation Community: 1: Low diversity grassland and exotic pasture; 2: Derived native grassland

8.5.4 Potential Scarred Trees

Fourteen scar-bearing trees were identified during survey. Eight have been classified as potential Aboriginal scarred trees (**Table 20**) and are the subject of this section. The remaining six trees have been assessed as being likely non-Aboriginal in origin (n = 6) by a professional arborist and are not considered here.

All potential Aboriginal scarred trees within the Project area comprise mature native Australian trees. All but one are living and standing. Species include White Box (*Eucalyptus albens*, n = 2), Bimble Box (*Eucalyptus populnea*, n = 4), Blakleys Red Gum (*Eucalyptus blakelyi*, n = 1) and unidentified Eucalypt (n = 1). Recorded scar forms include curved (pre-form) (n = 4), resource extraction (n = 1) and bark slab (sheet) (n = 3). Axe marks have been identified on four trees: WM-ST2-11, WM-ST4-11, WM-ST7-11 and WM-ST8-11. Those on WM-ST2-11, WM-ST7-11 and WM-ST8-11 can be confidently ascribed to a metal axe. Those on WM-ST4-11 are comparatively poorly defined, precluding definitive comment. Chainsaw marks are also present in one scar (i.e., WM-ST2-11).

Following Long (2005: 32), patterned metal axe marks on WM-ST7-11 and WM-ST8-11 are consistent with a European origin for the scars on these trees. Nonetheless, given that Aboriginal people are known to have worked as station hands on local properties throughout the 20th century (J.Delaney-John, pers. comm. May 2012), it is possible that they were, in fact, created by an Aboriginal person or persons. The proximity of the trees to a major Aboriginal camp site (WM-AS9-11) is also of note in this respect as is the fact that Aboriginal people living in the North West Slopes and Plains of NSW are known to have been in possession of metal axes as early as 1832 (see Mitchell 1839: 63). Accordingly, a precautionary approach is adopted here.

The presence of a potential resource extraction scar (WM-ST2-11) within the Project area is of particular interest given the rarity of these features on a local and regional scale. Following Long (2005), the scar on WM-ST2-11 has been identified as a possible 'possum hole'. Possum holes comprise holes cut into hollow trunks or limbs for the purposes of extracting game or honey (Long 2005: 27). Metal axe and chainsaw marks within the WM-ST2-11 scar are indicative of a relatively recent date for this feature (i.e., mid-to-late 20th century).

8.5.5 Grinding Groove Sites

Three grinding groove sites in open contexts have been identified within the Project area (**Table 21**). All are new sites and will be registered on AHIMS.

WM-GG1-11 consists of a large grinding groove site in a lower slope context on the property 'Molonga', which is located within the Western Mining Area. The site, which covers an area of around 5,000 m², is located approximately 550 m southeast of the main homestead. Grinding grooves within WM-GG1-11 occur on exposed sandstone bedrock and blocks (i.e. 'floaters'), with the latter concentrated in the northern portion of the site. Two main groups of grooves are apparent, with a few isolated examples occurring in-between. Both groups are associated with ephemeral, unnamed drainage lines. The southern group comprises a minimum of 50 (max 60) grooves on a non-continuous linear outcrop of sandstone bordered, to the south, by a dense stand of white cypress pine. The outcrop is located in a shallow, SW-NE trending drainage depression. Recorded grooves in this cluster are concentrated at the south-western end of the outcrop, with over 40 grooves in a c.25 m² area. This patterning is likely a product of natural water flow and pooling, with slight but noticeable depression in the sandstone in this area. The northern cluster is located approximately 85 m to the north of the southern outcrop in an area of heavily fractured sandstone bedrock. A total of 14 potential grooves were recorded in this cluster, with most occurring on the western edge of a slight but noticeable drainage depression. Natural furrowing is evident in this area and it possible that some of the grooves recorded are natural in origin. Groove definition across WM-GG1-11 is highly variable. However, the majority are well-defined. Recorded grooves are indicative of the sharpening of stone hatchet-heads and wooden spears.

WM-GG2-11 comprises an isolated grinding groove on a block of exposed sandstone bedrock on the north-western edge of Mt Watermark, approximately 15 to 20 m east of the mountain's western cliff face. Groove morphology is consistent with the sharpening of a stone hatchet-head. The site is located outside of the indicative Disturbance Boundary for the Project. WM-GG1-11 has a panoramic view of lands to the west and north-west.

WM-GG3-12 comprises a grinding groove site on an exposed bench of sandstone bedrock (c. 35 m²) on the property 'Cloveneden', which is located within the Eastern Mining Area. The site is located on a gently inclined vegetated upper slope approximately 130 m north-east of an unnamed 1st order stream. Twenty grooves are present on the bench in question, with all but two clustered in an area of around 3 m². As at WM-GG1-11, this patterning likely reflects natural water flow across the exposed bedrock. Pre-existing grooves notwithstanding, no depressions or holes capable of holding water for an extended period are present on-site. Most grooves are well-defined and all appear consistent with the sharpening of stone hatchet-heads.

Table 20 Potential Aboriginal scarred trees: summary information

Site name	Location		Species	Status	Height	Age (yrs)	Scar location	Size (LxW in m)	Height above ground (m)	Orientation	Scar Condition	Scar Form	Axe marks (yn)
	MGAE	MGAN											
WM-ST1-11	255931	6537381	Eucalypt sp.	Dead (fallen)	na	100-200+	Trunk	1.34 x .28	1.1 (estimated)	na	Poor	Curved	No
WM-ST2-11	256882	6536604	Eucalyptus populnea	Living (Standing)	14 m	100-200	Trunk	0.55 x 0.28	2.2	NW	Good	Extraction	Yes (metal). Chainsaw marks also present.
WM-ST3-11	247829	6538553	Eucalyptus albens	Living (Standing)	24 m	100-200+	Trunk	2.35 x 0.29	0.8	NE	Fair	Curved	2 possible
WM-ST4-11	252771	6538179	Eucalyptus blakelyi	Living (Standing)	23 m	100-150	Trunk	1.52 x 0.7	0.28	SW	Good	Bark slab	No
WM-ST5-11	247685	6542715	Eucalyptus albens	Living (Standing)	20 m	100-200	Trunk	1.38 x 0.19	0.6	NNW	Good	Curved	No
WM-ST6-11	246990	6543787	Eucalyptus populnea	Living (Standing)	15 m	100-200	Trunk	1.52 x 0.4	0.5	WSW	Good	Curved	No
WM-ST7-11	246732	6541087	Eucalyptus populnea	Living (Standing)	na	100-200	Trunk	1.88 x 0.8	na	E	Good	Bark slab	Yes (patterned metal)
WM-ST8-11	246683	6541177	Eucalyptus populnea	Living (Standing)	na	100-200	Trunk	Scar 1: 1.73 x 0.36 Scar 2: 1.89 x 0.5	Scar 1: 0.55 Scar 2: na	Scar 1: E Scar 2: W	Good	Bark slab	Yes (patterned metal)

Table 21 Hatchet grinding groove sites: summary information

Site name	Location		Site Area (m ²)	Number of grooves	Environmental Context				
	MGAE	MGAN			Landform	Surface Geology	Distance to water (m)	Slope (%)	Vegetation community
WM-GG1-11	243723	6540630	5,000 (approx)	60-70	1	Pub	0	1-3	1
WM-GG2-11	249376	6541372	1	1	2	Pub	325	10-32	2
WM-GG3-12	251721	6540020	35	20	3	Pub	130	3-10	1

Table 21 Key:

Landform: 1: Gently inclined footslope; 2: Level to undulating hills on plateau surfaces; 3: undulating to rolling hills

Vegetation Community: 1: Whitebox Grassy Woodland; 2: Regenerating Blakely's Red Gum Grassy Woodland

Surface geology: Pub: Late Permian Black Jack Group

8.5.6 Spatial Distribution

The distribution of Aboriginal archaeological materials within any given landscape can be assessed from two analytical positions. The first, known as a *site-based approach*, utilises the 'site' as the basic unit of analysis whilst the second, referred to as a *non-site approach*, utilises the individual artefact as the unit of analysis.

A combination of both approaches is employed here as a means of assessing the relationship of recorded sites and artefacts to the environmental variables of distance to water, stream order, landform, slope, geology and soils. Combining individual stone artefact locations (n = 675) with newly recorded scarred tree and grinding groove site locations (n = 11) provides a total of 686 discrete points for spatial analysis. AHIMS registered open artefact sites 29-1-0154, 29-1-0155, 29-1-0157, 29-1-0158, 29-1-0159 are not included in this analysis.

8.5.6.1 Distance To and Type of Watercourse

The proximity and permanency of potable water sources are routinely cited as key determinants of Aboriginal settlement patterns. Accordingly, **Table 22** tabulates the relationship of these variables to recorded artefact/site locations within the Project area. In terms of distance to water, as indicated, the majority (80.9%, n = 556) of artefacts and sites are located within 200 m of a watercourse. Differences in the relative frequency of site/artefact counts between distances classes within 200 m of watercourses are, on the whole, relatively minor. However, a slight trend towards higher artefact/site counts between 151 and 200 m of watercourses is apparent. A significant decrease in the relative frequency of artefacts/sites between the 151-200 m and 201-250 m classes can be contrasted with a notable increase between the 201-250 m and 251 m+ classes. Distances from watercourses in areas over 251 m range from 266 m to 1.4 km, with a mean distance of 751.1 m (Std dev = 264.8).

Most artefacts and sites (67.5%, n = 466) are associated with higher order (i.e., 2nd and 3rd order) streams, with 1st order associations accounting for less than 35% of the total. For 2nd order streams, examination of the relationship between stream order and distance to water indicates a slight trend towards higher artefact/site counts between 101 and 200 m of streams of this order. However, consideration of the distribution of erosion scalds along Watermark Gully suggests that this patterning is likely more apparent than real. For 3rd order streams, two of which are represented in the Project area, artefact/site counts are highest between 151 and 200 m, with significantly lower numbers in adjacent distance classes. In the case of the Mooki River, this patterning can be attributed to localised topographic conditions, with land closer to the river comprising active floodplain that, compared with adjoining landform elements, is unlikely to have witnessed sustained or intensive occupation. No artefacts were recorded within 50 m of streams of this order. First order streams contrast markedly with higher order streams in that the majority of artefacts and sites (51.8%) are located more than 200 m from streams of this order. However, this patterning is likely a product of the number of distance intervals used for analysis.

Although complicated by archaeological sampling and environmental biases, available data support the suggestion that the availability of potable water exerted a strong influence on the way in which Aboriginal people utilised the Project area. As demonstrated in other contexts (e.g., Kuskie 2000; Kuskie and Clarke 2004; White and McDonald 2010), the permanency of freshwater sources appears to have been particularly important, with reliable water sources the focus of repeated activity through time. Within the Project area, these likely comprised Watermark Gully, Native Dog Gully and the Mooki River. However, changes in flows rate and drainage patterns over time preclude more detailed comment.

Table 22 Relationship between watercourse distance/stream order and artefact/site counts

Distance to water (m)	Stream Order			Total	%
	1 st	2 nd	3 rd		
0-50	9	119	0	128	18.6
51-100	55	47	2	104	15.1
101-150	28	91	20	139	20.2
151-200	14	100	71	185	26.9
201-250	7	1	13	21	3.1
250+	107	2	0	109	16
Total	220	360	106	686	100

8.5.6.2 Landform

Examination of the distribution of recorded artefacts and sites in relation to landform (**Figure 14a**) indicates a strong trend towards higher artefact/site counts on gently inclined footslopes ($n = 332$, 48.4%) and level to gently undulating/inclined flood/drainage plains (333, $n = 48.5\%$), with 96.9% of all artefacts and sites occurring within these two landforms. Whilst acknowledging the bias introduced by higher *overall* levels of effective coverage within these landforms (**Section 8.5.1**), reference to the results of previous archaeological investigations in the Central and North West Slopes and Plains of NSW suggests that this patterning is real and not simply apparent. Sites and artefacts are comparatively poorly represented on undulating to rolling hills ($n = 20$, 3.9%) and level to undulating hills on plateau surfaces ($n = 1$, 0.2%). No artefacts or sites were identified on moderately to steeply inclined hillslopes, river banks below floodplain level and disturbed areas.

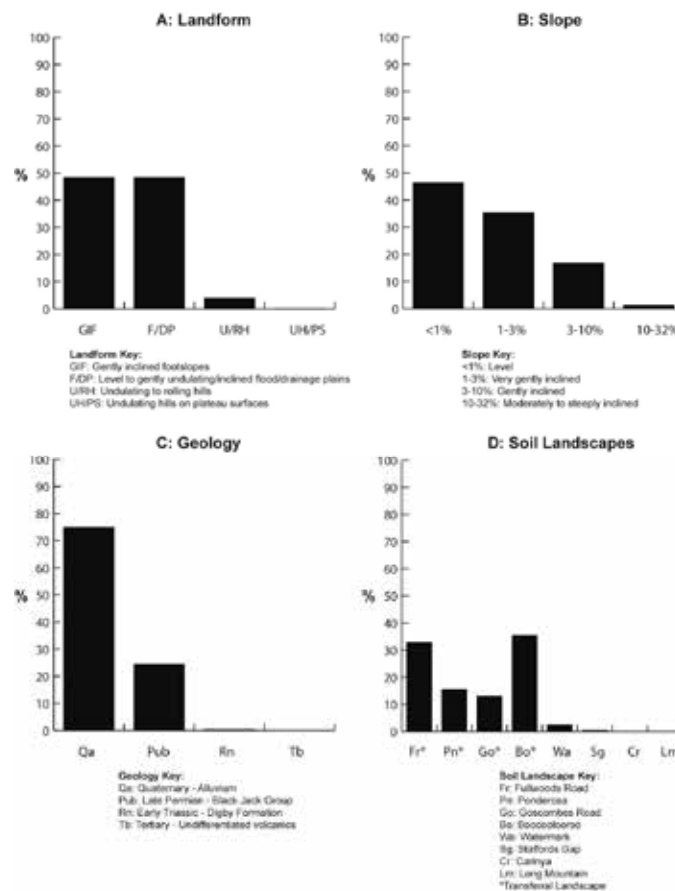


Figure 14 Relative frequency of artefacts/sites ($n = 686$) by landform (A), slope (B), geological formation (C) and soil landscape (D)

8.5.6.3 Slope

Comparison of artefact/site counts between slope classes (**Figure 14b**) reveals a strong trend for higher counts on low to very low gradient land surfaces. Site/artefact counts decrease from 319 (46.5%) on level (<1%) land surfaces to 243 (35.4%) on very gently inclined (1-3%) slopes and 115 (16.7%) on gently inclined (3-10%) slopes. Very few ($n = 9$, 1.3%) sites/artefacts are located on moderately to steeply inclined (10-32%) slopes. Together with the landform data described above, these data suggest that low to very low gradient land surfaces were favoured by Aboriginal people for camping and other activities.

8.5.6.4 Geology

Comparison of artefact/site counts between mapped geological formations within the Project area (**Figure 14c**) reveals a strong trend towards higher counts in areas of Quaternary Alluvium (Qa) ($n = 515$, 75.1%). Sites/artefacts are also well represented in areas mapped as Late Permian Black Jack Group (Pub) ($n = 167$, 24.3%). Very few, in contrast, fall within mapped areas of Triassic sandstone (Rn) ($n = 3$, 0.4%) and undifferentiated Tertiary volcanics (Tb) ($n = 1$, 0.1%). Taken at face value, these data suggest a preference, on the behalf of Aboriginal people camping within the Project area, for utilising areas underlain by particular

geological formations, specifically, Quaternary Alluvium (Qa) and the Late Permian Black Jack Group (Pub). However, it can be confidently concluded that what these data are, in fact, reflecting is an occupational emphasis on watercourses and associated low gradient land surfaces.

8.5.6.5 Soil Landscapes

Comparison of artefact/site counts between mapped soil landscapes within the Project area (**Figure 14d**) indicates a strong trend towards higher artefact/site counts on what are known as Transferral Landscapes. Banks (1995: 6) defines these as “deep deposits of mostly eroded parent material washed from areas directly upslope”. Artefact/site-bearing transferral landscapes within the Project area include the Fullwoods Road (fr), Ponderosa (pn), Goscombes Road (go) and Booloocooroo (bo) landscapes, all of which are characterised by low to very low gradient land surfaces and high water erosion hazard ratings. As above (**Section 8.5.6.4**), it is suggested that the concentration of artefacts and sites on these landscapes is a product of an occupational emphasis on watercourses and associated low gradient land surfaces as opposed to their preferential selection by Aboriginal people. Given that all artefact/site-bearing soil landscapes within the Project area are characterised by high water erosion hazard ratings (Banks 1995), differential susceptibility to erosion, resulting in marked inter-landscape differences in levels of archaeological visibility, is unlikely to account for the observed patterning.

8.5.7 Lithic Assemblage

8.5.7.1 Assemblage size and composition

As indicated in **Section 8.5.3**, a total of 675 stone artefacts were identified and recorded during survey. **Table 23** provides a typological breakdown of this assemblage. As shown, flake debitage (*sensu* Andrefsky 2006) dominates the survey assemblage, with complete (n = 363, inc. 16 redirecting examples) and broken (n = 56, 8.3%) flakes and flake shatter fragments (n = 83, 12.3%) accounting for 66.1% of the total. Non-flake debitage is comparatively poorly represented at 6.7% (n = 45). Cores (n = 83, 12.3%) and core fragments (n = 1, 0.1%), meanwhile, make up 12.4% of the assemblage, with multiple platform (n = 48, 7.1%), single platform (n = 23, 3.4%) and bifacial (n = 12, 1.8%) cores represented. Retouched and edge-ground implements (hatchet reworking flakes included) account for the remaining 6.5% of the assemblage.

Table 23 Typological breakdown of recorded survey assemblage

Type	Number	%
Complete flake	347	51.4
Flake shatter	83	12.3
Proximal flake	56	8.3
Multiple platform core	48	7.1
Angular shatter	45	6.7
Single platform core	23	3.4
Misc. retouched flake	17	2.5
Redirecting flake	16	2.4
Bifacial core	12	1.8
Scraper	11	1.6
Backed artefact	7	1
Edge-ground hatchet-head	4	0.6
Hatchet reworking flake	2	0.3
Unground hatchet-head	2	0.3
Core fragment	1	0.1
Tula ‘slug’	1	0.1
Total	675	100

8.5.7.2 Raw materials

Table 24 provides a breakdown of the relative frequency of raw material types in the survey assemblage. Chert/tuff is the dominant raw material overall, accounting for 67.1% (n = 397) of the identifiable total. ‘Other’ materials - those that could not be identified in the field or through post fieldwork research - account for 12.3% of the assemblage. Of the remaining identifiable types, quartz (n = 148, 21.9% of identifiable total) is the most common raw material, followed by quartzite (n = 34, 5.7% of identifiable total). Other, minor types identified include chalcedony (n = 4, 0.7%), petrified wood (n = 2, 0.3%), greywacke (n = 2, 0.3%), basalt (n = 1, 0.2%), hornfels (n = 1, 0.2%), cherty argillite (n = 1, 0.2%) and andesite (n = 1, 0.2%). Note that greywacke, basalt, hornfels, argillite and andesite identifications are provisional and require confirmation via petrographic analysis. All comprise raw materials used for the production of edge-ground hatchet-heads.

As to the source(s) of the lithic raw materials identified within the Project area, a review of existing geological literature and mapping, coupled with observations made during survey, suggests that most are available in conglomerate components of the Triassic Digby Formation and Late Permian Black Jack Group. As indicated in **Section 4.5**, surface deposits of loose pebble/cobble conglomerate are widely and abundantly distributed across the Project area and represent a near-inexhaustible supply of stone suitable for stone artefact manufacture. Knappable rock types observed in the conglomerate deposits of the Project area during survey included chalcedony, quartz, quartzite, chert/tuff and petrified wood. Although unquantified, the relative frequency of cortical types observed during survey support an emphasis on the procurement of conglomerate-derived pebbles and cobbles, with smooth, rounded cortical surfaces the most common form encountered⁹. Nonetheless, the presence within the Project area of several chert/tuff artefacts with angular cortical surfaces raises the possibility that Aboriginal knappers were also exploiting exposed seams of chert/tuff belonging to the Late Permian Black Jack Group. No such seams were identified during survey. However, their presence remains a possibility.

Identified raw materials with potential for non-local sources include greywacke, basalt, hornfels, cherty argillite and andesite. As noted above, all comprise raw materials used for hatchet manufacture. Potential sources for these materials are discussed by Wilson (1994: 9-11, 138-43), whose research has indicated various sources, both primary and secondary, within 100 km of the Project area. At present, the most convincing evidence for non-local raw material procurement in the Project area comprises the presence within WM-AS13-11 of a bifacially-flaked hatchet blank made on a flake of green-grey rock macroscopically consistent with the andesitic greywacke outcropping at the “Daruka” hatchet quarry, north of Tamworth (Jan Wilson, pers. comm. May 2011, Binns and McBryde 1972; McBryde 1991). If confirmed, the presence of this hatchet-head within the Project area compliments existing evidence for the long distance exchange of hatchet-heads and/or raw material obtained from this source (Binns and McBryde 1972; McBryde 1974; Wilson 1994).

Table 24 Raw materials

Type	Number	%
Chert/tuff	397	58.8
Quartz	148	21.9
Other	83	12.3
Quartzite	34	5
Chalcedony	4	0.6
Petrified wood	2	0.3
Greywacke	2	0.3
Basalt	1	0.1
Hornfels	1	0.1
Cherty argillite	1	0.1
Andesite	1	0.1
Total	675	100

⁹ It is acknowledged that a proportion of those artefacts exhibiting rounded cortical surfaces may derive from local/non-local fluvial contexts such as river/creek gravel bars and terraces.

8.5.7.3 Core reduction

Eighty-three complete cores and a single core fragment were recorded during survey. All can be classified as complete or partial flake cores and display attributes consistent with direct freehand percussion using hard hammers. Notably, bipolar reduction is not represented in the survey assemblage and it seems reasonable to conclude that this is primarily a product of raw material abundance, with local conglomerate deposits offering a near-inexhaustible supply of knappable stone and all but eliminating the need for Aboriginal knappers to maximise, via application of the bipolar technique, the potential of individual cores. At the same time, clasts exceeding 64 mm (i.e., cobbles) in maximum linear dimension are well represented in the conglomerate deposits of the Project area. These can be comfortably held in the hand and, assuming reasonably non-intensive freehand reduction, itself tied to raw material abundance, are unlikely to have routinely met or exceeded a size that necessitated bipolar reduction.

Multiple platform core reduction is the most commonly represented form of reduction in the survey assemblage. Cores of this type account for 57.8% (n = 48) of the complete core assemblage. Multiple platform core reduction involved detaching flakes in more than one direction from two or more platforms on the core. The selection of striking platforms during reduction appears to have been opportunistic in nature. Consideration of the relative frequency of the number of surviving striking platforms on multiple platform cores indicates that cores of this type were most commonly rotated a minimum of two times prior to discard, with 52.1% of identified examples (n = 25) retaining three (n = 20) or more (n = 5) striking platforms. Cores of this type displayed an average length of 40.2±17.7 mm (range: 19.9-120.2 mm), average width of 32.2±13.4 mm (range: 18-101.9 mm) and average thickness of 26.1±13.3 mm (range: 17.5-89 mm). An average of 3.5 flakes greater than 15 mm was detached from recorded multiple platform cores, with the maximum number of removals being ten.

Single platform core reduction is the second most common core reduction method represented in the survey assemblage (n = 23, 27.7%). Single platform core reduction involved detaching flakes from a single striking platform, with removals orientated in roughly the same direction. Nineteen core types of this type account for 29.7% of the total core assemblage. Recorded single platform cores exhibited an average length of 42.3±12.9 mm (range: 22.6-62.1 mm), average width of 32.5±8.8 mm (range: 21-49 mm) and average thickness of 23.5±7 mm (range: 13.3-37 mm). An average of 2.3 flakes greater than 15 mm was detached from single platform cores, with maximum number of removals being six.

Bifacial core reduction is comparatively poorly represented in the survey assemblage, with only 12 cores of this type identified (14.5% of the complete core assemblage). Bifacial core reduction involved the detachment of flakes from a single striking platform, but from two faces on the core. Cores of this type exhibited an average length of 53±35.1 mm (range: 26.6-123.2 mm), average width of 41.7±24.9 mm (range: 22.2-91.9 mm) and average thickness of 22.8±14.2 mm (range: 15.8-51.9 mm). An average of 3.9 flakes greater than 15 mm was removed from recorded bifacial cores, with the maximum number of removals being seven.

8.5.7.3.1 Core reduction: general comments

Following Shiner *et al.* (2007), a useful general measure of the intensity of core reduction within a given area or site can be attained through a comparison of the mean length of the longest core scars in the subject assemblage with the mean length of all complete flakes within the same assemblage. This simple comparative test is premised on the idea that as core reduction becomes more intensive, core size and the length of the longest flake scar on the core will decrease (Shiner *et al.* 2007: 39). For the survey assemblage, the mean length of the longest core scar ($\bar{x}$ = 23.8±8 mm) is less than that of the mean length of complete flakes ($\bar{x}$ = 24.9±9 mm), suggesting - at least superficially - that relatively intensive core reduction was occurring within the Project area. However, this observation is complicated by two additional lines of evidence. Firstly, the difference between means is negligible and not statistically significant (t = -1.092, df = 428, p = .276). Secondly, calculating the flake-to-core for the survey assemblage provides a value of only 5.5 flakes per core. Though based solely on number of removals and not core size, an important distinction when considering the *intensity* as opposed to *frequency* of individual core reduction episodes, this demonstrably low ratio (cf. Shiner *et al.* 2007) suggests that the relatively intensive core reduction cited above is likely more apparent than real. Although sample size precludes more detailed comment, a flake-to-core ratio of 5.5:1 is suggestive of frequent and typically short-lived (i.e., non-intensive) core reduction 'events' as opposed to sustained, intensive ones. It is hypothesised that the generally non-intensive core reduction suggested by the current survey assemblage is a product of basic raw material abundance, with surface deposits of loose pebble/cobble conglomerate within the Project area offering a readily accessible and near-inexhaustible supply of stone suitable for stone artefact manufacture.

A final issue worthy of consideration here concerns the question of whether the single, multiple and bifacial cores

identified within the Project area do, in fact, represent discrete - or at least relatively discrete - *chaînes opératoires* as opposed to sequential stages along a single reduction continuum. As highlighted by Kuhn (1995) and others (e.g., Wallace and Shea 2006), cores can and frequently do change form over the course of reduction. This has important implications for the interpretation of typological variability in core assemblages. For instance, with respect to the current survey assemblage we can propose a hypothetical model of sequential core reduction in which unmodified nodules or flakes were routinely transformed from single platform cores into multiple or bifacial types prior to discard. Rotation of bifacial cores outside of the bifacial plane during reduction will have resulted in multiple platform cores.

Following Kuhn (1995), a simple yet effective measure of the validity of the proposed model is that of core size. If valid, multiple and bifacial cores should be smaller than their single platform counterparts, having been more extensively 'consumed' prior to discard. In contrast, if these types represent discrete (or relatively discrete) reduction trajectories, all three should be reduced to approximately the same extent and there should be no systematic differences in their sizes (cf. Kuhn 1995: 99). Descriptive statistics for the maximum linear dimensions of single, bifacial and multiple platform cores in the survey assemblage favour the latter alternative. Although bifacial cores are, on average, slightly larger than their single and multiple platform counterparts (**Table 25**), a product, it must be noted, of the presence of two atypically large bifacial cores in the survey assemblage¹⁰, differences between types are statistically non-significant (**Table 26**). Taken together, these data suggest that core type has little relationship to variation in the extent of reduction within the Project area and support the hypothesis that at least three different methods of core reduction were employed by Aboriginal knappers within the Project area. This is not, of course, to deny a degree of technological and morphological overlap between single, multiple and bifacial cores. Rather, the point is made that a rigid transformational model in which the various core types represent different stages along a single reduction continuum is inappropriate.

Table 25 Descriptive statistics for the maximum linear dimensions of single, bifacial and multiple cores in survey assemblage

Statistic	Single	Multiple	Bifacial
Mean (mm)	44.3	42.4	53.2
Std dev.	13.2	19.5	35
CV	0.3	0.5	0.7
Min (mm)	25	23.4	28.4
Max (mm)	62.1	138.4	123.2

Table 26 T-test results for comparisons of mean maximum linear dimensions of single, multiple and bifacial cores in survey assemblage.

Comparison	Significance value
Single vs. multiple	t = 4.427, df = 69, p = .670
Single vs. bifacial	t = -1.031, df = 12.75, p = .322
Bifacial vs. multiple	t = -.849, df = 33, p = .412

8.5.7.4 Flakes

Unretouched flakes are well represented in the survey assemblage, accounting for 62.1% (n = 419) of the total. A comparison of the lengths of complete unretouched flakes and the longest cores scars in the assemblage (**Figure 15**) shows that the two share a similar distribution, supporting the inference that the former were struck from the cores discarded within the Project area. Of 419 flakes identified during survey, 347 (51.4%) comprised complete flakes, 56 (8.3%) proximal flakes and 16 (2.4%) redirecting flakes. Redirecting flakes retain former platform edges and are indicative of core rotation. Eighty-three flake shatter fragments were also recorded during survey. Complete unretouched flakes (n = 363) are generally small in size, with an average length of 25.1±9.2 mm (range: 10-63 mm), average width of 21.7±8.5 mm (range: 7.6-64 mm) and average thickness of 8.3±4.7 mm (range: 2-45 mm). Elongation data indicate a population of predominantly short, broad flakes, with 84.8% (n = 308) exhibiting a length-breadth ratio between 0.6 and 1.5.

¹⁰ Removing the cores in questions provides a revised mean of 40.1±18.8 mm for bifacial cores.

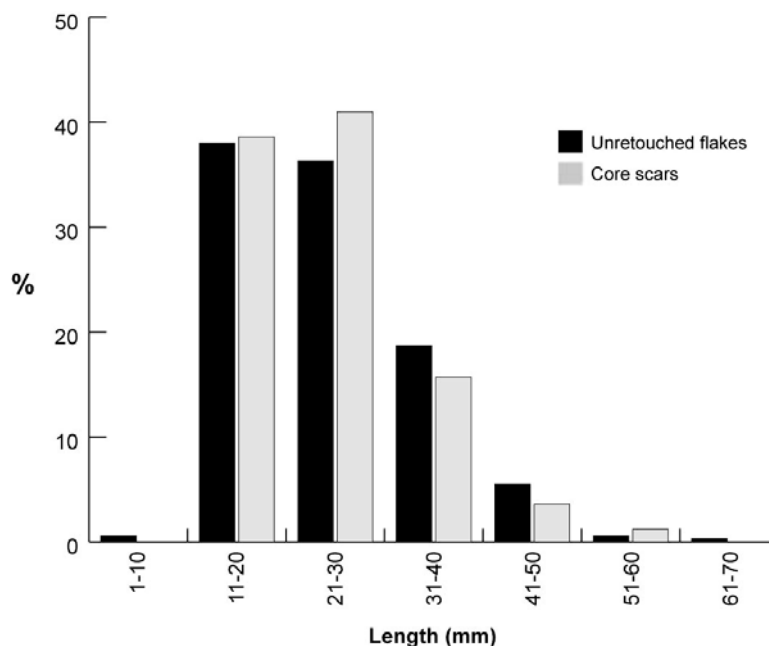


Figure 15 Comparison of complete unretouched flake lengths (n = 363) and maximum core scar lengths (n = 83).

8.5.7.5 Tools

Table 27 provides a breakdown of the tool sub-component of the survey assemblage. Miscellaneous retouched flakes were the most common type of retouched implement identified, with 17 specimens accounting for 38.6% of the total tool sub-assemblage. Backed artefacts and scrapers¹¹ are also well represented, with seven and 11 examples identified respectively. Four edge-ground hatchet-heads, two bifacially-flaked hatchet blanks, two hatchet reworking flakes and a single potential tula adze 'slug' complete the assemblage.

Table 27 Tool sub-component of survey assemblage

Type	Number	%
Misc. retouched flake	17	38.6
Scraper	11	25
Backed artefact	7	15.9
Edge-ground hatchet	4	9.1
Hatchet blank	2	4.5
Hatchet reworking flake	2	4.5
Tula adze	1	2.3
Total	44	100

Recorded backed artefacts within the Project area were manufactured exclusively out of chert/tuff. Asymmetrical (i.e., Bondi points, n = 4) forms dominate, with two symmetrical forms (i.e., Geometric microliths) and a single indeterminate specimen also recorded. Most (n = 5) specimens exhibit unidirectional backing and all but two are broken. Broken specimens likely represent manufacturing failures.

Scrapers were manufactured out of chert/tuff (n = 4), quartzite (n = 3), quartz (n = 2) and 'other' (n = 2) materials. All are complete and exhibit unifacial retouch initiated from the ventral surface. Retouch is typically abrupt and was applied to one (n = 6) or more (n = 5) margins. Recorded specimens exhibit an average length of 35.6±9.5 mm (range: 20.9-50 mm), average width of 35.4±9 mm (range: 26.1-60 mm) and average thickness of 14.5±3.3 mm (range: 9.9-21 mm).

¹¹ Note that a scraping function for these implements is inferred on the basis of retouch morphology, not demonstrated.

A single potential tula adze 'slug' was identified at WM-AS9-11. Manufactured out of high-quality chert/tuff, the specimen exhibits a cortical striking platform and measures 12.9 x 28.7 x 7.9 mm. Retouch has been initiated from the ventral surface and, as is typical for tula 'slugs' (Holdaway and Stern 2004: 253), almost abuts the platform.

Identified hatchet-heads include four edge-ground and two unground specimens, with the latter attesting to the existence of a well-developed bifacial flaking technology within the study region. Two hatchet reworking flakes were also identified during survey and are indicative of the maintenance or reworking of hatchet-heads post-grinding. Of the six complete hatchet-heads recorded during survey, two (WM-IF9-11 and WM-AS9-11) appear to have been manufactured on cobbles derived from either a fluvial context (i.e., a river/creek gravel bar/terrace) or surface conglomerate deposit. That at WM-AS9-11 appears to have been extensively hammer-dressed, though additional analysis would be required to confirm this. Possible hammer-dressing on one of the hatchet-heads identified at WM-AS1-11 likewise requires confirmation. Of the remaining four hatchet-heads, a non-cobble (i.e., quarried stone) origin appears likely for three specimens (WM-AS1-11 (both hatchets) and WM-AS13-11). Extent of reduction precludes an accurate assessment of blank type for the unground, bifacially-flaked specimen identified at WM-AS5-11. However, a quarried stone blank remains a possibility.

Reasons for discard for identified hatchet-heads are difficult to establish. Two (WM-AS9-11 and WM-AS1-11) are complete and in good condition, with no obvious reason for discard apparent. Another two (WM-AS1-11 and WM-IF9-11) exhibit re-worked cutting edges and appear to have been abandoned post-reworking. The unground hatchet-head from WM-AS5-11, meanwhile, appears to have been discarded following an unsuccessful attempt to remove an area of high mass from its butt end and can be categorised as a manufacturing failure. Lastly, although complete and in good condition, the small size of the bifacially-flaked andesitic greywacke "Daruka" hatchet-head from WM-AS13-11 (89.3 x 59.7 x 28.3 mm) may have precipitated its discard.

8.5.8 Chronology

In the absence of absolute dates obtained through controlled archaeological excavation and/or a detailed geomorphological dating programme, establishing a chronological context for recorded Aboriginal archaeological sites within the Project area is difficult. Unlike some other parts of the state, such as the Central Lowlands of the Hunter Valley (e.g. Deans Jones and Mitchell 1993) and semi-arid western NSW (e.g. Fanning 2002, Fanning *et al.* 2008; Holdaway *et al.* 2002, 2004, 2005; Rhodes *et al.* 2009), current understanding of the chronology of 'open' artefact-bearing soil units and land surfaces within the study region is extremely limited. Excavations to the south-west of the Project area, at Lime Springs and Trinkey, have provided some insight, with the black sandy clays exposed in those contexts ranging in age from around 22,000 BP to the 20th century AD. However, the small-scale nature of these excavations, combined with the somewhat unique geomorphological status of both sites, seriously impedes their broader interpretive utility. As in other contexts (e.g., Fanning *et al.* 2008), establishing the temporal history of the various sedimentary sequences present within the Project area will prove crucial for ascertaining the maximum age of the artefact-bearing land surfaces within it; so too the temporal context of the various erosional processes that have acted upon its archaeological record.

Although limited in respect to the chronological resolution that it offers, the typology of recorded stone artefacts within the Project area offers some insight into the antiquity of Aboriginal occupation within it. As highlighted in **Section 5.1.1**, Australian Aboriginal stone artefact assemblages have been divided into two temporal groups. The first, the *Australian Core Tool and Scraper Tradition*, dates from the earliest occupation of the continent to the mid-Holocene, c.3,000-6000 BP (Bowler *et al.* 1970). The second, the *Australian Small Tool Tradition*, is widely believed to have emerged in the mid-Holocene and to have persisted into the contact period (i.e. the last 200 years) (Gould 1969). As we have seen, artefacts characteristic of the *Australian Small Tool Tradition* have been identified within the Project area, with backed artefacts recorded at four scatter sites (WM-AS1-11, WM-AS2-11, WMAS5-11 and WM-AS9-11) and a single potential tula 'slug' recorded at WM-AS9-11. A mid-to-late Holocene date for these artefacts is inferred on the basis of well-dated stratified rockshelter assemblages, both within and outside of the study region (e.g., Gaynor 1997; McBryde 1974; Veth *et al.* 2011). A mid-to-late Holocene date for the complete and fragmentary stone hatchet-heads identified at WM-IF9-11, WM-AS9-11, WM-IF21-11, WM-AS1-11, WM-AS5-11 and WM-AS13-11 is inferred on the same grounds (see, for example, McBryde 1974, 1991). In northern Australia, complete and/or fragmentary edge ground hatchet-heads have been identified in Late Pleistocene contexts (Geneste *et al.* 2010; Morwood and Trezise 1989). However, in south-eastern Australia, the earliest known examples date to the mid-Holocene.

Whilst acknowledging the interpretive difficulties posed by the so-called 'palimpsest problem', on the basis of the typological evidence described above, it seems likely that most, if not all of the surface artefacts recorded during the current survey were deposited during the last 5,000 years of Aboriginal occupation. At present, potential

evidence for recent (i.e., post-contact) Aboriginal activity within the Project area is restricted to potential Aboriginal scarred trees WM-ST2-11, WM-ST7-11 and WM-ST8-11. No definitive or potential artefacts manufactured out of bottle glass were identified during survey.

8.5.9 Reassessment of Predictive Model

Section 7.0 outlined a predictive model for Aboriginal archaeology in the Project area. **Table 28** compares the predictions made with the results of the archaeological survey undertaken as basis for informing future archaeological investigations within and around the Project area.

Table 28 Evaluation of predictive model

Prediction	Survey result
Site types <i>likely</i> to occur within the Project area include artefact scatters, isolated finds, rockshelters with deposit or PAD and hatchet grinding grooves.	Open artefact sites (i.e., artefact scatters and isolated finds) dominate the surface archaeological record of the Project area, accounting for 78.3% (n = 41) of confirmed (n = 52) sites. Scarred trees are also reasonably well represented, with eight potential examples identified. Three grinding groove sites have also been identified. Contrary to expectation, no rockshelters with deposit and/or art or PAD were identified during survey. This may relate to the natural weathering properties of local sandstones.
Site types with limited potential to occur within the Project area include stone arrangements, rock engravings, stone quarries, burials and post-contact camps.	The results of the current survey are consistent with the assessed low likelihood of these site types occurring within the Project area. None were identified during survey.
The majority of isolated finds will occur within 200 m of a creekline (Prediction 1a).	The results of the current survey do not support this prediction. 65.2% (n = 15) of isolated finds (n = 23) are located more than 200 m from the nearest creekline.
The majority of isolated finds will be located on gently inclined footslopes and level to gently undulating/inclined flood/drainage plains (Prediction 1b).	The results of the current survey support this prediction. 82.6% (n = 19) of isolated finds are located on one of these two landforms.
The majority of isolated finds will occur on low to very low gradient land surfaces (Prediction 1c).	The results of the current survey support this prediction. 95.6% (n = 22) of isolated finds are located on low to very low gradient land surfaces (<1-10%).
The majority of isolated finds will comprise chipped stone artefacts. Edge-ground hatchet heads and grindstones may also occur (Prediction 2a).	The results of the current survey support this prediction. 91.3% (n = 21) of isolated finds identified during survey comprise chipped stone artefacts. One edge-ground hatchet-head and a single hatchet reworking flake were also identified. No grindstones - complete or fragmentary - were identified during survey.
The majority of isolated finds will exhibit fair to poor archaeological integrity due to past and/or present land uses (Prediction 3a).	The results of the current survey support this prediction. Relevant disturbance factors include vehicle traffic, stock movement, fluvial erosion activity and dam/vehicle track/contour bank construction.
The majority of artefact scatters will occur within 200 m of a creekline (Prediction 4a).	The results of the current survey support this prediction. 61.1% (n = 11) of confirmed scatters are located within 200 m of a creekline.
The majority of artefact scatters will be located on gently inclined footslopes or level to gently undulating/inclined flood/drainage plains (Prediction 4b).	The results of the current survey support this prediction. 72.2% (n = 13) of confirmed scatters (n = 18) are located on one of these two landforms.
The majority of artefact scatters will occur on low to very low gradient land surfaces (Prediction 4c).	The results of the current survey support this prediction. 88.9% (n = 16) of confirmed scatters (n = 18) are located on low to very low gradient land surfaces (<1-10%).
Chipped stone artefacts will be the most common form of artefact present within identified scatters. Edge-ground hatchet heads made from local or non-local raw materials may also occur (Prediction 5a).	The results of the current survey support this prediction.
The majority of scatters will contain less than 25 artefacts. Scatters with more than 50 artefacts will be rare. (Prediction 5b).	The results of the current survey support this prediction. 77.8% (n = 14) of confirmed scatters (n = 18) contain less than 25 artefacts.
Scatters with more than 50 artefacts will be rare (Prediction 5c).	The results of the current survey support this prediction. Only four scatters with more than 50 artefacts were identified during survey.
Chert/tuff will be the dominant raw material for chipped	The results of the current survey support this prediction. Chert/tuff

Prediction	Survey result
stone artefact manufacture (Prediction 5d).	artefacts account for 67.1% of the identifiable component of the survey assemblage (n = 592).
Most, if not all of the raw materials utilised for chipped stone artefact manufacture will have been sourced from locally occurring conglomerate deposits (Prediction 5e).	Although unquantified, the relative frequency of cortical types observed during survey supports this suggestion, with rounded cortical surfaces the most common form encountered. Most of the raw materials used for stone artefact manufacture within the Project area can be obtained from widely and abundantly distributed surface deposits of loose pebble/cobble conglomerate.
Flake debitage (<i>sensu</i> Andrefsky 2006) will dominate the survey assemblage (Prediction 5f)	The results of the current survey support this prediction. Flake debitage accounts for 66.1% of the total survey assemblage.
Chronologically diagnostic tool types will be restricted to backed artefacts and edge-ground hatchet-heads (Prediction 5g).	The results of the current survey do not support this prediction. A single potential tula adze (in 'slug' form) was also identified during survey.
Sites found in association with higher order creeklines ($\geq 2^{\text{nd}}$) will contain a higher number of artefact types than those found in association with 1 st order streams (Prediction 5h).	Changes in flow rates and drainage patterns since European settlement of the Project area preclude an accurate assessment of the validity of this prediction.
The majority of artefact scatters will exhibit fair to poor archaeological integrity due to past and/or present land uses (Prediction 6a).	The results of the current survey support this prediction. Relevant disturbance factors include vehicle traffic, stock movement, soil erosion and dam/vehicle track/contour bank construction.
The majority of scarred trees will occur within 200 m of a creekline (Prediction 7a).	The results of the current survey do not support this prediction. 50% (n = 4) of identified scarred trees are located more than 200 m from their nearest creekline.
The majority of scarred trees will occur within 200 m of other site types (Prediction 7b).	The results of the current survey do not support this prediction. 50% (n = 4) of scarred trees are located more than 200 m from other recorded site types.
The majority of scars will occur on box species (Prediction 8a).	The results of the current survey support this prediction. 85.7% of classifiable specimens (n = 7) are box species.
Curved scars (after Long 2005) will be most common scar form identified. Other scar types will be rare (Prediction 8b).	The results of the current survey provide limited support for this prediction. Scar types identified include four 'curved', three 'bark slab' and one 'extraction'.
The majority of scarred trees will exhibit fair to good archaeological integrity (Prediction 9a).	The results of the current survey support this prediction.
The majority of rockshelters will be located at the base of sandstone cliff formations (Prediction 10a).	Not applicable. No rockshelters were identified during survey.
Most rockshelter sites will be located within 200 m of a source of potable water (Prediction 10b).	Not applicable. No rockshelters were identified during survey.
Rockshelters with PAD will be the most form of rockshelter represented (Prediction 11a)	Not applicable. No rockshelters were identified during survey.
The majority of rockshelter sites will exhibit fair to good archaeological integrity (Prediction 12a).	Not applicable. No rockshelters were identified during survey.
Most grinding groove sites will occur in direct association with established creeklines (Prediction 13a)	The results of the current survey do not support this prediction.
Most grinding groove sites will exhibit more than one groove (Prediction 14a)	The results of the current survey support this prediction.
The majority of grinding groove sites will exhibit fair to good archaeological integrity (Prediction 15a).	The results of the current survey support this prediction.

8.5.10 Archaeological Sensitivity: Subsurface Archaeological Potential

Figure 16 presents AECOM's assessment of the archaeological sensitivity of land within the Project area. As indicated in **Section 8.4**, three levels of archaeological sensitivity are recognised on the basis of observed archaeology (i.e., its distribution and character), levels of past land disturbance and the predicted complexity of deposits within each category (refer to **Table 16, Section 8.4**).

As shown on **Figure 16**, the majority of land within the Project area has been assessed as being of low archaeological sensitivity. Areas of low sensitivity are defined here as those that are located more than 200 m

from a mapped watercourse¹² and have not been grossly disturbed. Moderately to steeply inclined terrain is also included in this category. A 200 m buffer for mapped watercourses has been selected on the basis of the spatial data presented in **Section 8.5.6.1**. Areas of low sensitivity within the Project area have the potential to contain subsurface archaeological deposit(s). However, the character of these deposits is predicted to differ to that identified in areas of high sensitivity in respect to artefact counts, densities and assemblage richness values (see below).

In common with areas of low sensitivity, areas of high sensitivity within the Project area have been defined on the basis of levels of past disturbance, proximity to water and slope, and have the potential to contain subsurface archaeological deposit(s). Areas of high sensitivity within the Project area fulfil the following criteria: 1) they are level to gently inclined (<1-10%); 2) they are located within 200 m of a mapped watercourse; and 3) have not been grossly disturbed. No distinction is drawn between higher and lower order streams in recognition of post-European settlement changes in flows rates and drainage patterns. Relative to areas of low sensitivity, it is predicted that subsurface archaeological deposits located within areas of high sensitivity will exhibit higher mean artefact counts, densities and assemblage richness values (i.e., with respect to the representation of technological types and raw materials).

Areas of 'nil' archaeological sensitivity within the Project area comprise those that have been grossly disturbed by modern and/or historic European land use practices. Aboriginal archaeological materials are highly unlikely to survive in these areas.

8.5.11 Synthesis

The archaeological survey undertaken for this investigation has resulted in a significant increase in the known Aboriginal archaeological resource of the Project area and environs, revealing a rich and diverse record of past Aboriginal activity. Although limited to the identification of surface evidence, the survey has enhanced considerably our understanding of Aboriginal site patterning on a local scale and has provided an important dataset for guiding future archaeological investigations within and surrounding the Project area.

Aboriginal archaeological sites are widely distributed across the Project area, attesting to an extensive Aboriginal presence in the past. However, in keeping with broader regional trends (e.g., Hughes 1984; Kuskie 2000; White and McDonald 2010), the results of the current survey are indicative of an occupational emphasis on higher order watercourses and associated low gradient land surfaces. Although changes in drainage patterns and flow rates over time preclude definitive comment, on the basis of available evidence, it seems likely that these watercourses comprised Watermark Gully, Native Dog Gully and the Mooki River. The presence of a large unmapped wetland to the south of The Dip Road in association with Native Dog Gully is also of note in this respect and may well have been a focal resource zone for Aboriginal people camping within, or passing through, the Project area.

These comments notwithstanding, the size and composition of the stone artefact assemblage recorded at WM-AS5-11, a medium-sized scatter (n = 60) found on the property Flakenhoe, highlights the problems of projecting uncritically the Project area's current hydrological scheme onto the past. Both, for example, are suggestive of what Shiner (2008), following Schlanger (1992), has termed a 'persistent place' (i.e., a place in the landscape that was the focus of repeated activity through time), yet the site is associated with what is currently a highly ephemeral 1st order stream. Such inconsistencies highlight the importance of using multiple streams of data for the reconstruction of past Aboriginal land use practises and assessments of archaeological sensitivity.

Confirmed open artefact sites (n = 18) within the Project area vary significantly in size and content. Most (66.7.4%) contain less than 10 artefacts. However, four sites contain more than 50 artefacts. All are best conceived of as opportunistic surface manifestations of a more-or-less continuous subsurface distribution of artefacts within the Project area, albeit with highly variable densities linked to environmental factors such as proximity to water, stream order and slope. Importantly, recorded artefacts likely represent only a fraction of the total stone artefact resource present within the Project area, with most artefacts currently obscured by vegetation and/or soil.

Surface deposits of loose pebble/cobble conglomerate are widely and abundantly distributed across the Project area and represent a near-inexhaustible supply of stone suitable for chipped stone tool manufacture within it. The relative frequencies of raw material types identified during survey attest to a clear preference for the use of

¹² Note that a 300 m buffer has been applied to the Mooki River on the grounds of localised topographic conditions.

chert/tuff, a preference that can be reasonably attributed to relative flaking quality. Raw materials with potential for non-local sources have also been identified within the Project area. All comprise raw materials used for stone hatchet manufacture. At present, the most convincing evidence for non-local raw material procurement in the Project area comprises the identification within WM-AS13-11 of a bifacially-flaked hatchet blank made on a flake of green-grey rock macroscopically consistent with the andesitic greywacke outcropping at the “Daruka” hatchet quarry, north of Tamworth (Binns and McBryde 1972). If confirmed, the presence of this hatchet-head within the Project area compliments existing evidence for the long distance exchange of hatchet-heads and/or raw material obtained from this source (Binns and McBryde 1972; McBryde 1974, 1991; Wilson 1994).

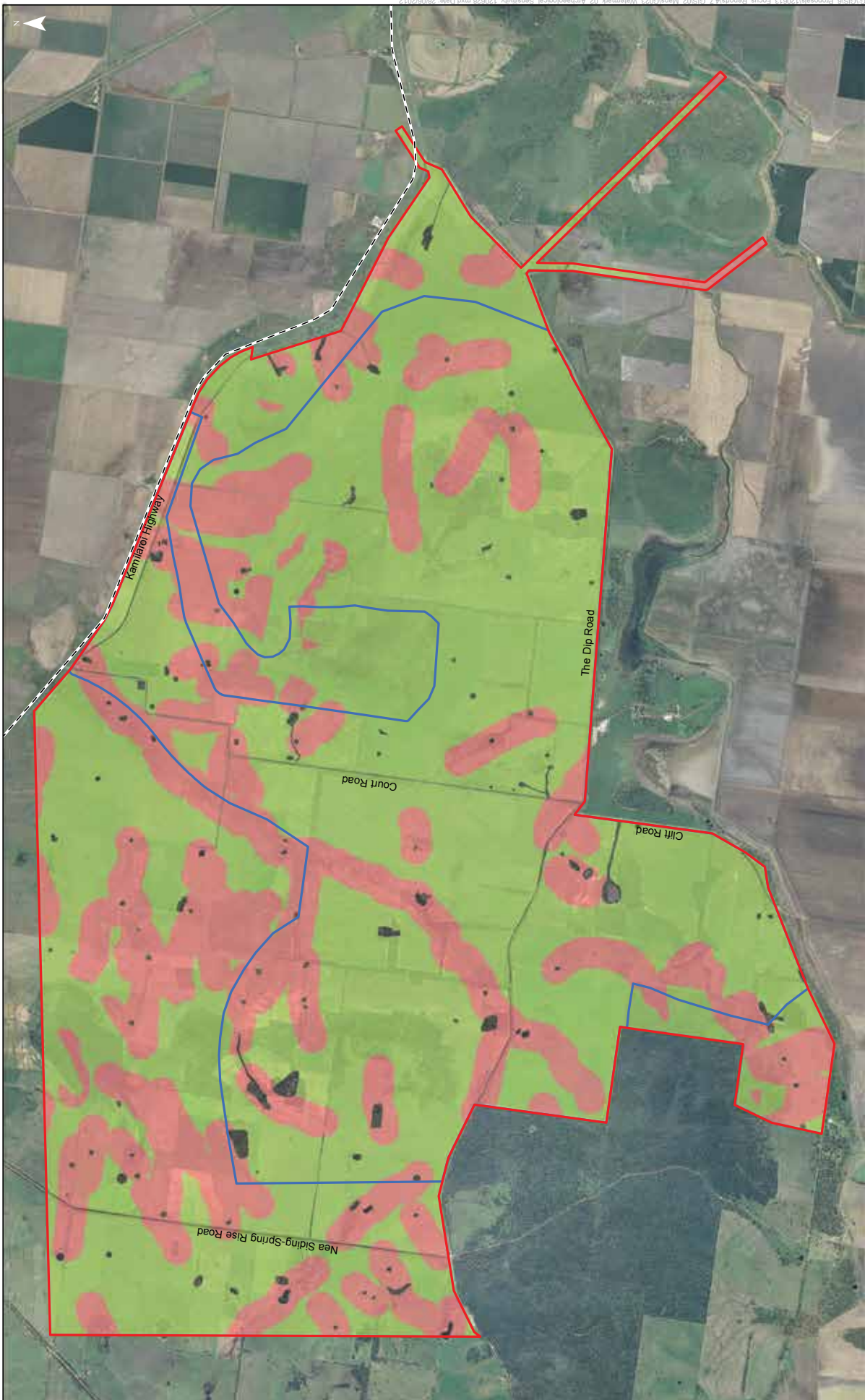
A total of 675 stone artefacts were identified and recorded during survey. On current evidence, the primary reduction technique employed by Aboriginal knappers within the Project area appears to have been direct freehand percussion using hard hammers. Bipolar reduction is not represented in the survey assemblage, a product, it is suggested, of both raw material abundance and clast size. Identified tools, meanwhile, attest to the production and use of a wide range of stone implements including backed artefacts (i.e., Bondi points and geometric microliths), scrapers, adzes and edge-ground hatchets. Bifacially-flaked hatchet-heads at WM-AS5-11 and WM-AS13-11 are indicative of a well-developed bifacial flaking technology. Miscellaneous retouched flakes are also well represented in the survey assemblage and were likely used for a variety of tasks.

Alongside the hatchet-heads identified during survey, both complete and partial, the presence of three grinding groove sites within the Project area attests to the economic importance of hafted edge-ground hatchets in local Aboriginal toolkits. At the same time, the position of WM-GG2-11 atop Mt Watermark suggests that locations that provided a broad outlook were important to Aboriginal people camping within (or passing through) the Project area, presumably functioning as lookouts for game and incoming hostile parties.

In common with the results of other archaeological surveys in north-western NSW (e.g., Wilson and McAdam 1994, JMcD CHM 1998), potential Aboriginal scarred trees recorded within the Project area indicate a preference for the use of Eucalyptus ‘Box’ species. Recorded scars provide possible evidence for the production and use of organic implements such as coolamons and shields, the use of bark slabs for shelter and traditional hunting techniques.

In the absence of absolute dates obtained through controlled archaeological excavation and/or a detailed geomorphological dating programme, establishing a chronological context for recorded Aboriginal archaeological sites within the Project area is difficult. Nonetheless, a broad mid-to-late Holocene date for the majority of sites is suggested on typological grounds. Potential evidence for more recent (i.e., post-contact) Aboriginal activity within the Project area is limited to three scarred trees bearing steel axe and/or chainsaw marks.

AECOM



WATERMARK COAL PROJECT
ARCHAEOLOGICAL SENSITIVITY

16



AECOM

Hansen Bailey

Environmental Impact Statement February 2013

WATERMARK
COAL PROJECT

9.0 Archaeological Significance Assessment

9.1 Introduction

This section provides an assessment of the archaeological (or scientific) significance of recorded Aboriginal archaeological sites within the Project area. Scientific significance ratings are presented as a means of determining, in conjunction with assessed levels of social or cultural significance by RAPs (see Connect for Effect 2012), the most appropriate management / mitigation options for these sites.

9.2 Principles of Assessment

Heritage sites hold value for different communities in a variety of different ways. All sites are not equally significant and thus not equally worthy of conservation and management (Pearson and Sullivan 1995: 17). One of the primary responsibilities of cultural heritage practitioners, therefore, is to determine which sites are worthy of preservation and management (and why) and, conversely, which are not (and why) (Smith and Bourke 2007: 227). This process is known as *the assessment of cultural significance* and, as highlighted by Pearson and Sullivan (1995: 127), incorporates two interrelated and interdependent components. The first involves identifying, through documentary, physical, or oral evidence, the elements that make a heritage site significant, as well as the type(s) of significance it manifests. The second involves determining the degree of value that the site holds for society (i.e., its cultural significance) (Pearson and Sullivan 1995: 126).

In Australia, the primary guide to the assessment of cultural significance is the *Australian ICOMOS Charter for Places of Cultural Significance* (1999), informally known as *The Burra Charter*, which defines cultural significance as the “*aesthetic, historic, scientific, social or spiritual value for past, present or future generations*” of a site or place (ICOMOS 1999: 2). Under the Burra Charter model, the cultural significance of a heritage site or place is assessed in terms of its aesthetic, historic, scientific, and social values, none of which are mutually exclusive (**Table 29**). Establishing cultural significance under the Burra Charter model involves assessing all information relevant to an understanding of the site and its fabric (i.e., its *physical* make-up) (ICOMOS 1999: 12). The assessment of cultural significance and the preparation of a statement of cultural significance are critical prerequisites to making decisions about the management of any heritage site or place (ICOMOS 1999: 11).

With respect to Aboriginal sites and places, it is possible to identify two major streams in the overall significance assessment process: the assessment of *scientific value(s)* by archaeologists and the assessment of *social (or cultural) value(s)* by Aboriginal people. The latter can only be identified through consultation with Aboriginal people and is addressed in the ACHVA report for the Project (see Connect for Effect 2012). The former, meanwhile, is the subject of this section.

Table 29 Values relevant to determining cultural significance, as defined by The Burra Charter (1999).

Value	Definition
Aesthetic	“Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use” (ICOMOS 1999: 12).
Historic	“Historic value encompasses the history of aesthetics, science and society...[a] place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may have historic value as the site of an important event” (ICOMOS 1999: 12).
Scientific	“The scientific or research value of a place will depend on the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information” (ICOMOS 1999:12).
Social	“Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group” (ICOMOS 1999: 12).

9.3 Scientific (Archaeological) Significance

The scientific (or archaeological) significance of Aboriginal archaeological sites relates primarily to their potential for providing information about past Aboriginal culture and is commonly assessed on the basis of their *research potential*, *representativeness* and *rarity*. Other criteria, such as aesthetic value and education potential, may also be relevant.

9.3.1 Research Potential

Research potential can be defined as the potential of an archaeological site to address what Bowdler (1981: 129) has referred to as “timely and specific research questions”. These questions may relate to any number of issues concerning past human lifeways and environments and, as suggested by Bowdler’s quote, will inevitably reflect current trends or problems in academic research (Burke and Smith 2004: 249). For their part, Bowdler and Bickford (1984:23-4) suggest that the relative research potential of an archaeological site can be determined by answering the following series of questions:

1. Can the site contribute knowledge which no other resource can?
2. Can the site contribute knowledge which no other such site can?
3. Is this knowledge relevant to general questions about human history or other substantive subjects?

Several criteria can be used to assess the research potential of an archaeological site. Particularly important in the context of Aboriginal archaeology are the intactness or integrity of the site in question, its complexity, the connectedness of the site to other sites and its potential for archaeological deposit (NPWS 1997: 7).

Integrity refers to the extent to which a site has been disturbed by natural and/or anthropogenic phenomena and includes both the state of preservation of particular remains (e.g., animal bones, plant remains) and, where applicable, stratigraphic integrity (NPWS 1997: 7). Assessments of archaeological integrity are predicated on the notion that undisturbed or minimally disturbed sites are likely to yield higher quality archaeological and/or environmental data than those whose integrity has been significantly compromised by natural and/or anthropogenic phenomena. Establishing levels of preservation or integrity in the context of a surface survey is difficult. Nonetheless, useful rating schemes are available for ‘open’ sites (Coutts and Witter 1977: 34) and scarred trees (Long 2005: 74).

The *complexity* of a site refers primarily to the nature or character of the artefactual materials or features that constitute it but also includes site structure (e.g., the physical size of the site, spatial patterning in observed cultural materials). In the case of open artefact sites, for example, the principal criteria used to assess complexity are the site’s size (i.e., number of artefacts and/or spatial extent), the presence, range and frequency of artefact and raw material types, and the presence of features such as hearths.

Connectedness concerns the relationship between archaeological sites within a given area and may be expressed through a combination of factors such as site location, type and contents. It may, for example, be possible to establish a connection between a stone quarry and hatchet found nearby. Demonstrating connectedness archaeologically, however, is far from straightforward, especially when dealing with surface evidence alone. Ultimately, this difficulty rests with the need to demonstrate contemporaneity between sites that may have been created hundreds, if not thousands, of years apart. As Shiner (2008: 13) has observed, “much of the surface archaeological record documents the accumulation of materials from multiple behavioural episodes occurring over long periods of discontinuous time”. Contemporaneity, then, needs to be demonstrated not assumed.

Potential for archaeological deposit refers to the potential of a site to contain subsurface archaeological evidence which may, through controlled excavation and analysis, assist in answering questions that are of contemporary archaeological interest. Assessing subsurface potential in the absence of test excavation is difficult. Nonetheless, consideration of a range of factors, including the integrity of the site, the complexity of extant surface evidence, the nature of the local geomorphology (as established through surface observations and documentary research) and the results of previous archaeological excavations in the area, will help inform assessment of this criterion.

9.3.2 Rarity and Representativeness

Rarity and *representativeness* are related concepts. *Rarity* refers to the relative uniqueness of a site within its local and regional context. The scientific significance of a site is assessed as higher if it is unique or rare within either context; conversely, it is considered to be of lower significance if it is common in one or both. The concept of representativeness, meanwhile, refers to the issue of whether or not a site is “a good example of its type,

illustrating clearly the attributes of its significance” (Burke and Smith 2004: 247). Representativeness is an important criterion as one of the primary goals of cultural heritage management is to preserve for future generations a representative sample of all archaeological site types in their full range of environmental contexts.

In common with rarity, assessments of representativeness within a region are dependent on the state of current knowledge concerning the number and type of archaeological sites present within that region¹³. This is a critical point, for as suggested by Kuskie (2000) and others (e.g., Bowdler 1981; Godwin 2011, Pearson and Sullivan 1995), the absence, across most of Australia, of regional-scale quantitative data concerning Aboriginal sites and places represents a major constraint in assessments of representativeness and rarity. As stressed by Bowdler (1981) some 30 years ago, detailed regional-scale assessments of the Aboriginal archaeological record of Australia are required to address this issue. Such assessments are reasonably outside the scope of EIS impact assessments. Nonetheless, in other contexts, some positive developments have been made in this regard, both in NSW (e.g., Brown 2010, Ridges 2010) and elsewhere (e.g., Bird and Rhodes 2011).

9.4 Assessment of Scientific Significance

An assessment of the scientific significance of newly and previously recorded Aboriginal archaeological sites within the Project area is presented in **Table 30**. AHIMS registered sites 29-1-0155 (Bacon Hill 2) and 29-1-0157 (Cloveneden 1) are excluded from assessment on the grounds that both have been re-assessed as natural stone occurrences. Significance assessments for AHIMS registered sites 29-1-0154 (Bacon Hill 1), 29-1-0158 (Tudgleys Hill 1) and 29-1-0159 (The Wilgas 1) are based on the information provided in their respective site cards.

Significance ratings are offered on the basis of the assessed research potential, rarity and representativeness of each site within an arbitrary 40 km² ‘region’ centred on the Project area. This approach has been adopted in view of the significant limitations imposed by the nature of existing archaeological data for the North West Slopes and Plains of NSW. In common with other parts of the state, detailed regional syntheses of the Aboriginal archaeological record of this region are lacking and only a tiny fraction of the region has been subject to systematic archaeological investigation. At the same time, significant differences in the quality of existing AHIMS data for the region seriously compromise the utility of the AHIMS database for assessing significance.

Accordingly, the significance ratings provided below are best considered as provisional. It is important that they are subject to periodic revision as our knowledge of the Aboriginal archaeological record of land both within and outside of the arbitrary ‘region’ defined here increases.

Table 30 Significance Assessment

Site name	Site type	Significance rating	Rationale
WM-IF1-11	IF	Low	WM-IF1-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF2-11	IF	Low	WM-IF2-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF3-11	IF	Low	WM-IF3-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is fair. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-IF4-11	IF	Low	WM-IF4-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and

¹³ There is, of course, a temporal fluidity to this criterion (i.e., as knowledge of the Aboriginal archaeology of a region increases, assessed levels of representativeness may change, a point of equal relevance to rarity).

Site name	Site type	Significance rating	Rationale
			regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF5-11	IF	Low	WM-IF5-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF6-11	IF	Low	WM-IF6-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF7-11	IF	Low	WM-IF7-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF8-11	IF	Low	WM-IF8-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF9-11	IF	Moderate	WM-IF9-11 has the potential to contribute knowledge not available from another resource or site. Information derived from the petrographic analysis of this hatchet-head could assist in addressing established research questions about the movement/exchange of hatchet-heads both within and outside of the study 'region' (as defined here) (i.e., Binns and McBryde 1972; Wilson 1994). WM-IF9-11 is a reasonable example of its type, with better examples known locally (i.e., in WM-A9-11) but not regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low. Though limited due to parent blank form, WM-IF9-11 retains some potential for establishing connectedness archaeologically.
WM-IF10-11	IF	Low	WM-IF10-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF11-11	IF	Low	WM-IF11-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF12-11	IF	Low	WM-IF12-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and

Site name	Site type	Significance rating	Rationale
			regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF13-11	IF	Low	WM-IF13-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF14-11	IF	Low	WM-IF14-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is fair. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-IF15-11	IF	Low	WM-IF15-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is fair. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-IF16-11	IF	Low	WM-IF16-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF17-11	IF	Low	WM-IF17-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF18-11	IF	Low	WM-IF18-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF19-11	IF	Low	WM-IF19-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF20-11	IF	Low	WM-IF20-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-IF21-11	IF	Moderate	WM-IF21-11 has the potential to contribute knowledge not available from another resource or site. Information derived from the

Site name	Site type	Significance rating	Rationale
			petrographic analysis of this hatchet reworking flake could assist in addressing established research questions about the movement/exchange of edge-ground hatchets both within and outside of the study 'region' (as defined here) (i.e., Binns and McBryde 1972; Wilson 1994). Site condition is poor. Reasonable potential for establishing connectedness archaeologically.
WM-IF22-12	IF	Low	WM-IF22-12 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-IF23-12	IF	Low	WM-IF23-12 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS1-11	AS	High	WM-AS1-11 has significant potential to contribute knowledge not available from another resource or site. Excavation of the terrace component of this site, in particular, would likely yield a large and complex assemblage of stone artefacts. Dateable hearths and other features (e.g., knapping floors) may also be present. Excavated evidence could be used to address a range of research questions concerning past Aboriginal settlement and subsistence patterns on a local and regional scale. WM-AS1-11 is an excellent example of its type. Scatters of this size and complexity are locally and regionally rare. The site contains a range of artefact, tool and raw material types. The presence of two edge-ground hatchet-heads is of particular note. Both appear to have been manufactured on non-cobble (i.e. quarried stone) blanks. Petrographic analysis of these hatchet-heads may assist in addressing established research questions about the movement/exchange of edge-ground hatchets both within and outside of the study 'region' (as defined here) (i.e., Binns and McBryde 1972; Wilson 1994). The spatial association of WM-AS1-11 and potential Aboriginal scarred tree WM-ST2-11 is also worthy of consideration, and raises the possibility of a connection between these sites. Expansive eastward views across the Mooki River towards the Melville Range imbue WM-AS1-11 with considerable aesthetic value.
WM-AS2-11	AS	Moderate	WM-AS2-11 has reasonable potential to contribute knowledge not available from another resource or site. The site is located c.300 m north of a large ephemeral wetland on the property 'The Dip'. It is highly likely that this area was focal resource zone for Aboriginal people camping within and adjacent to the Project area. As detailed in Fanning's (2012) geomorphological assessment for the Project (Appendix E), parts of WM-AS2-11 retain moderate subsurface archaeological preservation potential. Excavated evidence from this site could be used to address a range of research questions concerning past Aboriginal settlement and subsistence patterns on a local and regional scale. WM-AS2-11 is a reasonable example of its type. Scatters of this size are locally and regionally rare. However, compared with known scatters of a similar (or larger) size (i.e., WM-AS1-11, WM-AS5-11 and WM-AS9-11) the site contains a comparatively limited array of artefact/tool types.

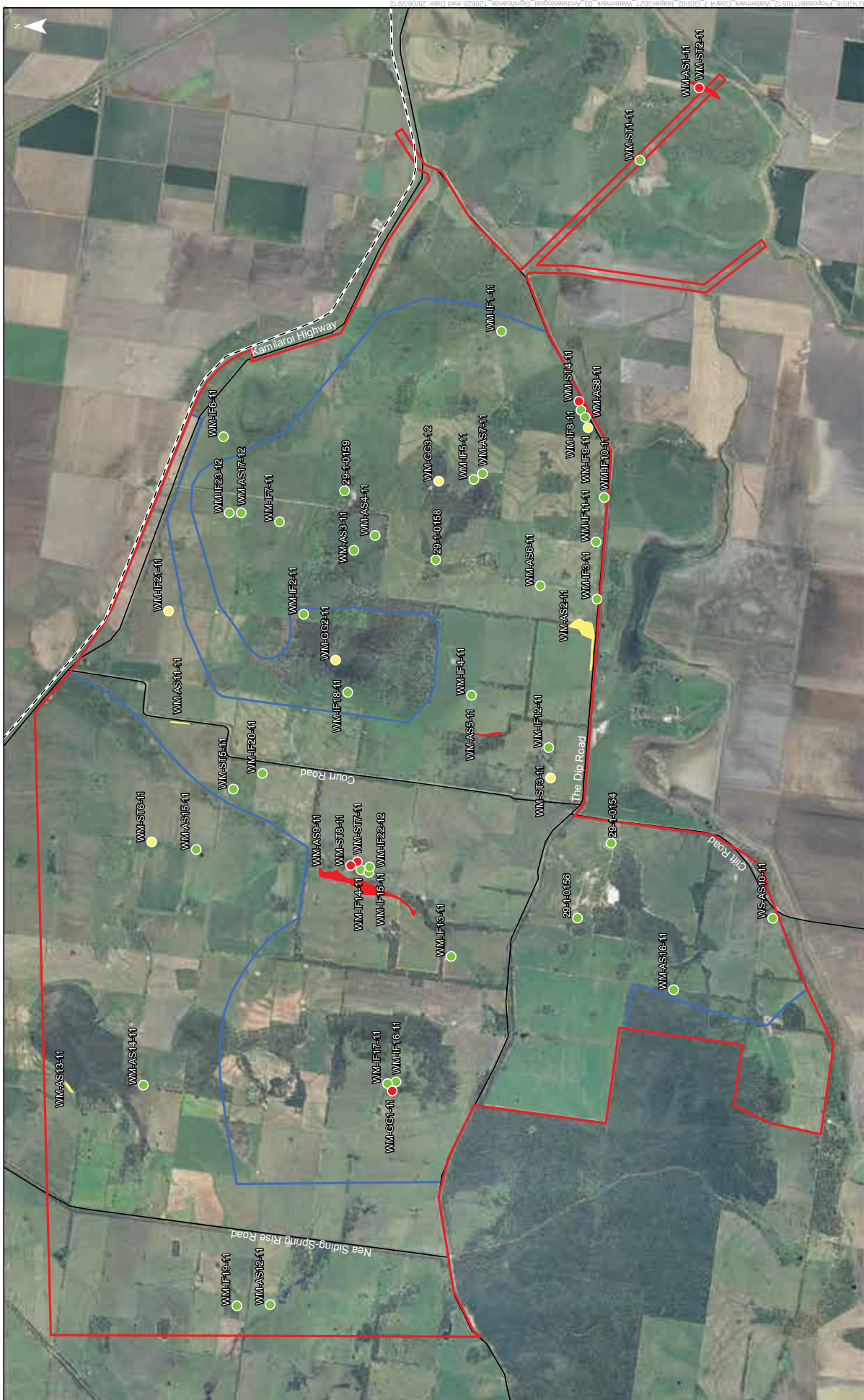
Site name	Site type	Significance rating	Rationale
WM-AS3-11	AS	Low	WM-AS3-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS4-11	AS	Low	WM-AS4-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS5-11	AS	High	WM-AS5-11 has significant potential to contribute knowledge not available from another resource or site. Subsurface archaeological preservation potential within the mapped boundaries of this site is low. However, in-field observations suggest that the more-or-less undisturbed land that exists to the immediate west of this site would likely yield a large and complex assemblage of stone artefacts. Dateable hearths may also be present. Excavated evidence could be used to address a range of research questions concerning past Aboriginal settlement and subsistence patterns on a local and regional scale. WM-AS5-11 is a good example of its type. Scatters of this size and complexity are locally and regionally rare. The site contains a range of artefact, tool and raw material types, including backed artefacts, scrapers and a bifacially flaked hatchet blank.
WM-AS6-11	AS	Low	WM-AS6-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS7-11	AS	Low	WM-AS7-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS8-11	AS	Low	WM-AS8-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS9-11	AS	High	WM-AS9-11 has significant potential to contribute knowledge not available from another resource or site. Recorded surface evidence and in-field observations suggest that excavations within the mapped boundaries of this site would likely yield a large and complex assemblage of stone artefacts. Dateable hearths and other features (e.g., knapping floors) may also be present. Excavated evidence could be used to address a range of research questions concerning past Aboriginal settlement and subsistence patterns on a local and regional scale. Fanning (2012) has assessed parts of WM-AS9-11 as having high subsurface archaeological preservation potential (Appendix E). WM-AS9-11 is an excellent example of its type. Scatters of this size and complexity are locally and regionally rare.

Site name	Site type	Significance rating	Rationale
			The site contains a range of artefact, tool and raw material types, including a probable tula 'slug', a tool type typically found in arid and semi-arid contexts (Veth <i>et al.</i> 2011). The site is in fair condition.
WM-AS10-11	AS	Low	WM-AS10-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-AS11-11	AS	Moderate	WM-AS11-11 has some potential to contribute knowledge not available from another resource or site. This potential relates specifically to the hatchet reworking flake identified within this site. Information derived from the petrographic analysis of this flake could assist in addressing established research questions about the movement/exchange of edge-ground hatchets both within and outside of the study 'region' (as defined here) (i.e., Binns and McBryde 1972; Wilson 1994). Better examples of this type of site exist locally and regionally. Site condition is fair. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-AS12-11	AS	Low	WM-AS12-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is fair. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-AS13-11	AS	Moderate	WM-AS13-11 has some potential to contribute knowledge not available from another resource or site. This potential relates specifically to the bifacially flaked hatchet blank identified within this site, manufactured on green-grey rock macroscopically consistent with the andesitic greywacke outcropping at the "Daruka" hatchet quarry, north of Tamworth. Information derived from the petrographic analysis of this flake could assist in addressing established research questions about the movement/exchange of edge-ground hatchets from this source, both within and outside of the study 'region' (as defined here) (i.e., Binns and McBryde 1972; Wilson 1994). Better examples of this type of site exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS14-11	AS	Low	WM-AS14-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS15-11	AS	Low	WM-AS15-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-AS16-11	AS	Low	WM-AS16-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and

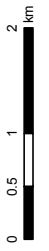
Site name	Site type	Significance rating	Rationale
			regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
WM-AS17-12	AS	Low	WM-AS17-12 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common site type (i.e., open artefact site). Better examples exist locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be moderate.
Bacon Hill 1 (29-1-0154)	AS	Low	Bacon Hill 1 is highly unlikely to contribute knowledge not available from another resource or site. The reported contents of this site suggest that it is a poor example of its type, with better examples known locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
Bacon Hill 3 (29-1-0156)	AS	Low	Bacon Hill 3 is highly unlikely to contribute knowledge not available from another resource or site. The observed and reported contents of this suggest that it is a poor example of its type, with better examples known locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
Tudgleys Hill 1 (29-1-0158)	AS	Low	Tudgleys Hill 1 is highly unlikely to contribute knowledge not available from another resource or site. The reported contents of this site suggest that it is a poor example of its type, with better examples known locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
The Wilgas 1 (29-1-0159)	AS	Low	The Wilgas 1 is highly unlikely to contribute knowledge not available from another resource or site. The reported contents of this site suggest that it is a poor example of its type, with better examples known locally and regionally. Site condition is poor. The potential for subsurface archaeological deposit(s) within the mapped boundaries of this site is considered to be low.
WM-ST1-11	ST	Low	WM-ST1-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common type of scarred tree. Better examples exist locally and regionally.
WM-ST2-11	ST	High	WM-ST2-11 has reasonable potential to contribute knowledge not available from another resource or site. The site is a good example of a locally and regionally rare form of scarred tree (i.e., resource extraction). A mid-to-late 20 th century date for scar on this tree is inferred on the basis of steel hatchet and chainsaw marks. If Aboriginal in origin, WM-ST2-11 demonstrates clearly the continuation of a traditional hunting technique into the 20 th century and provides important evidence for the continued presence of Aboriginal people in the area post-contact. The site is located within the mapped boundaries of WM-AS1-11 and, in this sense, the two sites can reasonably be considered to be 'connected'.
WM-ST3-11	ST	Moderate	WM-ST3-11 has some potential to contribute knowledge not available from another resource or site. The size of the scar on this tree (2 m+) and presence of two potential hatchet marks stand WM-ST3-11 apart from other recorded examples. The tree and scar are in very poor and poor condition respectively.

Site name	Site type	Significance rating	Rationale
WM-ST4-11	ST	High	WM-ST4-11 is an excellent example of a locally and regionally rare type of scarred tree (i.e. bark slab removal). The tree and scar are in fair and excellent condition respectively.
WM-ST5-11	ST	Low	WM-ST5-11 is highly unlikely to contribute knowledge not available from another resource or site. It is a poor example of a locally and regionally common type of scarred tree. The tree and scar are in fair and good conditions respectively.
WM-ST6-11	ST	Moderate	WM-ST6-11 is unlikely to contribute knowledge not available from another resource or site. It is, however, a good example of a locally and regionally common type of scarred tree. The tree and scar are in fair and excellent conditions respectively.
WM-ST7-11	ST	High	WM-ST7-11 is an excellent example of a locally and regionally rare form of scarred tree. Following Long (2005: 32), patterned steel axe marks on WM-ST7-11 are consistent with a European origin, as is the morphology of the scar identified. Nonetheless, given that Aboriginal people are known to have worked as station hands on local properties throughout the 20 th century (J.Delaney-John, pers. comm. May 2012), it is possible that the scar on this tree was, in fact, created by an Aboriginal person or persons. The proximity of the tree to a major Aboriginal camp site (WM-AS9-11) is also of note in this respect as is the fact that Aboriginal people living in the North West Slopes and Plains of NSW are known to have been in possession of metal axes as early as 1832 (see Mitchell 1839: 63). Accordingly, a precautionary approach is adopted here.
WM-ST8-11	ST	High	WM-ST8-11 is an excellent example of a locally and regionally rare form of scarred tree. Following Long (2005: 32), patterned steel axe marks on WM-ST8-11 are consistent with a European origin, as is the morphology of the two scars identified. Nonetheless, given that Aboriginal people are known to have worked as station hands on local properties throughout the 20 th century (J.Delaney-John, pers. comm. May 2012), it is possible that the scars on this tree were, in fact, created by an Aboriginal person or persons. The proximity of the tree to a major Aboriginal camp site (WM-AS9-11) is also of note in this respect as is the fact that Aboriginal people living in the North West Slopes and Plains of NSW are known to have been in possession of metal axes as early as 1832 (see Mitchell 1839: 63). Accordingly, a precautionary approach is adopted here.
WM-GG1-11	GG	High	WM-GG1-11 is an excellent example of a locally rare but regionally common site type. WM-GG1-11 is one of only five grinding groove sites within the study region (as defined here) with more than 50 grooves. Attention is also drawn to the rarity, in terms of size, of WM-GG1-11 within the greater North West Slopes and Plains region (see Appendix F). The site is in good condition. Fanning (2012) has assessed parts of this site as having high subsurface archaeological preservation potential (Appendix E).
WM-GG2-11	GG	Moderate	WM-GG2-11 is a good example of a locally rare but regionally common site type. Whilst comparable to isolated examples in other contexts (i.e., in respect to groove morphology and presence on outcropping sandstone), the location of the WM-GG2-11 atop a mountain (Mt Watermark) stands it apart from other examples in the study region. WM-GG2-11 has panoramic views of land to west and northwest of Mt Watermark and, as such, has considerable aesthetic value. The site is in good condition.

Site name	Site type	Significance rating	Rationale
WM-GG3-11	GG	Moderate	WM-GG3-12 is a good example of a locally rare but regionally common site type. Available AHIMS data indicate that the number of grooves present within WM-GG3-12 (n = 20) is below-average for the study region (n = 28). Fanning (pers. comm., March 2012) has assessed land in the immediate vicinity of this site as having low subsurface archaeological preservation potential. The site is in good condition.



WATERMARK COAL PROJECT
ARCHAEOLOGICAL SIGNIFICANCE



17

10.0 Impact Assessment

10.1 Project Construction Details and Impacts

As outlined in **Section 1.4** and shown on **Figure 2**, the Project involves the development of a large open cut coal mine within the Project area. Mining-related activities may potentially result in the disturbance of around 59% (5,630 ha) of land within the Project area (9,500 ha) (see Disturbance Boundary (indicative) on **Figure 2**).

Key impacts comprise open cut mining, overburden emplacement and the construction of mine-related infrastructure. Principal infrastructure projects include a Mine Infrastructure Area (MIA), a Coal Handling and Preparation Plant (CHPP), a rail spur and loop, a Mine Access Road and a comprehensive Mine Water Management System incorporating clean water catchment dams, diversions, sedimentation dams, culverts and, potentially, one or more pipelines for supplementary water supply.

A total of 54 Aboriginal archaeological sites have been identified within the Project area, with a single additional site (WM-ST2-11) located within 70 m of the Project Boundary. Excluded from this total are AHIMS registered sites 29-1-0155 (Bacon Hill 2) and 29-1-0157 (Cloveneden 1), both of which have been re-assessed as natural stone occurrences. Of the 54 sites located within the Project area, 12 are located outside of the indicative Disturbance Boundary for the Project. The remaining 42 sites fall within this boundary.

An assessment of the potential impacts of the Project on the known Aboriginal archaeological resource of the Project area is provided below.

10.2 Direct Impacts

10.2.1 Open cut mining (including overburden emplacement)

The project seeks approval for sequential open cut mining within three separate mining areas. It is anticipated that any Aboriginal archaeological sites (or portions thereof) located within the proposed open cut disturbance boundaries for these areas will be completely destroyed by mining-related earthworks. Sites in the immediate vicinity of these areas may also be significantly disturbed or destroyed, with major potential impacts including earthworks, vehicle traffic and blasting.

Consideration of the location of identified sites in relation to the open cut disturbance boundaries for the proposed Eastern, Western and Southern Mining Areas indicates that 24 sites (or parts thereof) fall within these boundaries. A further six sites are located within 100 m of open cut disturbance boundaries. A list of these 30 sites and their relationship to the proposed mining areas is provided in **Table 31**. The scientific significance ratings assigned to each site are also provided. As indicated, three of these sites have been assessed as being of high scientific significance, three as being of moderate scientific significance and 24 as being of low scientific significance.

Regarding impacts to newly identified sites WM-IF8-11, WM-IF9-11, WM-AS8-11 and WM-ST4-11, all of which are located to the immediate north of The Dip Road adjacent to the Eastern Mining Area, AECOM understands that Shenhua Watermark is committed to the *in-situ* conservation of these sites throughout the operational life of the Project and has made appropriate management recommendations to this effect (see **Section 11.2.5** below). Direct impacts are assumed for the remaining 26 sites.

Table 31 Impact Assessment: Open Cut Mining Areas and Overburden Emplacement Areas

Mining area	Site name / AHIMS ID	Site type	Significance	Relationship to mining area
Eastern	WM-IF1-11	IF	Low	c.57 m east of open cut disturbance boundary
Eastern	WM-IF3-11	IF	Low	c.35 m south of open cut disturbance boundary
Eastern	WM-IF4-11	IF	Low	Inside open cut disturbance boundary
Eastern	WM-IF5-11	IF	Low	Inside open cut disturbance boundary
Eastern	WM-IF7-11	IF	Low	Inside open cut disturbance boundary

Mining area	Site name / AHIMS ID	Site type	Significance	Relationship to mining area
Eastern	WM-IF8-11	IF	Low	Inside open cut disturbance boundary
Eastern	WM-IF9-11	IF	Moderate	Inside open cut disturbance boundary
Eastern	WM-IF10-11	IF	Low	c.39 m south of open cut disturbance boundary
Eastern	WM-IF11-11	IF	Low	Inside open cut disturbance boundary
Eastern	WM-AS2-11	AS	Moderate	Partially inside open cut disturbance boundary
Eastern	WM-AS3-11	AS	Low	Inside open cut disturbance boundary
Eastern	WM-AS4-11	AS	Low	Inside open cut disturbance boundary
Eastern	WM-AS5-11	AS	High	c. 15 m west of open cut disturbance boundary
Eastern	WM-AS6-11	AS	Low	Inside open cut disturbance boundary
Eastern	WM-AS7-11	AS	Low	Inside open cut disturbance boundary
Eastern	WM-AS8-11	AS	Low	Inside open cut disturbance boundary
Eastern	29-1-0159	AS	Low	Inside open cut disturbance boundary
Eastern	29-1-0158	AS	Low	Inside open cut disturbance boundary
Eastern	WM-ST4-11	ST	High	c.9 m south of open cut disturbance boundary
Eastern	WM-GG3-12	GG	Moderate	Inside open cut disturbance boundary
Eastern	WM-IF23-12	IF	Low	Inside open cut disturbance boundary
Eastern	WM-AS17-12	AS	Low	Inside open cut disturbance boundary
Southern	WM-AS10-11	AS	Low	c.1 m south of open cut disturbance boundary
Southern	WM-AS16-11	AS	Low	Inside open cut disturbance boundary
Southern	29-1-0154	AS	Low	Inside open cut disturbance boundary
Southern	29-1-0156	AS	Low	Inside open cut disturbance boundary
Western	WM-IF13-11	IF	Low	Inside open cut disturbance boundary
Western	WM-IF16-11	IF	Low	Inside open cut disturbance boundary
Western	WM-IF17-11	IF	Low	Inside open cut disturbance boundary

Mining area	Site name / AHIMS ID	Site type	Significance	Relationship to mining area
Western	WM-GG1-11	GG	High	Inside open cut disturbance boundary

10.2.2 Project Infrastructure

In addition to open cut mining activities, the Project is seeking approval for the construction of the following infrastructure:

- A Coal Handling and Preparation Plant (CHPP);
- A rail spur from the Project area to the Werris Creek-Moree Railway Line;
- A Mine Infrastructure Area (MIA) incorporating:
 - Administration, office and bathhouse buildings for mine employees;
 - Heavy and light vehicle parking;
 - Waste water treatment plant;
 - Electrical substation;
 - A helicopter pad;
 - Heavy and light vehicle workshops and hardstand areas;
 - Tyre change bay and storage areas;
 - Stores building and laydown areas;
 - Dangerous goods store;
 - Vehicle wash down facilities;
 - Bulk oil and fuel storage tanks and refuelling facilities; and
 - Associated water management infrastructure.
- A Mine Access Road;
- A new 'T' intersection at the intersection of the Mine Access Road and Kamilaroi Highway;
- A rail overpass; and
- A comprehensive Mine Water Management System incorporating:
 - Clean water catchment dams;
 - Diversions;
 - Sedimentation dams;
 - Culverts; and
 - Off-site water supply pipelines (if required).

Examination of the location of identified sites in relation to the above-listed infrastructure indicates that three sites - isolated finds WM-IF20-11 and WM-IF21-11 and artefact scatter WM-AS11-11 - are likely to be directly impacted by the construction of mine-related infrastructure. An additional four sites can be identified as having the potential to be directly impacted. These sites comprise artefact scatters WM-AS1-11 and WM-AS2-11 and isolated finds WM-IF3-11 and WM-IF10-11.

Impacts to WM-IF20-11 relate to the proposed rail loop whilst those to WM-IF21-11 and WM-AS11-11 relate to the proposed Mine Access Road. As indicated in **Table 32**, WM-IF20-11 is located within 10 m of the proposed rail loop. WM-IF21-11, meanwhile, is located within the footprint of the proposed Mine Access Road. WM-AS11-11 is located approximately 28 m to the east of this road. It is anticipated that all three sites will be destroyed as a result of the construction of these infrastructure items. WM-IF20-11, WM-IF21-11 and WM-AS11-11 have been assessed as being of low, moderate and moderate scientific significance respectively.

Impacts to WM-AS1-11, WM-AS2-11, WM-IF3-11 and WM-IF10-11, assessed as being of high, moderate, low and low scientific significance respectively, relate to potential off-site water supply pipeline routes (**Table 32**). Current mine plans show pipelines passing directly through parts of artefact scatters WM-AS1-11 and WM-AS2-

11 and within close proximity to isolated finds WM-IF3-11 and WM-IF10-11, both of which are located outside of proposed open cut mining and overburden emplacement areas.

Regarding potential impacts from pipeline installation, AECOM understands that there is considerable flexibility with respect to the alignment of pipeline routes and that off-site water supply may not necessarily be required for the Project. These points notwithstanding, should proposed route options be selected as is, there remains the potential for direct impacts to these sites. Impacts may derive from the installation of the pipeline itself and/or associated vehicle traffic.

Table 32 Impact Assessment: Project Infrastructure

Infrastructure item	Site name	Site type	Significance	Relationship to infrastructure
Rail loop	WM-IF20-11	IF	Low	c.9 m west of rail spur
Mine Access Road	WM-IF21-11	IF	Moderate	Inside Mine Access Road footprint
Mine Access Road	WM-AS11-11	AS	Moderate	c.28 m west of Mine Access Road
Off-site water supply pipeline	WM-AS1-11	AS	High	Pipeline route passes through site
Off-site water supply pipeline	WM-AS2-11	AS	Moderate	Pipeline route passes through site
Off-site water supply pipeline	WM-IF3-11	IF	Low	Pipeline route within 50 m of site.
Off-site water supply pipeline	WM-IF10-11	IF	Low	Pipeline route within 50 m of site.

10.2.3 General Run of Mine Activities

This impact category relates to the nine sites that fall within the indicative Disturbance Boundary for the Project but are located more than 100 m from proposed open cut mining areas and mine-related infrastructure: WM-IF12-11, WM-IF14-11, WM-IF15-11, WM-IF22-12, WM-AS9-11, WM-ST3-11, WM-ST5-11, WM-ST7-11 and WM-ST8-11 (**Table 33**). Given the presence of these sites within the Disturbance Boundary, there is a possibility that they will be directly impacted over the 30 year life of the Project. Impacts may, although not necessarily, arise from open cut mining activities and/or the construction/maintenance of mine-related infrastructure.

Regarding potential impacts to these sites, AECOM understands that Shenhua Watermark is committed to the *in-situ* conservation of these sites throughout the operational life of the Project and has made appropriate management recommendations to this effect (see **Section 11.2.1** and **Section 11.2.5** below).

Table 33 Impact Assessment: Disturbance Boundary (generic)

Site name	Site type	Significance	Nearest open cut mining area	Nearest infrastructure item
WM-IF12-11	IF	Low	Eastern (c.183 m)	Mine Infrastructure Area (c.381 m)
WM-IF14-11	IF	Low	Western (c.717 m)	Rail loop (c.340 m)
WM-IF15-11	IF	Low	Western (c.685 m)	Rail loop (c.310 m)
WM-IF22-12	IF	Low	Western (c. 755 m)	Rail loop (c.260 m)
WM-AS9-11	AS	High	Western (c.145 m)	Rail spur (c.460 m)
WM-ST3-11	ST	Moderate	Eastern (c.585 m)	Mine Infrastructure Area (c.445 m)
WM-ST5-11	ST	Low	Eastern (c.1,905 m)	Rail loop (c.365 m)
WM-ST7-11	ST	High	Western (c.830 m)	Rail loop (c. 285 m)
WM-ST8-11	ST	High	Western (c.780 m)	Rail loop (c.375 m)

10.3 Project Impact Summary

As indicated in **Section 9.1** above, a total of 54 Aboriginal archaeological sites have been identified within the Project area, with a single additional site (WM-ST2-11) located within 70 m of the Project Boundary. Excluded from this total are AHIMS registered sites 29-1-0155 (Bacon Hill 2) and 29-1-0157 (Cloveneden 1), both of which have been re-assessed as natural stone occurrences.

Of the 54 sites located within the Project area, 12 are located outside of the indicative Disturbance Boundary for the Project. With the possible exception of WM-AS1-11, none of these sites will be impacted by the Project.

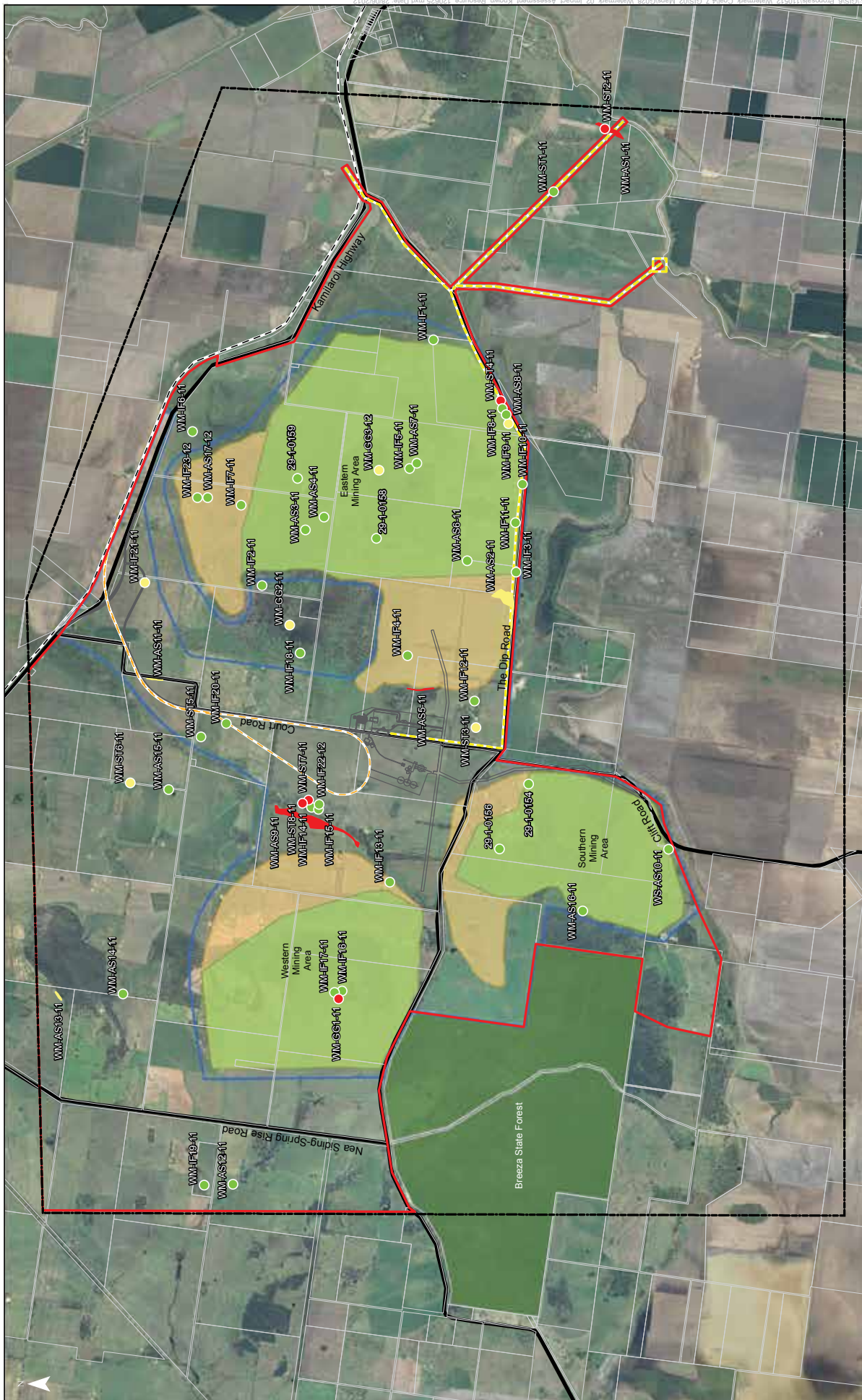
In total, 43 sites can be identified as having the potential to be directly impacted by the Project through open cut mining activities and/or the construction of mine-related infrastructure (**Table 34**). These comprise 36 open artefact sites (i.e. artefact scatters and isolates), five scarred trees and two grinding groove sites. Seven sites have been assessed as being of high scientific significance, five as being of moderate scientific significance and the remaining 31 as being of low scientific significance.

In addition to identified surface sites, it is considered likely that a body of subsurface Aboriginal archaeological material will be impacted by the Project. Management of the Aboriginal archaeological resource of the Project area must involve a consideration of this potential resource.

Table 34 Summary of impacts to known Aboriginal sites

Impact	Site ID	Site Type	Significance
Open cut mining <u>Significance Tally</u> High – 3 Moderate – 2 Low – 22	WM-IF1-11	Isolated find	Low
	WM-IF4-11	Isolated find	Low
	WM-IF5-11	Isolated find	Low
	WM-IF7-11	Isolated find	Low
	WM-IF8-11	Isolated find	Low
	WM-IF9-11	Isolated find	Moderate
	WM-IF11-11	Isolated find	Low
	WM-IF13-11	Isolated find	Low
	WM-IF16-11	Isolated find	Low
	WM-IF17-11	Isolated find	Low
	WM-IF23-11	Isolated find	Low
	WM-AS3-11	Artefact scatter	Low
	WM-AS4-11	Artefact scatter	Low
	WM-AS5-11	Artefact scatter	High
	WM-AS6-11	Artefact scatter	Low
	WM-AS7-11	Artefact scatter	Low
	WM-AS8-11	Artefact scatter	Low
	WM-AS10-11	Artefact scatter	Low
	WM-AS16-11	Artefact scatter	Low
	WM-AS17-11	Artefact scatter	Low
	29-1-0154	Artefact scatter	Low
	29-1-0156	Artefact scatter	Low
	29-1-0158	Artefact scatter	Low
	29-1-0159	Artefact scatter	Low

Impact	Site ID	Site Type	Significance
	WM-ST4-11	Scarred tree	High
	WM-GG1-11	Grinding grooves	High
	WM-GG3-12	Grinding grooves	Moderate
Open cut mining and project infrastructure <u>Significance Tally</u> High – 0 Moderate – 1 Low – 2	WM-AS2-11	Artefact scatter	Moderate
	WM-IF3-11	Isolated find	Low
	WM-IF10-11	Isolated find	Low
Project infrastructure <u>Significance Tally</u> High – 1 Moderate – 1 Low – 2	WM-IF20-11	Isolated find	Low
	WM-IF21-11	Isolated find	Low
	WM-AS11-11	Artefact scatter	Moderate
	WM-AS1-11	Artefact scatter	High
General run of mine activities <u>Significance Tally</u> High – 3 Moderate – 1 Low – 5	WM-IF12-11	Isolated find	Low
	WM-IF14-11	Isolated find	Low
	WM-IF15-11	Isolated find	Low
	WM-IF22-12	Isolated find	Low
	WM-AS9-11	Artefact scatter	High
	WM-ST3-11	Scarred tree	Moderate
	WM-ST5-11	Scarred tree	Low
	WM-ST7-11	Scarred tree	High
	WM-ST8-11	Scarred tree	High



10.4 Cumulative Impact Assessment

10.4.1 Assessment of Ecologically Sustainable Development (ESD)

In NSW, the NPW Act provides the legislative framework for the protection of Aboriginal objects and places. Section 2A(2) of the NPW Act stipulates that such protection is to be achieved by applying the principles of Ecologically Sustainable Development (ESD). ESD requires the integration of *economic* and *environmental* considerations (including cultural heritage) in decision-making processes and, in the context of Aboriginal cultural heritage, can be achieved through the implementation of two key principles: intergenerational equity and the precautionary principle.

Intergenerational equity is the principle whereby the present generation should ensure the health, diversity and productivity of the environment for the benefit of future generations. With regards to Aboriginal heritage, intergenerational equity can be assessed in terms of cumulative impacts to Aboriginal objects and places in a region. Central to any assessment of intergenerational equity is the proposition that regions with fewer Aboriginal objects and places necessarily retain fewer opportunities for future generations of Aboriginal people to enjoy their cultural heritage. Accordingly, information regarding the known and potential Aboriginal heritage resource of a given region is critical to any assessment of intergenerational equity.

The precautionary principle holds that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation. In NSW, the precautionary principle is relevant to OEH's consideration of potential impacts to Aboriginal cultural heritage in situations where:

- the proposed development involves a risk of serious or irreversible damage to Aboriginal objects or places or to the value of those objects or places; and
- there is uncertainty about the Aboriginal cultural heritage values or scientific or archaeological values, including in relation to the integrity, rarity or representativeness of the Aboriginal objects or places proposed to be impacted.

In these instances, OEH has indicated that a precautionary approach should be taken and all cost-effective measures implemented to prevent or reduce damage to Aboriginal objects and/or places (DECCW 2009b).

10.4.2 Intergenerational Equity - Cumulative Impacts of the Project

Two avenues for assessing the cumulative impact of the Project on the Aboriginal archaeological resource of the Project area can be pursued:

1. A comparison, using the results of an AHIMS search, of the known Aboriginal archaeological resource of the Project area with that of the surrounding study 'region' (as defined in **Section 9.4**); and
2. The use of existing environmental data sources (e.g., digital land use data, topographic/geological/soil landscape maps) to identify the *potential* Aboriginal heritage resource of the region as a whole.

Known Resource

A search of the AHIMS database provides a means of assessing the cumulative impact of the Project on the existing Aboriginal archaeological resource of the study 'region', defined, as above, as a 1,600 km² area centred upon the Project area and incorporating all lands in, around and between the townships of Spring Ridge, Curlewis, Breeza and Caroona. A search of the AHIMS database for this area in December 2011 returned a total of 99 records, two of which can be excluded from consideration here on the grounds that they relate to 'sites' that have been reassessed in the context of the current investigation as natural stone occurrences (i.e., non-cultural sites). A breakdown of the remaining 97 AHIMS records by site type is provided in **Table 35** below.

Table 35 AHIMS search results for study region

Site Type	Count	%
Artefact scatter	15	15.5
Artefact scatter and scarred tree	1	1
Isolated find	7	7.2
Grinding groove(s)	19	19.6
Grinding groove(s) and stone arrangement	1	1

Site Type	Count	%
Scarred tree	50	51.5
Rock engraving	1	1
Burial(s)	1	1
Burial(s) & Aboriginal Ceremony and Dreaming	1	1
Burial(s) & stone arrangement	1	1
Total	97	100

Alongside those identified within the Project area, existing Aboriginal sites in the study region offer opportunities for future research, conservation and education. Accordingly, it is necessary to quantify the impacts of the Project on this joint resource. As indicated in **Section 10.3** above, a total of 43 sites have been identified as having the potential to be directly impacted by the Project. On current evidence, these sites represent 29.1% of all known Aboriginal sites within the study region (n = 148). Assuming, for the purposes of this analysis, the destruction of all 43 sites throughout the operational life of the Project, it can be stated that the loss of these sites would constitute a significant adverse impact to the known Aboriginal archaeological resource of the region. It is, however, important to qualify this conclusion by reiterating the fact that only a fraction of the study region has been subject to archaeological survey, with very few Aboriginal archaeological investigations having been undertaken to date. The demonstrably small number of registered sites within the study region is a product of this lack of investigation and introduces a major bias into any cumulative impact calculations involving AHIMS site numbers. Of critical importance here is the observation that the *true impact* of the Project on the Aboriginal archaeological resource of the study region is likely to be significantly lower than the percentages derived from calculations involving these numbers suggest.

Significant differences in the quantity and quality of information available on AHIMS site cards preclude a detailed comparative analysis of the known archaeological resource of the Project area with the study region as a whole. Nonetheless, some general type-specific comments can be made. Turning first to open artefact sites (i.e., artefact scatters and isolates), as indicated above, a total of 36 such sites have been identified as having the potential to be directly impacted by the Project. On current evidence, these sites represent 57.1% of all known open artefact sites within the study region (n = 63). Assuming, as above, the loss of all 36 sites throughout the operational life of the Project, it is reasonable to conclude this would constitute a significant adverse impact to the known open artefact site resource of the region. Once again, however, it is essential to qualify this conclusion with the observation that it is highly likely that only a fraction of the total number open artefact sites present within the study region have, in fact, been identified and that the true impact of the Project on this resource will be significantly lower than the calculated value of 57.1% suggests. This point notwithstanding, it is pertinent to note that a comparison of the basic character of AHIMS registered (n = 23) and newly recorded (n = 40) open artefact sites within the study region suggests that at least eight of the latter can reasonably be considered to be of higher research value than any of the former. In the case of isolated finds, this assessment is made on the basis of artefact type, with three newly identified isolated finds comprising edge-ground hatchet-heads or fragments thereof. In the case of scatters, higher artefact counts and assemblage richness values are equated with increased research potential. It remains to be seen, of course, whether additional open artefact sites of comparable or higher research potential exist within the region.

Scarred trees dominate the known Aboriginal archaeological record of the study region, with 59 examples accounting for 39.9% of all known sites (n = 148). As indicated above, a total of five scarred trees have been identified as having the potential to be directly impacted by the Project. Three of these trees have assessed as being of high scientific significance, one as being of moderate significance and one as being of low significance. On current evidence, these sites represent 8.5% of all known scarred trees within the study region. On this basis, it is reasonable to conclude that the loss of all five trees would not constitute a significant adverse impact to the known scarred tree resource of the study region. Given that site cards are available for only 19 (37.3%) of the 51 AHIMS registered scarred trees within the study region, a detailed comparative analysis of the character of newly versus previously recorded scarred trees is not feasible. Nonetheless, attention is drawn to the potential for direct impacts to three scarred trees of high scientific significance, all of which (i.e., WM-ST4-11, WM-ST7-11 and WM-ST8-11) appear, on the basis of available evidence, to be regionally-rare.

Grinding groove sites are also reasonably well-represented within the study region, with 23 examples accounting for 15.4% of all known sites (n = 146). Three grinding groove sites have been recorded within the Project area, two of which (WM-GG1-11 and WM-GG3-12) have been identified as having the potential to be directly impacted

by the Project. On current evidence, these sites constitute 8.7% of all known grinding groove sites within the study region (n = 23). In keeping with the scarred tree assessment above, taken at face value, this figure is not consistent with a significant adverse impact to the known grinding groove resource of the region. This said, consideration of the nature of existing and newly recorded grinding groove sites within the study region suggests that the loss of WM-GG1-11 would, in fact, constitute a significant adverse impact to this resource. WM-GG1-11 is one of only six sites within the study region known to contain over 50 grooves and is an excellent example of its type. The site has been assessed as being of high scientific significance.

Potential Resource

Based as they are on the results of archaeological investigations covering only a fraction of the total study region, the AHIMS-derived figures presented above provide an insufficient picture of the cumulative impact of the Project on the Aboriginal archaeological resource of the study region. Accordingly, an assessment of the *potential* Aboriginal archaeological resource of this area is also required. For the present analysis, digital land use data and relevant topographic, geological and soil landscape maps have been used to prepare a provisional assessment of this resource.

Analysis of available land use data for the study region (**Table 36**) indicates that grossly modified or disturbed terrain (i.e., roads and railways, urban areas, intensive animal production areas, mined/quarried land and farm/irrigation dams) accounts for around 2.7% of land within the region. Outside of grossly disturbed areas, cropped agricultural land is particularly well represented (46.1%), as is fully to semi-cleared grazing land (41.4%). Areas specifically reserved for conservation, meanwhile, account for approximately 2.2% of land within the region, with a further 3.1% comprising intact or regenerating native forest. Natural landscape features (i.e., rivers, creeks, lakes, wetlands and rock outcrops) make up the remaining 4.6%.

Table 36 Land use analysis

Existing Land Use	Ha	%
Agriculture	73733.80	46.08
Grazing	66179.89	41.36
Rivers, creeks and lakes	7246.68	4.53
Native forest	4913.25	3.07
Conservation area	3540.30	2.21
Mining / quarrying	2156.60	1.35
Roads and railways	1171.97	0.73
Farm/irrigation dams	488.27	0.31
Urban	376.43	0.24
Intensive animal production	82.57	0.05
Cliff/rock outcrops	59.92	0.04
Wetland	50.71	0.03
Total	160,000	100

Source: NSW Landuse (ANZMeta v1.2 Metadata), June 2000-June 2007.

Viewed from an Aboriginal archaeological perspective, the results of the land use analysis presented in **Table 36** support the suggestion that the majority of the study region's Aboriginal archaeological resource represents a *potential resource*. As indicated, land upon which Aboriginal archaeological objects and features are unlikely to survive (e.g., urban areas, roads, proposed/existing mines and quarries) currently accounts for less than 5% of land within the region. This figure increases to around 90% if agricultural and grazing land is included. However, as indicated by the results of numerous Aboriginal archaeological investigations, both within and outside of the study region, cropped and grazed areas can, and frequently do, retain evidence of past Aboriginal occupation, albeit typically of lower integrity to that identified in otherwise undisturbed areas. It can, therefore, be concluded that over 95% of land within the study region has the potential to retain evidence of past Aboriginal occupation. Whilst acknowledging the fact that the nature and distribution of such evidence will vary markedly in relation to environmental variables such as landform and the availability of potable water, analysis of available land use data does help to quantify the extent of the region's potential Aboriginal archaeological resource. Moreover, it provides a basis from which assess the cumulative impact of the Project on this resource.

As indicated in **Section 10.1**, approximately 59% (5,630 ha) of land the Project area (9,500 ha) may be disturbed throughout the operational life of Project. Assuming, for the purposes of this analysis, a complete loss of archaeological potential for land inside the Project's indicative Disturbance Boundary, it can be stated that the Project will result in a c.3.6% decline in the region's potential Aboriginal archaeological resource. Upon completion of the project, it is anticipated that approximately 94% of land within the study region will remain as a potential resource, offering opportunity for the identification of a range of Aboriginal site types. Given that 94% is a *minimum value* - it is unlikely that all land within the indicative Disturbance Boundary will, in fact, be disturbed by the Project - on the basis of this evidence, it is reasonable to conclude that the impact of the Project on the potential Aboriginal archaeological resource of the region will be relatively low.

With regards to the existence, outside of the Project area, of environmental contexts that have the potential to contain sites comparable to those identified within it, an examination of relevant topographic, geological and soil landscape maps for the study region indicates that many such contexts exist. Recorded Aboriginal archaeological site types within the Project area include stone artefact scatters and isolates (i.e., open artefact sites), scarred trees and grinding grooves and it is pertinent to consider each type in turn.

Regarding open artefact sites, as demonstrated by the results of the current survey and previous archaeological investigations within and adjacent to the study region, although open artefact sites can occur in *any landform context*, they are most commonly found in contexts within 200 m of watercourses and other aquatic features such as lakes and wetlands (e.g., creek/river banks and terraces, proximal flood/drainage plains, swamp margins, lake shores). At the same time, the permanency of water sources appears to have played a critical role in influencing the intensity of occupation in their vicinity, with more permanent sources typically associated with larger and more complex sites. On the basis of this evidence, it can be confidently concluded that land outside of the current Project area but within the study region contains a significant, as yet unidentified, open artefact site resource. Landform elements within 200 m of reliable sources of potable water, in particular, retain enormous potential for the identification of open artefact sites of comparable character and significance to those identified within the Project area. Watercourses and bodies worthy of intensive investigation include the Mooki River, Lake Goran, Currabubula Creek, Quirindi Creek, Quipolly Creek, Werris Creek, Oak Creek and Curlew Swamp.

In common with open artefact sites, scarred trees within the study region have been identified in a range of environmental contexts. Together with the land use analysis detailed above, examination of relevant topographic maps suggests that there exists significant potential for the presence of additional, as yet unidentified, scarred trees outside of the Project area. Of particular note in this respect is the presence of five State Forests (Breeza, Doona, Spring Ridge, Trinkey, Goran and Wondoba) within the study region. These areas, in particular, retain significant potential for the presence of large numbers of culturally scarred trees. However, as demonstrated by the results of the current investigation and those other assessments, attention is also drawn to the frequent presence of scarred trees in areas of grazing land, with linear strips of native vegetation often surviving in road reserves and Travelling Stock Routes (TSRs). Scattered mature paddock trees may also exhibit cultural scars. Scarred trees are less likely to have survived in areas of intensively cultivated agricultural land.

Grinding groove sites tend to be found on flat to relatively flat outcrops of sandstone within close proximity to watercourses. However, as demonstrated by the grinding groove sites identified as part of the current investigation, the presence of an established or ephemeral watercourse is not a prerequisite for their presence. Consideration of available geological and topographic maps for the study region suggests that there exists significant potential for the presence of additional, as yet unidentified, grinding groove sites outside of the Project area, a proportion of which are likely to be of comparable or higher significance to those identified within it. Particular attention is drawn to the presence of large areas of terrain underlain by Triassic lithic and quartzite sandstones of the Digby Beds of the Narrabeen Group and Permian formations with sandstone components. Doona, Breeza and Goran and Wondoba State Forests are excellent examples of the former and these areas, in particular, are highly likely to contain as yet unidentified grinding groove sites. It is anticipated that the majority of sites, both within and outside of these areas, will occur in direct association with drainage lines.

10.4.3 The Precautionary Principle

As indicated in **Section 10.4.1**, the precautionary principle holds that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

In the context of the current investigation, it can be stated that AECOM has adopted a precautionary approach in our assessment of the impacts of the Project on the Aboriginal archaeological resource of the Project area and that this approach is reflected in our proposed management strategy (**Section 11.0**).

11.0 Management Strategy

11.1 Statutory Requirements

As indicated in **Section 1.1**, the Aboriginal archaeology impact assessment detailed in this report forms part of an EIS being prepared by Hansen Bailey to support Shenhua Watermark's application for State Significant Development Consent under Division 4.1 of Part 4 of the EP&A Act.

The draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) detail the relevant statutory requirements for Aboriginal cultural heritage impact assessments conducted under Division 4.1 of Part 4 of the EP&A Act. Although not statutorily binding for Division 4.1 assessments, OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) and *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011) provide 'best practice' documents for Aboriginal Cultural Heritage Impact Assessments in NSW. Both documents have been used in the formulation of the management strategy detailed below.

11.2 Management Strategy

A total of 43 Aboriginal archaeological sites have been identified as having the potential to be directly impacted by the Project through open cut mining activities and/or the construction/maintenance of Project infrastructure. At the same time, it is considered likely that a body of subsurface Aboriginal archaeological material will be impacted by the Project. A management strategy to address the potential impacts of the Project on the known and potential Aboriginal archaeological resource of the Project area is provided below. This strategy addresses all RAP concerns raised during Stage 4 of the Aboriginal community consultation process for the Project.

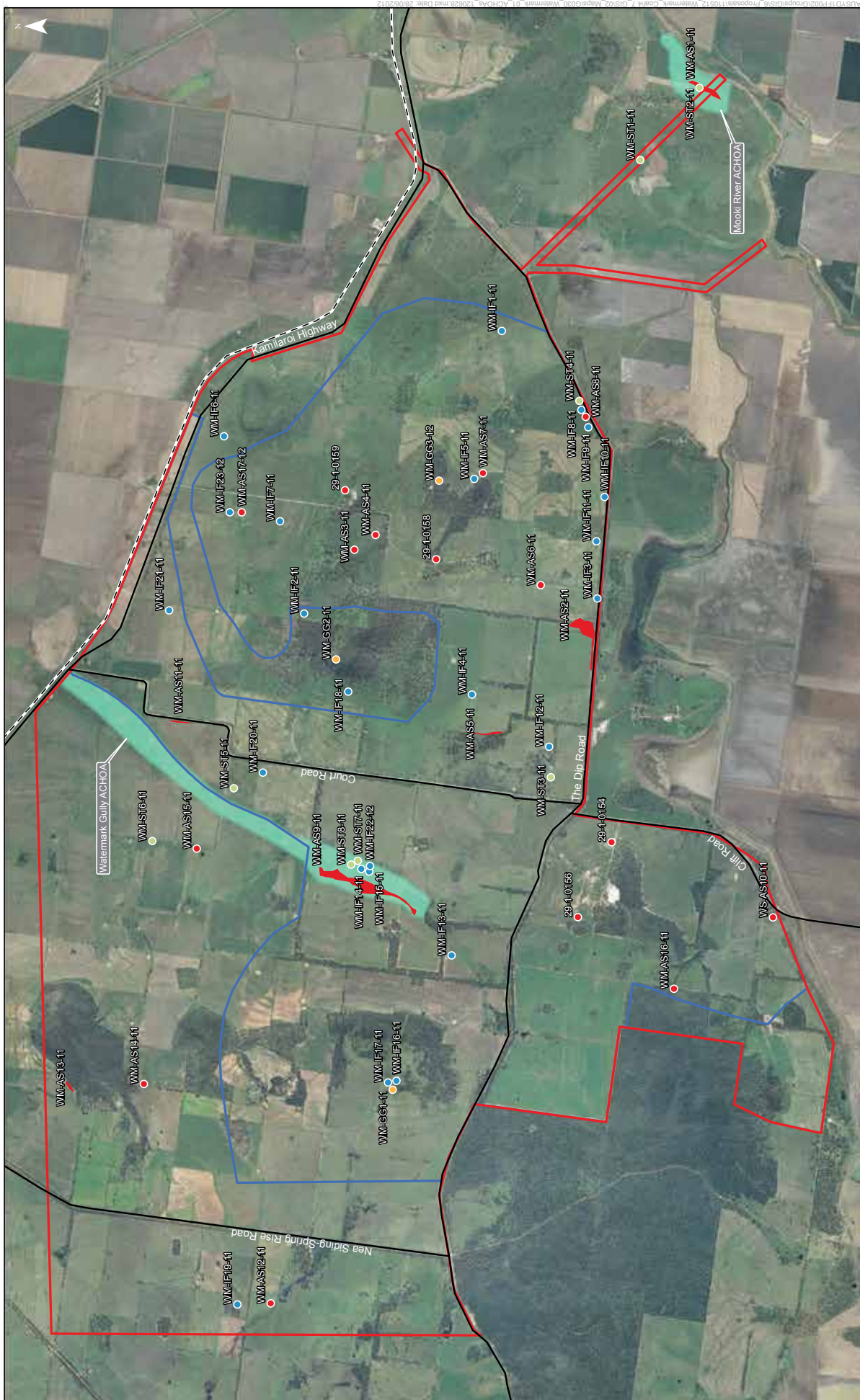
It is recommended that this strategy be detailed in an Aboriginal Cultural Heritage Management Plan (ACHMP) for the Project, which should be prepared in consultation with RAPs, OEH and DP&I. Subject to Division 4.1 Development Consent, this ACHMP will guide the management of the known and potential Aboriginal archaeological resource of the Project area.

11.2.1 Aboriginal Cultural Heritage Offset Areas

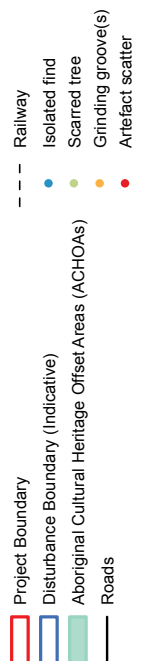
In order to offset the impact of the Project on the known and potential Aboriginal archaeological resource of the Project area, two Aboriginal Cultural Heritage Offset Areas (ACHOAs) should be established on Shenhua-owned land within and directly adjacent to the Project area: the 'Watermark Gully Aboriginal Cultural Heritage Offset Area' and 'Mooki River Aboriginal Cultural Heritage Offset Area' (**Figure 19**). Both have been identified as suitable offsets on archaeological and cultural grounds and cover areas of 165.7 and 40.7 ha respectively. Shenhua Watermark is committed to the conservation of the Watermark and Mooki River ACHOAs throughout the operational life of the Project.

The Watermark Gully Aboriginal Cultural Heritage Offset Area (Watermark Gully ACHOA) encompasses six Aboriginal archaeological sites (WM-IF14-11, WM-IF15-11, WM-IF22-12, WM-AS9-11, WM-ST7-11 and WM-ST8-11), including three sites of high scientific significance (WM-AS9-11, WM-ST7-11 and WM-ST8-11). Three out of four of the site types identified within the Project area are present within this offset area (i.e., artefact scatters, isolated finds and scarred trees). WM-AS9-11 is currently the largest and most complex Aboriginal artefact scatter known within the study 'region' for this assessment (as defined in **Section 9.4** above) and incorporates landform elements with high subsurface archaeological potential. WM-ST7-11 and WMST8-11, meanwhile, are excellent examples of a locally and regionally rare form of scarred tree. In addition to known sites, available archaeological and geomorphological data suggest that it is highly likely that this offset area contains a significant subsurface archaeological resource.

The Mooki River Aboriginal Cultural Heritage Offset Area (MRACHOA) encompasses two Aboriginal archaeological sites (WM-AS1-11 and WM-ST2-11), both of which have been assessed as being of high scientific significance on the basis of their research potential, rarity and representativeness. WM-AS1-11 is currently the second largest artefact scatter known within the study region for this assessment and incorporates a landform element (i.e., a terrace of the Mooki River) with high subsurface archaeological potential. WM-ST2-11 is a good example of a locally and regionally rare form of scarred tree (i.e., resource extraction). In common with the Watermark Gully ACHOA, available archaeological and geomorphological data suggest that it is highly likely that this offset area contains a significant subsurface archaeological resource.



WATERMARK COAL PROJECT
ABORIGINAL CULTURAL HERITAGE OFFSET AREAS (ACHOAs)



The ACHMP for the Project should include provisions specific to the Watermark and Mooki River ACHOAs. At a minimum, these will

- define precisely the boundaries of the ACHOAs;
- identify relevant parties and their responsibilities with respect to the ACHOAs;
- describe the cultural and scientific heritage values of the ACHOAs;
- identify potential threats to these values;
- discuss specific management activities including, but not limited to, soil, water, flora, fauna and fire;
- outline protocols for access; and
- discuss monitoring and reporting procedures.

The Watermark and Mooki River ACHOAs should be fenced and domestic stock excluded from both areas to allow regeneration of native vegetation and, where appropriate, the implementation of erosion and weed control measures.

11.2.2 Archaeological Salvage Program

A comprehensive archaeological salvage program should be undertaken within the Project area prior to the commencement of any Project-related ground clearance works. Should Shenhua Watermark wish to proceed with the salvage of any identified sites prior to Project and ACHMP approval, an Aboriginal Heritage Impact Permit (AHIP) will need to be applied for and granted by OEH.

The archaeological salvage program for the Project should incorporate the following four components:

1. Surface collection of 25 open artefact sites (i.e., artefact scatters and isolated finds) of low ($n = 24$) to moderate ($n = 1$) scientific significance. These sites comprise: WM-IF1-11, WM-IF3-11, WM-IF4-11, WM-IF5-11, WM-IF7-11, WM-IF10-11, WM-IF11-11, WM-IF13-11, WM-IF16-11, WM-IF17-11, WM-IF20-11, WM-IF21-11, WM-IF23-12, WM-AS3-11, WM-AS4-11, WM-AS6-11, WM-AS7-11, WM-AS10-11, WM-AS11-11, WM-AS16-11, WM-AS17-12, 29-1-0154, 29-1-0156, 29-1-0158 and 29-1-0159.

Surface collection is considered an appropriate and effective mitigation option for these sites given their contents and significance. Note that the single open artefact site of moderate scientific significance earmarked for surface collection comprises an isolated edge-ground hatchet-head. Subsurface archaeological investigations are not warranted for this site.

2. Surface collections and archaeological excavations at two newly identified open artefact sites: artefact scatters WM-AS2-11 and WM-AS5-11, assessed as being of moderate and high scientific significance respectively. Archaeological excavations at both sites will involve test and open area excavations.

Topographic surveys of WM-AS2-11 and WM-AS5-11 should be undertaken as part of archaeological salvage works at these sites. Resulting site plans should, at a minimum, show all relevant natural and man-made features within and immediately surrounding the sites as well as archaeological excavation areas (i.e., test pit and open area excavation units). Surveys should be carried out by one or more professional surveyors.

Detailed geomorphological assessments of both sites should also be undertaken for the purposes of characterising and describing exposed soils and profiles, elucidating localised landform histories and defining, where appropriate, the extent and location of ground disturbance. Assessments should be carried out by a qualified geomorphologist.

3. The relocation of newly identified grinding groove sites WM-GG1-11 and WM-GG3-12 following a comprehensive pre-removal program of works including:
 - a. Topographic mapping;
 - b. Three-dimensional photo documentation;
 - c. Cleaning and vegetation clearance for the purposes of sandstone delineation;
 - d. A program of archaeological test pitting and, if appropriate, open area hand excavation; and
 - e. A geomorphological assessment employing hand auguring.

4. A program of archaeological test pitting and open area excavation in selected areas of low and high archaeological sensitivity within the Project's indicative Disturbance Boundary, as determined through consultation with RAPs.

The ACHMP for the Project should include a detailed research design for the surface collection and excavation components of the salvage program. The methodology for the relocation of grinding groove sites WM-GG1-11 and WM-GG3-12 should also be detailed in the ACHMP.

All archaeological salvage works should be undertaken by - or under the supervision of - one or more archaeologists and one or more rostered RAP representatives. Post-salvage work for the surface collection and excavation components of the archaeological salvage program should, at minimum, include:

- The analysis and cataloguing of all recovered Aboriginal objects (e.g., stone artefacts, hearth stones) by a suitably qualified person or persons;
- Non-destructive geochemical analyses of salvaged hatchet-heads and hatchet-head fragments for the purposes of raw material characterisation and sourcing;
- The submission, where deemed appropriate by a qualified archaeologist and/or geomorphologist, of excavated charcoal samples for conventional or Accelerator Mass Spectrometry (AMS) radiocarbon dating. No more than 25 samples will be submitted for analysis;
- The submission, where deemed appropriate by a qualified geomorphologist, of excavated sediment samples for Optically Stimulated Luminescence (OSL) dating. No more than 25 samples will be submitted for analysis;
- The submission, where deemed appropriate by a qualified archaeologist, of a selection of stone artefacts for functional use-wear/residue analysis. No more than 25 artefacts will be submitted for analysis; and
- The submission, where deemed appropriate by a qualified archaeologist, of a selection of non-artefactual rock samples to a qualified geologist for the purposes of raw material identification. No more than 25 samples will be submitted for analysis.

All Aboriginal objects salvaged as part of the archaeological salvage program should be curated in an appropriate manner, as determined through consultation with RAPs, OEH and DP&I during preparation of the ACHMP. Temporary off-site storage of salvaged objects should be allowed for the purposes of analysis and recording.

Aboriginal Site Impact Recording (ASIR) forms for all salvaged sites should be submitted to OEH at the completion of the salvage program.

11.2.3 AHIMS Registered Sites 29-1-0155 and 29-1-0157

AHIMS registered sites 29-1-0155 (Bacon Hill 2) and 29-1-0157 (Clovenden 1) have been reassessed by AECOM archaeologists and rostered RAP field representatives as natural stone occurrences. Neither 'site' is considered to contain 'Aboriginal objects', as defined under the NPW Act and, as such, both have been omitted from the significance and impact assessment components of this investigation.

AECOM's reassessment notwithstanding, it is noted that both 'sites' will be directly impacted by the proposed southern (29-1-0155) and eastern (29-1-0157) open cut mining operations. Accordingly, both 'sites' should be re-inspected by RAPs and a qualified archaeologist as part of the surface collection component of the archaeological salvage program. Should any Aboriginal objects be identified in either site, these should be salvaged in accordance with the surface collection methodology detailed in the ACHMP for the Project.

In respect of RAP wishes, AECOM will not seek to modify the site cards for 29-1-0155 and 29-1-0157. If in the future, RAPs agree with AECOM's reassessment of 29-1-0155 and 29-1-0157, the ASIR forms for both 'sites' should reflect this.

11.2.4 Staged Clearance Process

In recognition of poor GSV conditions within the Project area and RAP concerns regarding survey coverage, a staged Aboriginal heritage clearance process for proposed impacts areas within the indicative Disturbance Boundary should be undertaken.

Areas earmarked for disturbance by Shenhua Watermark should be subject to archaeological survey on a priority basis. All survey should be undertaken on foot by a combined field team of one or more archaeologists and

rostered RAP representatives. Where no Aboriginal archaeological materials are identified, areas should be deemed 'cleared for disturbance' and designated as such in writing by the attending archaeologist(s) and RAPs.

Management actions for any newly identified Aboriginal archaeological sites can be implemented as outlined in the ACHMP for previously unrecorded Aboriginal archaeological evidence.

11.2.5 Conservation of Non-Impacted Sites Outside of ACHOAs

All Aboriginal archaeological sites that fall outside of the Watermark and Mooki River ACHOAs but will not be impacted by the Project¹⁴ (n = 18) should be conserved *in-situ* (**Table 37**). Sites should be protected via permanent stock-proof fencing and appropriate associated signage. All relevant staff and contractors should be made aware of the nature and locations of these sites as well as Shenhua Watermark's legal obligations with respect to them. Protected sites should be identified on all relevant mine site plans.

Table 37 List of sites for permanent protective fencing and signage

Site ID / Name	Site Type	Scientific Significance
WM-IF2-11	Isolated find	Low
WM-IF6-11	Isolated find	Low
WM-IF8-11	Isolated find	Low
WM-IF9-11	Isolated find	Moderate
WM-IF12-11	Isolated find	Low
WM-IF18-11	Isolated find	Low
WM-IF19-11	Isolated find	Low
WM-AS8-11	Artefact scatter	Low
WM-AS12-11	Artefact scatter	Low
WM-AS13-11	Artefact scatter	Moderate
WM-AS14-11	Artefact scatter	Low
WM-AS15-11	Artefact scatter	Moderate
WM-GG2-11	Grinding groove	Moderate
WM-ST1-11	Scarred tree	Low
WM-ST3-11	Scarred tree	Moderate
WM-ST4-11	Scarred tree	High
WM-ST5-11	Scarred tree	Low
WM-ST6-11	Scarred tree	Moderate

11.2.6 Annual Monitoring of Conserved Sites

Provisions for the monitoring of all conserved Aboriginal archaeological sites within the Project area should be included in the ACHMP for the Project. Monitoring should be undertaken on an annual basis by a qualified archaeologist (mutually agreed by RAPs and Shenhua Watermark) and RAP representatives. Photographic and written records of each site should be compiled as basis for assessing, and where necessary, addressing changes in site condition over the operational life of the Project. Monitoring inspections should be documented in the form of short monitoring reports.

11.2.7 Third Party Review of Australian Tree Consultant's Arboricultural Assessment Report

RAPs involved in the Project have raised concerns regarding the process undertaken to assess potential Aboriginal scarred trees, which included an inspection of all trees by a professional arborist, and subsequent decision making about which trees were likely to be Aboriginal in origin, without RAP involvement.

¹⁴ As determined through consultation with Hansen Bailey and Shenhua Watermark and/or an assessment of their position in relation to proposed open cut mining areas and project infrastructure.

To address RAP concerns, an independent third party review of Australian Tree Consultant's arboricultural assessment report should be undertaken by a person or persons mutually selected by the RAPs and Shenhua Watermark. As part of this third party review, a plain English report detailing the results of this review should be prepared for RAPs. It is anticipated that the third party review will require an additional field investigation.

11.2.8 AHIMS Site Cards

AHIMS site cards should be submitted to OEH in a timely fashion for all newly recorded Aboriginal archaeological sites within and directly adjacent the Project area (n = 51). These comprise 23 isolated finds, 17 artefact scatters, eight potential Aboriginal scarred trees and three grinding groove sites.

In the event that a previously unidentified Aboriginal site is discovered within the Project area at any point during the operational life of the Project, an AHIMS site card for that site should be submitted to OEH as promptly as possible. Timing protocols for the submission of AHIMS site cards should be included in the ACHMP for the Project.

11.2.9 Previously Unrecorded Aboriginal Archaeological Evidence

Provisions regarding the appropriate management action(s) for previously unrecorded Aboriginal archaeological evidence identified within the Project area throughout the operational life of the Project should be incorporated into the ACHMP. Management action(s) will vary according to the type of evidence identified, its significance (both scientific and cultural) and the nature of potential impacts.

11.2.10 Human Skeletal Remains

In the event that possible human skeletal remains are identified within the Project area throughout the operational life of the Project, the following standard procedure, to be detailed in the ACHMP for the Project, should be followed.

1. All work in the vicinity of the remains should cease immediately;
2. The location should be cordoned off and the appropriate authorities notified; and
3. A physical or forensic anthropologist should be commissioned to inspect the remains *in situ* and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or modern).

Subsequent management actions will be dependent on the findings of the inspection undertaken under Point 3.

- If the remains are identified as modern and human, the area will become a crime scene under the jurisdiction of the NSW Police;
- If the remains are identified as pre-contact or historic Aboriginal, the site will be secured and OEH and all RAPs notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided, remains will be retrieved via controlled archaeological excavation and reburied outside of the Disturbance Boundary in a manner and location determined by RAPs;
- If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Branch contacted; and
- If the remains are identified as non-human, work can recommence immediately.

11.2.11 Aboriginal Site Database

A comprehensive Aboriginal Site Database for the Project area and its immediate environs should be established upon commencement of the Project. Shenhua Watermark would be responsible for the creation and maintenance of this database which will, at a minimum, contain the name, type, size (where applicable), MGA coordinates and status of all Aboriginal sites within and directly adjacent to the Project area (i.e., within 100 m of the Project Boundary). The database should be regularly updated throughout the operational life of Project. Printed site lists and maps should be made available to RAPs upon request.

11.2.12 Reporting under the ACHMP

All Aboriginal heritage management and mitigation works carried out under the ACHMP for the Project should be documented to a standard comparable to that required by the *Code of Practice for Archaeological Investigation of Aboriginal Objects 2010* (DECCW 2010a). Plain English summaries of technical archaeological salvage reports

should also be prepared. Printed and/or digital copies of all archaeological salvage reports (plain English and technical) should be made available to RAPs upon request.

11.2.13 Continuing Access to Non-Salvaged Sites for Archaeological Research Purposes

Provisions regarding continuing access to non-salvaged sites within and outside of the indicative Disturbance Boundary for the Project for archaeological research purposes should be included in the ACHMP for the Project. Requests will be assessed by Shenhua Watermark, in consultation with RAPs and OEH, on the basis of merit. Where granted, access would be subject to relevant operational and safety considerations. Access to some areas would be restricted during periods of construction or mining.

11.2.14 Periodic Review of ACHMP

The ACHMP for the Project should be subject to periodic review to ensure that all management policies are being adhered to and are working effectively. Periodic reviews will also provide an opportunity to make modifications to existing policies and to add, where appropriate, new policies.

12.0 References Cited

- Allen, F.J & R. Jones. 1980. Oyster Cove: archaeological traces of the last Tasmanians and notes on the criteria for the authentication of flakes glass artefacts. *Papers and Proceedings of the Royal Society of Tasmania* 114:225-233.
- Allen, J. & J. F.O'Connell, J.F. 1995. Introduction, in J.Allen & J.F. O'Connell (eds.), *Transitions: Pleistocene to Holocene in Australia and Papua New Guinea*, pp. 7-9. *Antiquity* 265.
- Andrefsky, W. 2006. *Lithics: macroscopic approaches to analysis*. 2nd ed. Cambridge: Cambridge University Press.
- Archaeological Surveys & Reports Pty Ltd. 2004. *Aboriginal heritage assessment for proposed Werris Creek Coal Mine*. Unpublished report to Werris Creek Coal Pty Ltd.
- Attenbrow, V. 2007. *What's changing? Population size or land-use patterns? The archaeology of Upper Mangrove Creek, Sydney Basin*. Terra Australis 21. Canberra: ANU E-Press.
- Attenbrow, V. 2010. *Sydney's Aboriginal Past*. 2nd ed. Sydney: UNSW Press
- Attenbrow, V., G. Robertson & P. Hiscock. 2009. The changing abundance of backed artefacts in south-eastern Australia: a response to Holocene climate change. *Journal of Archaeological Science* 36:2765-2770.
- Austin, P.K. 1992. *Dictionary of Gamilaraay, northern New South Wales*. Melbourne: La Trobe University.
- Austin, P.K. 2011. The Gamilaraay (Kamilaroi) language, northern New South Wales: a brief history of research. Retrieved from www.hrelp.org/aboutus/staff/peter_austin/AustinGamilar.pdf
- Austin, P., C.Williams & S.A. Wurm. 1980. The linguistic situation in north central New South Wales. In B.Rigsby & P.Sutton (eds.) *Papers in Australian linguistics No. 13: Contributions of Australian linguistics*, pp.167-80. Canberra: Pacific Linguistics.
- Balme, J. 1986. *The North-Central Rivers Archaeological Research Project*. Unpublished report to NSW National Parks and Wildlife Service.
- Barton, H. 2003. The thin film of human action: interpretations of arid zone archaeology. *Australian Archaeology* 57: 32-41.
- Banks, R.G. 1995. *Soil landscapes of the Curlew 1:100 000 Sheet (Breeza, Carroona, Pine Ridge, Colly Blue, Goran Lake)*. Sydney: Department of Conservation and Land Management.
- Beaton, J.M. 1985. Evidence for a coastal occupation time-lag at Princess Charlotte Bay (north Queensland) and implications for coastal colonization and population growth theories for Aboriginal Australia. *Archaeology in Oceania* 20:1-20.
- Beck, W., I. Davidson & P. Gaynor. nd. *Article describing an excavation at Kawambarai cave in 1987*. Unpublished manuscript held at Gunnedah Shire Library.
- Beck, W. & D. Murphy. 2006. Plant remains from Kawambarai Cave, near Coonabarabran, Eastern Australia. In J. Balme & A. Paterson (eds) *Archaeology in Practice: a student guide to archaeological analyses*: 305-10. Oxford: Blackwell Publishing.
- Bell, D. 1983. *Daughters of the dreaming*. Sydney: McPhee Gribble/George Allen & Unwin.
- Berdnt, R.M. & C.H.Berdnt. 1988. *The world of the first Australians. Aboriginal traditional life: past and present*. Canberra: Aboriginal Studies Press.
- Bickford, A. & S.Sullivan. 1984. Assessing the research significance of historic sites, in S.Sullivan & S.Bowdler (eds), *Site survey and significance assessment in Australian Archaeology*, pp.19-26. Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.
- Binns, R.A. & I. McBryde. 1972. *A petrological analysis of ground-edge artefacts from northern New South Wales*. Australian Aboriginal Studies Prehistory and Material Culture Series 10. Canberra: Australian Institute of Aboriginal Studies.
- Bird, C. & J.W.Rhoads. 2011. Topographic archaeology revisited: regional archaeological structure in the southern Wimmera, Victoria, Australia. *Records of the Western Australian Museum* 79: 109-122.

- Bowdler, S. 1981. Unconsidered trifles? Cultural resource management, environmental impact statements and archaeological research in NSW. *Australian Archaeology* 12:123-33.
- Bowler, J.M., R.Jones, H.Allen & A.G.Thorne. 1970. Pleistocene human remains from Australia: a living site and human cremation from Lake Mungo, western New South Wales. *World Archaeology* 2:39-60.
- Broughton, A. 1994. *Mooki River catchment hydrogeological investigation and dryland salinity studies*. Unpublished report for Department of Water Resources.
- Brown, O.J.F. 2010. Aboriginal cultural heritage and mapping: aspects of cultural boundaries, sub-bioregions and site distribution in the Sydney Basin. *Archaeological Heritage* 2:9-16.
- Brumm, A. & M. Moore. 2005. Symbolic revolutions and the Australian archaeological record. *Cambridge Archaeological Journal* 15(2): 157-175.
- Bureau of Meteorology. 2011. Bureau of Meteorology Climate Data Online, viewed 15 September 2011, <<http://www.bom.gov.au/climate/data/>>.
- Burke, H. & C. Smith. 2004. *The archaeologist's field handbook*. Crows Nest: Allen & Unwin.
- Byrne, D. & M. Nugent. 2004. *Mapping attachment: a spatial approach to Aboriginal post-contact heritage*. Sydney: Department of Environment and Conservation.
- Connect for Effect. 2012. *Resilience, identity, connections and legacy – enduring cultural, historic, social, aesthetic and scientific values and significance. Aboriginal cultural heritage values assessment report - proposed Shenhua Watermark project NSW*. Unpublished report to Hansen Bailey for Shenhua Watermark.
- Cooper, Z. & S. Bowdler. 1998. Flaked glass tools from the Andaman Islands and Australia. *Asian Perspectives* 31(1): 74-83.
- Corkill, T. 1999. *Here and there: links between stone sources and Aboriginal archaeological sites in Sydney, Australia*. Unpublished Master of Philosophy thesis, Department of Archaeology, University of Sydney, Sydney.
- Coutts, P.J.F. & D.C. Witter. 1977. *A guide to recording archaeological sites in Victoria*. Melbourne: Ministry for Conservation.
- Cumberland Ecology. 2011. *Watermark Coal Project: ecological impact assessment*. Unpublished report for Hansen Bailey.
- MacDonald, K. & I. Davidson. 1998. *The Bayswater Archaeological Research Project*. Unpublished report to the Bayswater Colliery Company Pty Ltd.
- Dean-Jones, P. & P.B. Mitchell. 1993. *Hunter Valley Aboriginal Sites Assessment Project: environmental modelling for archaeological site potential in the Central Lowlands of the Hunter Valley*. Unpublished report to NSW National Parks and Wildlife Service.
- DECCW. 2009. Operational policy: protecting Aboriginal cultural heritage. Sydney: Department of Environment, Climate Change and Water NSW.
- DECCW. 2010a. *Code of practice for archaeological investigation of Aboriginal objects in New South Wales*. Sydney: Department of Environment, Climate Change and Water NSW.
- DECCW. 2010b. *Aboriginal cultural heritage consultation requirements for proponents*. Sydney: Department of Environment, Climate Change and Water NSW.
- Dodson, J.R. & R.V.S.Wright. 1989. Humid to arid to subhumid vegetation shift on Pilliga Sandstone, Ulungra Springs, New South Wales. *Quaternary Research* 32: 182-92.
- Doleman, T. 2008. *Time to quarry: the archaeology of stone procurement in northwestern New South Wales, Australia*. Bar International Series 1801. Oxford: Archaeopress.
- Draper, N. 1987. Context for the Kartan: a preliminary report on excavations at Cape du Couedic rockshelter, Kangaroo Island. *Archaeology in Oceania* 22: 1-8.
- Durrant, D. & L.Roworth. 1973. Breeza: history of the district and centenary of education 1973. *Historical notes: Quirindi and District Historical Society*. Volume II(4).
- Ebert, J.I. 1992. *Distributional archaeology*. Albuquerque: University of New Mexico Press.

- Fanning, P.C. 2002. *Beyond the divide: a new geoarchaeology of Aboriginal stone artefact scatters in Western New South Wales, Australia*. PhD thesis, Macquarie University, Sydney, Australia.
- Fanning, P.C., S.J. Holdaway & E.J. Rhodes. 2008. A new geoarchaeology of Aboriginal artefact scatters in western NSW, Australia: establishing spatial geomorphic controls on the surface archaeological record. *Geomorphology* 101: 524-532.
- Fison, L. & A.W. Howitt. 1880. *Kamilaroi and Kurnai*. Photomechanic reprint 1967. New York: Humanities Press Inc.
- Flood, J. 1999. *Archaeology of the dreamtime: the story of prehistoric Australia and its people*. 3rd ed. Sydney: Harper Collins Publishers.
- Foley, R. 1981. Off-site archaeology: an alternative approach for the short-sighted. In I. Hodder, G. Issac & N. Hammond (eds.), *Patterns of the past: studies in honour of David Clarke*, pp. 157-183. Cambridge: Cambridge University Press.
- Gaynor, P. 1996. *The importance of quartz in stone artefact assemblages: a technological analysis of five Aboriginal sites of the Coonabarabran/Warrumbungle Region*. Unpublished MA thesis, University of New England, Armidale.
- Gaynor, P. 1997. *Short accounts of the findings from the examination of Coonabarabran/Warrumbungle Aboriginal stone artefacts recovered the excavation of the Crazyman Shelter 1989, the salvage of Jack Halls Creek Camp Site 1991, a small excavation at Camp Pincham 1988, and the excavation of the Ukerbaerley Hayshed site 1990*. Unpublished manuscript held at Gunnedah Shire Library.
- Gaynor, P. & J. Wilson. 1995. *An archaeological survey of the proposed andesite quarry at Currabubula, NSW*. Unpublished report to Valerie Smith & Associates.
- Geneste, J.M., B. David, H. Pilsson, C. Clarkson, J.J. Delannoy, F. Petchey & R. Whear. 2010. Earliest evidence for ground-edge hatchets: 35,400±410 cal BP from Jawoyn Country, Arnhem Land. *Australian Archaeology* 71: 66-69.
- Godwin, L. 2011. The application of assessment of cumulative impacts in cultural heritage management: a critique. *Australian Archaeology* 73: 88-91.
- "Goorie" Aboriginal Heritage Consultancy. 1995. *An investigation for Aboriginal sites and relics of a proposed optic fibre cable route from Spring Ridge to Red Bobs Exchange*. Unpublished report to Telstra.
- Gorecki, P.P. 1980a. *Forty one trips and a few tests: Tambar Springs 1980*. Unpublished report to NSW National Parks and Wildlife Service.
- Gorecki, P.P. 1980b. *Killawarra Shelter: auger sampling of 100 cm² - August 1980*. Unpublished report to NSW National Parks and Wildlife Service.
- Gorecki, P.P. 1980c. *Scully 1189 (TS 868266)*. Unpublished report to NSW National Parks and Wildlife Service.
- Gorecki, P.P., D. Gojak, P. Greenwood, C. Houghton-James & K. Pratt. 1980. *Malloka (Lake Goran) test excavation: report on excavation of 3m² - August 1980*. Unpublished report to NSW National Parks and Wildlife Service.
- Gorecki, P.P., D.R. Horton, N. Stern & R.V.S. Wright. 1984. Coexistence of humans and megafauna in Australia: improved stratified evidence. *Archaeology in Oceania* 19(3): 117-19.
- Gould, R.A. 1969. Puntutjarpa Rockshelter: a reply to messrs. Glover and Lampert. *Archaeology and Physical Anthropology in Oceania* 4: 229-237.
- Greenaway, Rev. C.C. 1910a. Kamilaroi Tribe. *Science of Man* 11(10): 197-200.
- Greenaway, Rev. C.C. 1910b. Kamilaroi Tribe. *Science of Man* 11(10): 217-218.
- Hall, J. 1999. The impact of sea level rise on the archaeological record of the Moreton region, southeast Queensland, in J. Hall & I.J. McNiven (eds.) *Australian coastal archaeology*, pp. 169-84. Canberra: ANH Publications, Department of Archaeology and Natural History, RSPAS, The Australian National University.
- Hansen Bailey. 2011. *Watermark Coal Project. Preliminary Environmental Assessment October 2011*. Unpublished report to Shenhua Watermark Coal Pty Ltd Limited.

- Harrison, R. 1996. *'It's the way it shatters that matters': an analysis of Aboriginal glass artefacts from the Shark Bay and Swan regions, Western Australia*. Unpublished BA (Hons) thesis, University of Western Australia, Perth.
- Harrison, R. 2000. "Nowadays with glass": regional variation in Aboriginal bottle glass artefacts from Western Australia. *Archaeology in Oceania* 35(1): 34-47.
- Holdaway, S. 1993. *Archaeological assessment standards and methodological design*. Unpublished report to NSW NPWS.
- Holdaway, S., P.C.Fanning & D.Witter. 2000a. *Report of the Western New South Wales Archaeological Project*. Unpublished report to NSW NPWS.
- Holdaway, S., P.C.Fanning & D.Witter. 2000b. Prehistoric Aboriginal occupation of the rangelands: interpreting the surface archaeological record of far western New South Wales. *The Rangelands Journal* 22(1): 58-71.
- Holdaway, S.J., P.C. Fanning, D. Witter, M. Jones, G. Nicholls & J.Shiner. 2002. Variability in the chronology of Late Holocene Aboriginal occupation on the arid margin of southeastern Australia. *Journal of Archaeological Science* 29:351-363.
- Holdaway, S.J., P.C. Fanning & J. Shiner. 2005. Absence of evidence or evidence of absence? Understanding the chronology of Indigenous occupation of western New South Wales, Australia. *Archaeology in Oceania* 40: 33-49.
- Holdaway, S.J., J. Shiner & P.C. Fanning. 2004. Hunter-gatherers and the archaeology of the long term: an analysis of surface stone artefact scatters from Sturt National Park, New South Wales, Australia. *Asian Perspectives* 43(1): 34-72.
- Hiscock, P. 1994. Technological responses to risk in Holocene Australia. *Journal of World Prehistory* 8(3): 267-291
- Hiscock, P. 1999. Holocene coastal occupation of western Arnhem Land, in J. Hall & I.J. McNiven (eds.) *Australian coastal archaeology*, pp.91-104. Canberra: ANH Publications, Department of Archaeology and Natural History, RSPAS, The Australian National University.
- Hiscock, P. 2006. Blunt and to the point: changing technological strategies in Holocene Australia, in I. Lilley (ed.), *Archaeology in Oceania: Australia and the Pacific Islands*, pp.69-95. London: Blackwell.
- Hiscock, P. & V. Attenbrow. 2002. Morphological and reduction continuums in eastern Australia: measurement and implications at Capertee 3. In S.Ulm, C. Westcott, J. Reid, A. Ross, I.Lilley, J. Prangnell & L. Kirkwood (eds) *Barriers, borders, boundaries. Proceedings of the 2001 Australian Archaeological Association Annual Conference, Tempus 7*: 164-174. Brisbane: Anthropology Museum, University of Queensland.
- Hiscock, P. & V. Attenbrow. 2003. Early Australian implement variation: a reduction model. *Journal of Archaeological Science* 30: 239-249.
- Hiscock, P. & V. Attenbrow. 2005. *Australia's Eastern Regional Sequence Revisited: technology and change at Capertee 3*. BAR International Series 1397. Oxford: Archaeopress.
- Hiscock, P. 2008. *Archaeology of Ancient Australia*. London: Routledge.
- Hudson, S.R. 1997. An archaeological survey of the proposed Lochaber irrigation development on 'Lochaber', Spring Ridge Road, Carroona, NSW. Unpublished report to George Clift, "Birriwa", Carroona, NSW.
- Australia ICOMOS. 1999. *The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance*. Burwood: Australia ICOMOS Incorporated.
- Jo McDonald CHM. 1998. *Aboriginal archaeology and European heritage assessments of sites along the proposed natural gas pipeline Dubbo-Tamworth (& Gunnedah)*. Unpublished report to Manisis Roberts Consultants on behalf of AGL.
- Kuhn, S. 1995. *Mousterian lithic technology: an ecological approach*. Princeton: Princeton University Press.
- Kuskie, P.J. 2000. *An Aboriginal archaeological assessment of the proposed Mount Arthur Coal Mine, near Muswellbrook, Hunter Valley, New South Wales*. Unpublished report to URS Australia Pty Ltd.
- Kuskie, P.J. 2009. Ulan Coal Continued Operations: *Aboriginal heritage assessment*. Volume A. Unpublished report to Umwelt (Australia) Pty Ltd.

- Kuskie, P.J. & E.A. Clarke. 2004. *Salvage of Aboriginal heritage sites in the Mount Arthur North Coal Mine Lease, Hunter Valley, New South Wales*. Volume A. Unpublished report to BHO Billiton – Hunter Valley Energy Coal. Central West Archaeological and Heritage Services. 1998. *An archaeological survey of the proposed Piallaway optic fibre cable route, near Gunnedah, NSW North West Plains*. Unpublished report to Telstra Environmental Evaluation Team.
- Lampert, R.J. 1981. *The great Kartan mystery*. Terra Australis 5. Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.
- Lampert, R.J. 1983. The Kartan mystery revisited. *Australian Archaeology* 16: 175-77.
- Long, A. 2005. *Aboriginal scarred trees in New South Wales: a field manual*. Sydney: Department of Environment, Climate Change and Water.
- Lourandos, H. 1997. *Continent of hunter-gatherers: new perspectives in Australian prehistory*. Cambridge: Cambridge University Press.
- Lourandos, H. & A. Ross. 1994. The great 'intensification' debate: its history and place in Australian archaeology. *Australian Archaeology* 39: 54-63.
- Matthews, R.H. 1897. The Bora of the Kamilaroi tribe (Talwood). *Journal of the Royal Society of Victoria* 9: 137-73.
- Matthews, R.H. 1898. The Kamilaroi divisions. *Science of Man* 1(7): 155-58.
- Matthews, R.H. 1903. Languages of the Kamilaroi and other tribes of New South Wales (Bigamul and Guinbrai). *Journal of the Royal Anthropological Institute* 33: 259-83.
- Matthews, R.H. 1917. Description of two bora grounds of the Kamilaroi tribes (at Terry Hie Hie and Kunopia). *Journal of the Royal Society of New South Wales* 51: 423-30.
- McBryde, I. 1974. *Aboriginal prehistory in New England*. Sydney: Sydney University Press.
- McBryde, I. 1977. Determinants of assemblage variation in New England prehistory: environment, subsistence economies, site activities, or cultural tradition. In R.V.S. Wright (ed.), *Stone tools as cultural markers: change, evolution and complexity*, pp. 225-250. Canberra: Australian Institute of Aboriginal Studies.
- McBryde, I. 1991. *Stone quarry site on 'Daruka', Moore Creek, northern New South Wales*. Unpublished report to NSW National Parks and Wildlife Service.
- McCarthy, F.D. 1941. An hatchet quarry at Moor Creek, Tamworth District, New South Wales. *Records of the Australian Museum* 21(1): 19-20.
- McCarthy, F.D. 1948. The Lapstone Creek excavation. Two culture periods revealed in eastern New South Wales. *Records of the Australian Museum* 22(1):1-34.
- McCarthy, F.D. 1961. Regional reports: Australia. *Asian Perspectives* 5(1):98-104.
- McCarthy, F.D. 1964. The archaeology of the Capertee Valley, New South Wales. *Records of the Australian Museum* 26(6):197-246.
- McCarthy, F.D. 1967. *Australian Aboriginal stone implements*. 2nd ed. Sydney: The Australian Museum Trust.
- McNiven, I. 1992. Shell middens and mobility: the use of off-site faunal remains, Queensland, Australia. *Journal of Field Archaeology* 19:495-508.
- Mitchell, T.L. 1839. Three expeditions into the interior of eastern Australia with descriptions of the recently explored region of Australia felix and of the present colony of New South Wales. 2 Vols. London: T & W Boone.
- Moore, M.W. 2004. The Tula adze: manufacture and purpose. *Antiquity* 78(299): 61-73.
- Moorwood, M.J. & P.J. Trezise. 1989. Edge-ground hatchets in Pleistocene greater Australia: new evidence from S.E. Cape York Peninsula, Australia. *Queensland Archaeological Research* 6:77-90.
- Niemoeller, G. & D. Guse. 1999. Inter-regional variation in glass bottle reduction and technology in the Northern Territory. *Australian Archaeology* 48: 47-48.
- Patterson, A. 1999. *Confronting the sources: the archaeology of culture-contact in the south-western Lake Eyre Basin, Central Australia*. Unpublished PhD thesis, University of Sydney, Sydney.

- NSW National Parks and Wildlife Service. 1997. *Standards for archaeological practice in Aboriginal heritage management*. Hurstville: NSW NPWS.
- Nexus Archaeology & Heritage. 2009. *Desktop investigation of Aboriginal and historical cultural heritage: Shenhua Watermark Coal Project – Exploration Drilling, Breeza, NSW*. Unpublished report to Shenhua Watermark Coal Pty Ltd.
- O'Rourke, M. 1997. *The Kamilaroi lands: north-central New South Wales in the early 19th century*. Griffith: Self published.
- O'Rourke, M. 2005. "Sung for Generations": 'Old' Joe Bungaree's tales about Red Kangaroo, an 18th century Gamilaraay 'Big-Man' of the central Namoi River NSW: The "Red Chief" of Ion Idriess. Braddon, ACT: Self published.
- Pearson, M. & S.Sullivan. 1995. *Looking after heritage places: the basics of heritage planning for managers, landowners and administrators*. Melbourne: Melbourne University Press.
- Purcell, P. 2000. Aboriginal cultural heritage assessment Stage 1 - preliminary report. NSW Western Regional Assessments.
- Rhodes, E.J., P.Fanning, S.Holdaway & C. Bolton. 2009. Archaeological surfaces in western NSW: stratigraphic contexts and preliminary OSL dating of hearths. In A.Fairburn, S. O'Connor & B.Marwick (eds), *New Directions in Archaeological Science*, pp. 189-200. Terra Australis 28. Canberra: ANU E-Press.
- Ridges, M. 2010. *Aboriginal Sites Decision Design Tool (ASDST): state-wide product online and technical summary*. Sydney: Department of Environment, Climate Change and Water.
- Ridley, W. 1866. *Kamilaroi, Dippil, and Turrubul: languages spoken by Australian Aborigines*. Sydney: Government Printer.
- Ridley, W. 1875. *Kamilaroi and other Australian languages*. Sydney: Government Printer.
- Robins, R.P. 1997. Patterns in the landscape: a case study in nonsite archaeology from southwest Queensland. *Memoirs of the Queensland Museum, Cultural Heritage Series* 1(1):23-56.
- Roworth, H. 2000. *Kamilaroi dreaming: a history of the Aboriginal people of the Quirindi area before 1850*. Quirindi: Quirindi Newspaper Company.
- Shiner, J. 2008. *Place as occupational histories: an investigation of the deflated surface archaeological record of Pine Point and Langwell Stations, Western New South Wales, Australia*. BAR International Series 1763. Oxford: British Archaeological Reports.
- Smith, M.A. 1985. A morphological comparison of Central Australian seedgrinding implements and Australian Pleistocene grindstones. *The Beagle* 2(1): 23-38.
- Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. *Transactions of the American Geophysical Union* 8(6): 913-920.
- Strata Control Technology. 2012. Geotechnical and geomorphology investigation of the WM-GG1 and WM-GG3-12 grinding groove sites. Unpublished report to Hansen Bailey.
- Tindale, N.B. 1937. Relationship of the extinct Kangaroo Island culture with cultures of Australia. *Records of the South Australian Museum* 4: 483-488.
- Tindale, N.B. 1974. *Aboriginal tribes of Australia*. Canberra: Australian National University Press.
- Ulm, S., T. Earles & S. L'Estrange . 1999. Post-European Aboriginal occupation of the southern Curtis Coast, central Queensland. *Australian Archaeology* 48:42-43.
- Umwelt Australia Pty Ltd. 2008. *Review of Environmental Factors for Caroon Exploration Program Seismic Survey*. Unpublished report to BHP Billiton.
- Veth, P. 1993. *Islands in the interior: the dynamics of prehistoric adaptations within the Arid Zone of Australia*. International Monographs in Prehistory. Archaeological Series 3. Michigan: Ann Arbor.
- Veth, P., P. Hiscock & A. Williams. 2011. Are tulas and ENSO linked in Australia? *Australian Archaeology*: 72: 7-14.

- Wallace, I.J. & J.J. Shea. 2006. Mobility patterns and technologies in the Middle Palaeolithic of the Levant. *Journal of Archaeological Science* 33: 1293-1309.
- Wentworth, C.K. 1922. A scale of grade and class terms for clastic sediments. *The Journal of Geology* 30(5): 377-92.
- White, B. & J.McDonald. 2010. Lithic artefact distribution in the Rouse Hill development Area, Cumberland Plain, New South Wales. *Australian Archaeology* 70: 29-38.
- White, P., T. Konecny, R.Lennon & J.Webster. 1980. *Billy's Cave: report on excavation of 1m²*. Unpublished report to NSW National Parks and Wildlife Service.
- Whitehead, J. 2004. *Tracking and mapping the explorers*. Vol 2. Lismore: Southern Cross University Printery.
- Wilson, J. 1994. *The use of Aboriginal hatchet quarries in the Tamworth region and their socio-economic context when seen in relation to the "Daruka" "Long Transfer Quarry"*. Unpublished BA(Hons) thesis, Department of Archaeology and Palaeoanthropology, University of New England, Armidale.
- Wilson, J. & L. McAdam. 2000. *The Tamworth Aboriginal/Archaeological Site Study*. Unpublished report to Tamworth City Council, Northern NSW.
- Witter, D. 2004. Regional variation of the archaeology in western New South Wales. *Rangelands Journal* 26(2); 129-149.
- Woodgate, F. 1995. *Kamilaroi and assimilation*. Collaroy Beach: self-published.
- Wright, R.V.S. 1985. *Preliminary report on excavations at Trinkey Swamp*. Unpublished report to NSW National Parks and Wildlife Service.
- Wright, R.V.S. 1986. New light of the extinction of the Australian megafauna. *Proceedings of the Linnaean Society of New South Wales* 109(1): 1-9.

Appendix A

RAP responses to draft
field survey methodology
(Non-disclosure – not
available for public
review)

Appendix B

Survey Coverage Data

Table B1: Survey coverage data

Transect Id	Landform(s) ¹	Length (m)	Survey unit area ² (m ²)	Visibility (%)	Exposure (%)	Effective coverage area (m ²)	Effective coverage (%)
PT1	2	793.07	63,445.74	40	20	5,076	8
PT2	3, 7	3,906.09	312,487.51	60	40	74,997	24
PT3	3	944.89	75,591.52	90	90	61,229	81
PT4	2,6	2,277.57	182,205.20	30	20	10,932	6
PT5	2,6	4,510.97	360,877.69	20	20	14,435	4
PT6	2,3	1,454.44	116,354.86	20	20	4,654	4
PT7	2,3,6	3,163.87	253,109.24	50	40	50,622	20
PT8	3,6	3,627.46	290,196.94	40	20	23,216	8
PT9	2,3,6	3,707.41	296,592.67	30	10	8,898	3
PT10	2,3,6	4,382.86	350,628.88	50	40	70,126	20
PT11	2,3,6	2,697.56	215,805.01	50	30	32,371	15
PT12	2,3	2,784.19	222,735.42	50	30	33,410	15
PT13	2,3,6	5,533.46	442,676.87	50	20	44,268	10
PT14	2,3	1,196.67	95,733.72	60	40	22,976	24
PT15	2,6	1,471.83	117,746.40	40	20	9,420	8
PT16	2,6	3,943.80	315,503.74	20	10	6,310	2
PT17	2,3,6	7,666.90	613,352.09	30	20	36,801	6
PT18	4,5,6	2,288.11	183,048.72	10	10	1,830	1
PT19	6	1,134.56	90,764.84	10	10	908	1
PT20	4,5,6	3,831.77	306,541.56	10	10	3,065	1
PT21	6	1,574.91	125,992.72	10	10	1,260	1
PT22	4,5,6	3,634.46	290,756.81	30	10	8,723	3
PT23	6	776.64	62,131.22	20	20	2,485	4
PT24	2,6	3,014.53	241,162.44	20	10	4,823	2
PT25	2,3,4,5	4,413.86	353,108.80	30	20	21,187	6
PT26	2	2,324.25	185,939.66	30	20	11,156	6
PT27	3	2,215.33	177,226.78	0	0	0	0
PT28	2,3	251.20	20,096.33	30	10	603	3
PT29	3	2,010.06	160,804.50	10	10	1,608	1
PT30	2,3	3,209.97	256,797.43	10	10	2,568	1
PT31	2,3	979.52	78,361.44	30	10	2,351	3
PT32	2,6	1,150.72	92,057.21	30	20	5,523	6
PT33	2	2,105.66	168,452.81	30	10	5,054	3
PT34	2,3	5,398.56	431,884.87	70	50	151,160	35
PT35	2	776.28	62,102.71	10	10	621	1

Transect Id	Landform(s) ¹	Length (m)	Survey unit area ² (m ²)	Visibility (%)	Exposure (%)	Effective coverage area (m ²)	Effective coverage (%)
PT36	2	1,346.57	107,725.68	50	30	16,159	15
PT37	2,3	1,796.71	143,736.97	20	20	5,749	4
PT38	3,6	3,869.07	309,525.89	80	80	198,097	64
PT39	6	2,271.31	181,705.19	10	10	1,817	1
PT40	3,6	5,815.40	465,232.15	30	10	13,957	3
PT41	3,6	2,115.44	169,235.56	10	10	1,692	1
PT42	3,6	2,729.07	218,325.91	20	10	4,367	2
PT43	6	1,483.24	118,658.95	70	70	58,143	49
PT44	2	2,244.67	179,573.29	20	10	3,591	2
PT45	2,3,6	3,044.95	243,596.03	20	10	4,872	2
PT46	2	478.68	38,294.14	10	10	383	1
PT47	2,6	315.23	25,218.27	10	10	252	1
PT48	4,6	1,870.78	149,662.15	10	10	1,497	1
PT49	1,2,4	2,843.10	227,447.99	30	10	6,823	3
PT50	4,5,6	1,793.67	143,493.41	10	10	1,435	1
PT51	2,6	4,577.85	366,228.15	50	40	73,246	20
PT52	2,4,5	6,268.65	501,491.92	30	10	15,045	3
PT53	2,3	5,981.32	478,505.33	20	10	9,570	2
PT54	3	4,013.38	321,070.57	40	10	12,843	4
PT55	3,6	2,616.84	209,346.96	20	10	4,187	2
PT56	3,6	2,075.44	166,035.42	10	10	1,660	1
PT57	3	1,409.16	112,732.82	10	10	1,127	1
PT58	2,3	5,361.23	428,898.18	20	10	8,578	2
PT59	2,3	1,638.96	131,116.64	30	10	3,934	3
VT1	2,3,6	5,672.02	na	10	10	na	na
VT2	2,6	2,145.96	na	10	10	na	na
VT3	6	554.61	na	10	10	na	na
VT4	2,3	4,881.23	na	10	10	na	na
VT5	2	823.86	na	10	10	na	na
VT6	2,6	2,149.03	na	10	10	na	na
VT7	2,3	1,654.48	na	10	10	na	na
VT8	2,3,6	4,204.85	na	10	10	na	na
VT9	3	1,675.84	na	10	10	na	na
VT10	2,6	5,197.92	na	30	20	na	na
VT11	2,3	2,939.18	na	10	10	na	na
VT12	2,3	1,122.57	na	10	10	na	na

Transect Id	Landform(s) ¹	Length (m)	Survey unit area ² (m ²)	Visibility (%)	Exposure (%)	Effective coverage area (m ²)	Effective coverage (%)
VT13	3	2,783.34	na	10	10	na	na
VT14	6	885.98	na	10	10	na	na
VT15	6	557.62	na	10	10	na	na
VT16	2,3	2,201.07	na	10	10	na	na
VT17	3,6	1,603.34	na	10	10	na	na

¹**Landform:** 1 = Disturbed; 2 = Gently inclined footslopes; 3 = Level to gently undulating/inclined flood/drainage plains; 4 = Level to undulating hills on plateau surfaces; 5 = Moderately to steeply inclined hillslopes; 6 = undulating to rolling hills; 7 = River banks below floodplain level

² Calculated using a standard 80 m transect width.

Appendix C

Site Descriptions

Site name: WM-IF1-11 **GDA Coordinates:** 253690mE 6539199mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

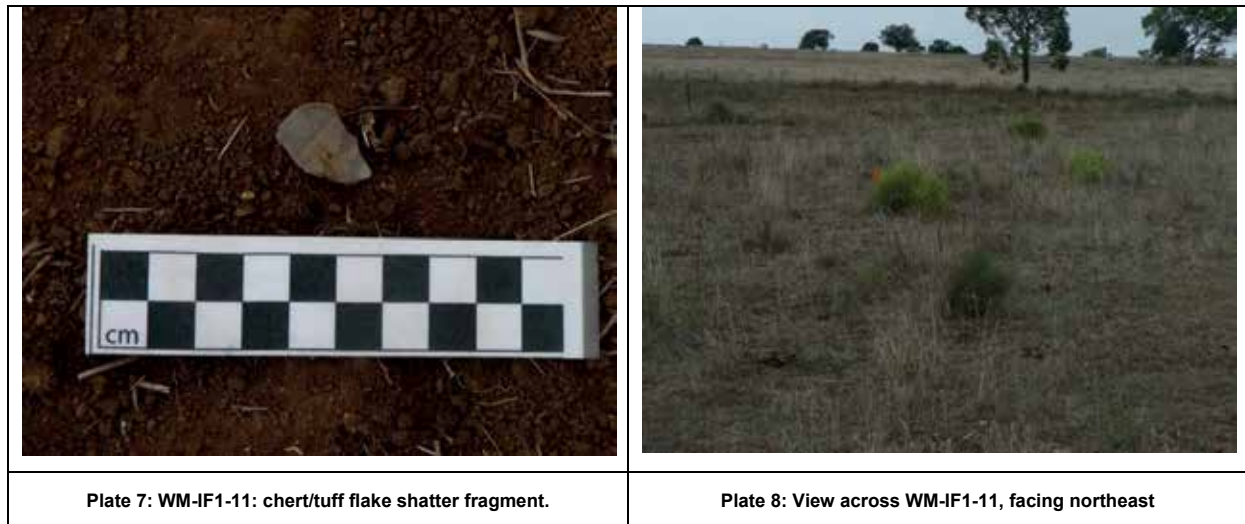
Survey landform: Gently inclined footslope **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 345 m

Site description: WM-IF1-11 comprises an isolated chert/tuff flake shatter fragment in the northeastern corner of a cleared paddock on the property 'Carinya'. The fragment, which measures 20.4 x 12.4 x 4.7 mm, exhibits a complete termination but no striking platform or point of percussion (**Plate 7**). The artefact is located approximately 60 m south-southwest of the entrance to the paddock in question. An unsealed vehicle track running parallel to the paddock's northernmost east-west running fenceline is located approximately 10 m to the north of the site (**Plate 8**). This track leads to a cattle yard and farm dam complex around 850 m to the west. GSV on and immediately surrounding the site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, stock trampling and ploughing.

Plates:



Site name: WM-IF2-11 **GDA Coordinates:** 249976mE 6541792mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

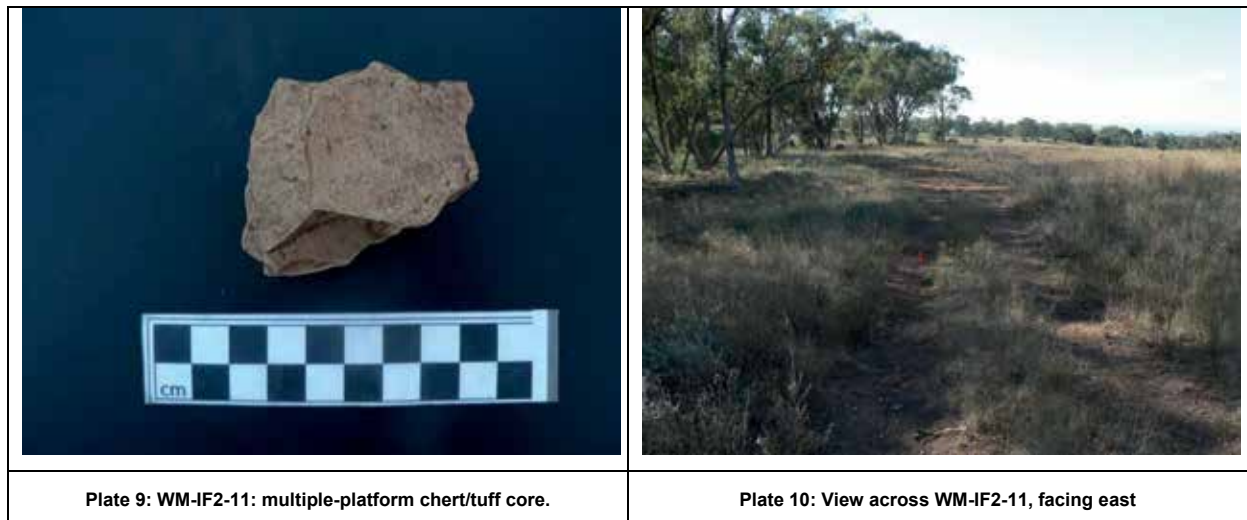
Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 125 m

Site description: WM-IF2-11 comprises an isolated single platform chert/tuff core (61.9 x 43 x 27 mm) on an unsealed ESE running vehicle track on the property 'Demeter', approximately 700 m north-northeast of Mt Watermark and 1.4 km due west of Roworth Road (**Plate 9 & Plate 10**). The site sits at the head of small valley bordered to the south by Mt Watermark and to the north by an unnamed series of hills. GSV on the track is excellent (91-100%) but very poor (0-10%) either side of it. No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, vehicle traffic and gully erosion. Remnant native vegetation to the immediate north of the site has been mapped as White Box Grassy Woodland.

Plates:



Site name: WM-IF3-11 **GDA Coordinates:** 250177mE 6537945mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

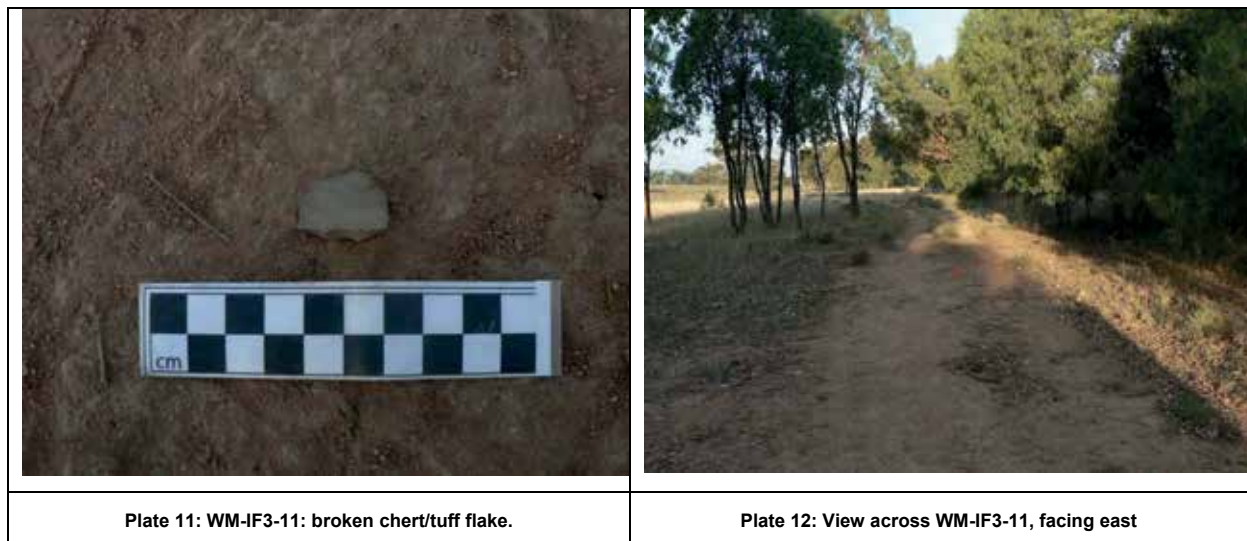
Landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 1380 m

Site description: WM-IF3-11 comprises a broken chert/tuff flake (21 x 23 x 4 mm) on an unsealed E-W running vehicle track on the property 'Hill 60' (**Plate 11 & Plate 12**). The track in question runs parallel to The Dip Road, which is located approximately 30 m to the south of the site. A c.25 m wide strip of remnant native vegetation separates the track from The Dip Road and has been mapped as Inland Grey Box Grassy Woodland. Patchy regrowth along the northern edge of the track has likewise been mapped as Inland Grey Box Grassy Woodland. Open artefact scatter WM-AS2-11 is located approximately 300 m west of the site. GSV on the track is excellent (91-100%) but poor (11-30%) to very poor (0-10%) either side of it. No other artefacts were observed on the track to the east or west. Overall site condition can be characterised as fair. Relevant disturbance factors include native vegetation clearance, vehicle traffic and soil erosion.

Plates:



Site name: WM-IF4-11 **GDA Coordinates:** 248916mE 6539590mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

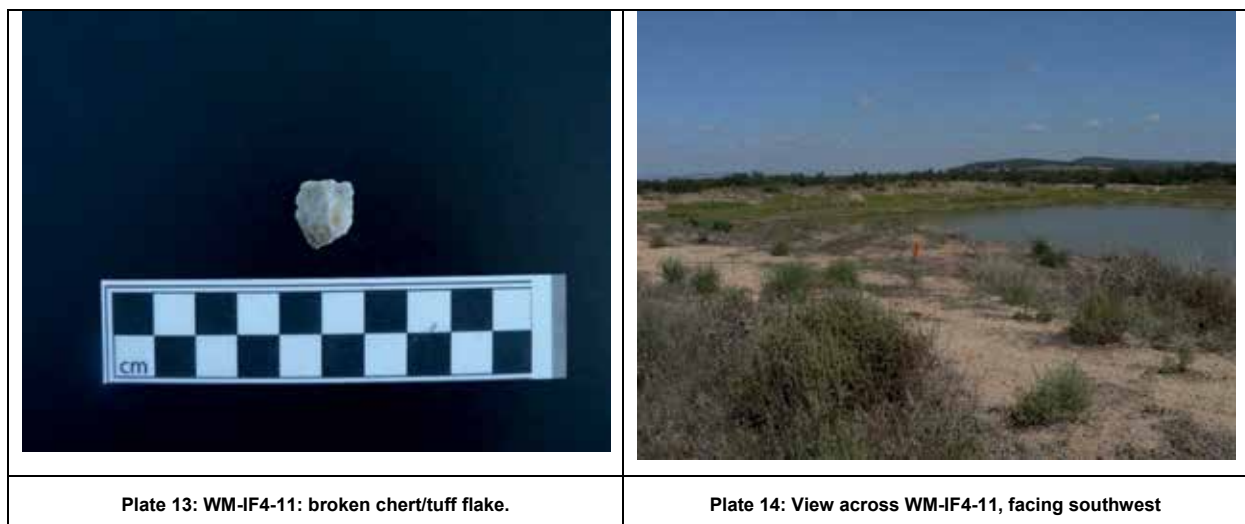
Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 690 m

Site description: WM-IF4-11 comprises a broken chert/tuff flake (15.9 x 13.3 x 4.5 mm) on the eastern bank of a large farm dam on the property 'Flakenhoe' (**Plate 13 & Plate 14**). The artefact has been exposed by the construction of the dam and is not *in-situ*. Open artefact scatter WM-AS9-11 is located approximately 500 m southwest of the site. GSV on and immediately surrounding the site is excellent (91-100%). No other artefacts were observed on the banks of the dam. Overall site condition can be characterised as poor. Relevant disturbance factors include dam construction, native vegetation removal, stock trampling and bank erosion. A linear strip of remnant native vegetation approximately 150 m southeast of the site has been mapped as Inland Grey Box Grassy Woodland.

Plates:



Site name: WM-IF5-11 **GDA Coordinates:** 251746mE 6539560mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

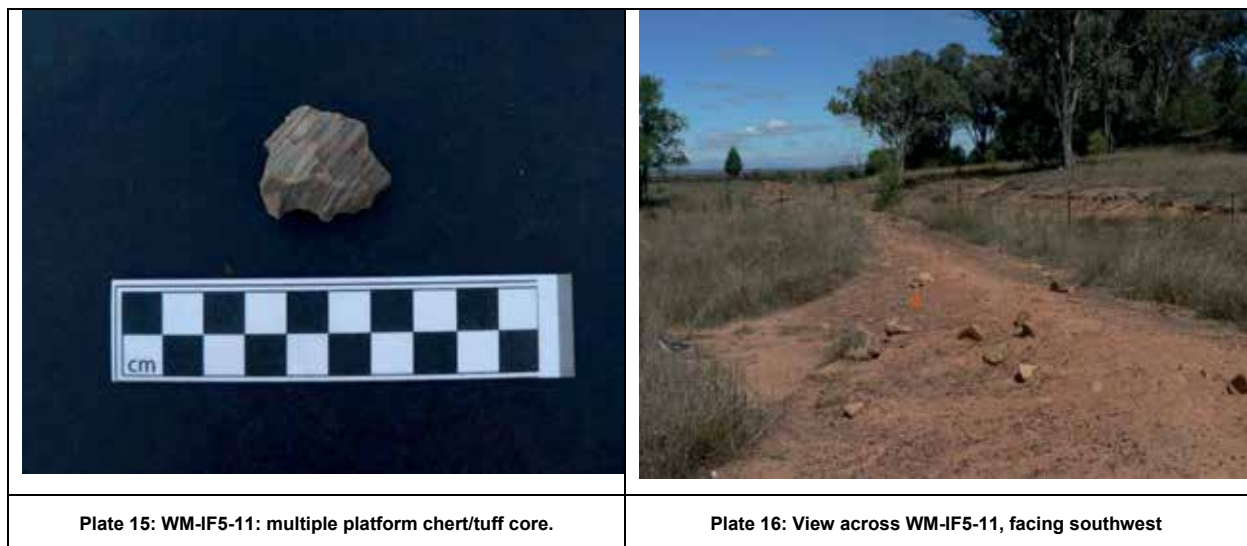
Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 215 m

Site description: WM-IF5-11 comprises a multiple platform banded chert/tuff core (30.2 x 27.7 x 18.5 mm) on a deflated NNW-SSE running contour bank on the property 'Cloveneden' (**Plate 15 & Plate 16**). The artefact has been exposed by the construction of the contour bank and is not *in-situ*. An unsealed vehicle track running more-or-less parallel to the contour bank in question is located around 10 m to the east. Open artefact scatter WM-AS7-11 is located approximately 105 m southwest of the site. Visibility on the contour bank site is excellent (91-100%) but very poor (0-10%) off it. No other artefacts were observed on the bank. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction of the contour bank, native vegetation clearance, stock trampling and sheet erosion. Remnant native vegetation to the west of the site has been mapped as White Box Grassy Woodland.

Plates:



Site name: WM-IF6-11 **GDA Coordinates:** 252304mE 6542845mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Moderately to steeply inclined hillslope **Slope class:** 10-32%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 180 m

Site description: WM-IF6-11 comprises a broken chert/tuff flake (13.6 x 18.2 x 2.4 mm) in the south-eastern corner of a cleared paddock on the property 'The Wilgas' (**Plate 17 & Plate 18**). The site is located on a moderately inclined mid-slope associated with adjacent Black Mountain and lies approximately 400 m due south of the Kamilaroi Highway. Roworth Road is located approximately 730 m due west of the site. GSV on and immediately surrounding the site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and ploughing. Existing native vegetation to the southeast has been mapped as Whitewood Woodland.

Plates:

	
Plate 17: WM-IF6-11: broken chert/tuff flake.	Plate 18: View across WM-IF6-11, facing southeast

Site name: WM-IF7-11 **GDA Coordinates:** 251191mE 6542108mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform unit(s): Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 245 m

Site description: WM-IF7-11 comprises a complete chert/tuff flake (37.7 x 16 x 7.6 mm) on a WNW-ESE running contour bank on the property 'Demeter' (**Plate 19 & Plate 20**). The artefact has been exposed by the construction of the contour bank and is not *in-situ*. Roworth Road lies approximately 260 m due east of the site. Visibility on the contour bank is excellent (91-100%) but very poor (0-10%) off it. No other artefacts were observed on the contour bank in question. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction of the contour bank, native vegetation clearance and stock trampling. Existing native vegetation to the south of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 19: WM-IF7-11: complete chert/tuff flake.	Plate 20: View across WM-IF7-11, facing southeast

Site name: WM-IF8-11 **GDA Coordinates:** 252654mE 6538154mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 905 m

Site description: WM-IF8-11 comprises a complete chert/tuff flake (63 x 41 x 13 mm) on the southern edge of ploughed paddock on the property 'Carinya', approximately 65 m due north of The Dip Road (**Plate 21 & Plate 22**). GSV on and surrounding the site is fair (31-50%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, stock trampling and ploughing. Remnant native vegetation bordering The Dip Road to the south has been mapped as Poplar Box Woodland.

Plates:

	
Plate 21: WM-IF8-11: complete chert/tuff flake.	Plate 22: View across WM-IF8-11, facing southeast

Site name: WM-IF9-11 **GDA Coordinates:** 252425mE 6538061mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform unit(s): Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 905 m

Site description: WM-IF9-11 comprises a near-complete edge-ground hatchet-head manufactured on a fluvial or conglomerate-derived greywacke cobble (**Plate 23**). The hatchet-head is located on the southern edge of a ploughed paddock on the property 'Carinya', approximately 85 m due north of The Dip Road (**Plate 24**). It appears to have been discarded following retouch to both lateral margins, which has removed portions of the ground cutting edge. The purpose of this retouch is unclear but may have been repair-related. GSV on and immediately surrounding the site is good (51-70%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, stock trampling and ploughing. Remnant native vegetation bordering The Dip Road to the south has been mapped as Poplar Box Woodland.

Plates:

	
Plate 23: WM-IF9-11: edge-ground hatchet-head.	Plate 24: View across WM-IF9-11, facing southwest

Site name: WM-IF10-11 **GDA Coordinates:** 251509mE 6537848mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform unit(s): Level to gently undulating/inclined flood/drainage plain **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 1050 m

Site description: WM-IF10-11 comprises a complete, unifacially-retouched chert/tuff scraper (50 x 60 x 21 mm) on a NE-SW running contour bank on the property 'Cloveneden' (**Plate 25 & Plate 26**). The Dip Road is located approximately 40 m due south of the site. The artefact is not *in-situ* but has been exposed by the construction of the contour bank. Visibility on the contour bank is excellent (91-100%) but very poor (0-10%) off it. No other artefacts were observed on the bank within 50 m. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction / erosion of the contour bank and native vegetation clearance. Remnant vegetation bordering the Dip Road to the south has been mapped as Poplar Box Woodland.

Plates:



Site name: WM-IF11-11 **GDA Coordinates:** 250928mE 6537956mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform unit(s): Level to gently undulating/inclined flood/drainage plain **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 1120 m

Site description: WM-IF11-11 comprises a multiple platform chert/tuff core (36.5 x 32.1 x 27.6 mm) on an unsealed vehicle track on the property 'Cloveneden' (**Plate 27 & Plate 28**). The artefact is located on a very gently inclined drainage plain approximately 100 m due north of The Dip Road and 25 m west of a former farm dam. GSV on the track is good (51-70%) but poor (11-30%) to very poor (0-10%) either side of it. No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, vehicle traffic and ploughing. Remnant native vegetation to the south of the site has been mapped as Poplar Box Woodland whilst that to the north has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 27: WM-IF11-11: multiple platform chert/tuff core.	Plate 28: View across WM-IF11-11, facing south

Site name: WM-IF12-11 **GDA Coordinates:** 248229mE 6538576mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 325 m

Site description: WM-IF12-11 comprises an isolated bifacial quartzite core (60 x 45 x 50 mm) on the southwestern edge of a ploughed paddock on the property 'Flakenhoe' (**Plate 29 & Plate 30**). An unsealed vehicle track running along the southern boundary of the paddock in question is located within 10 m of the site. GSV on and immediately surrounding the site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and ploughing. Remnant native vegetation to the west has been mapped as Poplar Box Woodland whilst that to the south has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 29: WM-IF12-11: bifacial quartzite core.	Plate 30: View across WM-IF12-11, facing south

Site name: WM-IF13-11 **GDA Coordinates:** 245488mE 6539856mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 8 m

Site description: WM-IF13-11 consists of an isolated chert/tuff flake (19 x 13 x 4 mm) on a N-S running contour bank in a cleared paddock on the property 'Watermark' (**Plate 31 & Plate 32**). The site is located approximately 940 m south-southwest of the main homestead and 730 m due north of The Dip Road. Visibility on the contour bank is excellent (91-100%) but very poor (0-10%) either side of it. No other artefacts were observed on the bank within 50 m. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction and ongoing erosion of the contour bank and native vegetation clearance. Remnant native vegetation to the north of the site has been mapped as Fuzzy Box Woodland.

Plates:

	
Plate 31: WM-IF13-11: chert/tuff flake.	Plate 32: View across WM-IF13-11, facing south

Site name: WM-IF14-11 **GDA Coordinates:** 246623mE 6541043mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 95 m

Site description: WM-IF14-11 comprises an isolated chert/tuff flake (25.5 x 17 x 5.5 mm) on the eastern proximal drainage plain of Watermark Gully on the property 'Watermark' (**Plate 33**). The flake is located approximately 95 m due east of the creek in a sparsely-treed area mapped as Poplar Box Woodland (**Plate 34**). Open artefact scatter WM-AS9-11 is located approximately 130 m due west of the site. GSV on and immediately surrounding the site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as fair.

Plates:

	
Plate 33: WM-IF14-11: chert/tuff flake.	Plate 34: View across WM-IF14-11, facing southeast

Site name: WM-IF15-11 **GDA Coordinates:** 246591mE 6540937mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 95 m

Site description: WM-IF15-11 comprises a broken quartzite flake (26.9 x 24.5 x 8.6 mm) on the eastern proximal drainage plain of Watermark Gully on the property 'Watermark' (**Plate 35**). The artefact is located approximately 110 m south-southwest of WM-IF14-11 in a sparsely-treed area mapped as Poplar Box Woodland (**Plate 36**). Open artefact scatter WM-AS9-11 is located approximately 140 m due west of the site. GSV on and immediately surrounding the site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as fair.

Plates:



Plate 35: WM-IF15-11: broken quartzite flake.



Plate 36: View across WM-IF15-11, facing north.

Site name: WM-IF16-11 **GDA Coordinates:** 243843mE 6540580mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 3-10%

Vegetation community (current): Derived native grassland

Distance to nearest water: 240 m

Site description: WM-IF16-11 comprises an isolated chert/tuff flake (24 x 23 x 5.3 mm) in a cleared lower-slope context on the property 'Molonga' (**Plate 37 & Plate 38**). The artefact is located in a small (c.2x1 m) erosion scar approximately 120 m east of grinding groove site WM-GG1-11. Exposed sandstone bedrock in the exposure indicates a very thin soil profile in the area. Extensive slope wash is inferred. Grasses excluded, no native vegetation remains on-site. Surrounding vegetation is dominated by white cypress (*Callitris glaucophylla*) regrowth. GSV within the exposure is very good (71-90%) but very poor (0-10%) outside of it. No other artefacts were observed during survey. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation removal and ongoing sheet erosion.

Plates:

	
Plate 37: WM-IF16-11: complete chert/tuff flake.	Plate 38: View across WM-IF16-11, facing southeast.

Site name: WM-IF17-11 **GDA Coordinates:** 243822mE 6540693mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 3-10%

Vegetation community (current): Derived native grassland

Distance to nearest water: 125 m

Site description: WM-IF17-11 comprises an isolated chert/tuff flake (24.5 x 10.1 x 2.4 mm) in a cleared lower-slope context on the property 'Molonga' (**Plate 39 & Plate 40**). The artefact is located in a cattle track exposure approximately 115 m north-northwest of isolated find WM-IF17-11 and 100 m northeast of grinding groove site WM-GG1-11. Grasses excluded, no native vegetation remains on-site. That to the west has been mapped as regenerating Blakely's Red Gum Grassy Woodland. GSV on site is very poor (0-10%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as fair. Relevant disturbance factors include native vegetation clearance and stock trampling.

Plates:

	
Plate 39: WM-IF17-11: complete chert/tuff flake.	Plate 40: View across WM-IF17-11, facing southeast.

Site name: WM-IF18-11 **GDA Coordinates:** 248953mE 6541212mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Undulating to rolling hills **Slope Class:** 10-32%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 405 m

Site description: WM-IF18-11 comprises an isolated broken quartz flake (18 x 13 x 2 mm) on a N-S running contour bank on the property 'Gunnadoo' (**Plate 41 & Plate 42**). The site is located approximately 875 m southeast of the main homestead and 1km due west of Court Road. Steep, forested terrain associated with Mount Watermark borders the site to the east. Visibility on the contour bank is excellent (91-100%) but very poor (0-10%) either side of it. No other artefacts were observed on the bank within 100 m. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction and ongoing erosion of the contour bank as well as native vegetation clearance and stock trampling. Remnant native vegetation to the east of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 41: WM-IF18-11: broken quartz flake.	Plate 42: View across WM-IF18-11, facing south.

Site name: WM-IF19-11 **GDA Coordinates:** 240905mE 6542668mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 270 m

Site description: WM-IF19-11 comprises an isolated single platform chert/tuff core (46.3 x 38.1 x 36.1 mm) in a linear exposure (c.110x15 m) bordering an area of dense Yellow Box Woodland regrowth on the property 'Marney' (**Plate 43 & Plate 44**). WM-IF19-11 is located approximately 175 m west of the main homestead on the property. GSV within the exposure is excellent (91-100%). No other artefacts were observed within the exposure. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and vehicle traffic.

Plates:

	
Plate 43: WM-IF19-11: single platform chert/tuff core.	Plate 44: View across WM-IF19-11, facing west.

Site name: WM-IF-20-11 **GDA Coordinates:** 247891mE 6542332mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 285 m

Site description: WM-IF20-11 comprises an isolated chert/tuff scraper (42.9 x 40.2 x 17.6 mm) in a ploughed and contour-banked paddock on the property 'Inverness' (**Plate 45**). The site is located approximately 140 m due west of Court Road and 500 m south-south west of the intersection of Court and Colley Roads. GSV on site is poor (11-30%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and ploughing. Remnant vegetation bordering Court Road to the east of the site has been mapped as Poplar Box Woodland.

Plates:



Plate 45: WM-IF20-11: chert/tuff scraper.

Site name: WM-IF-21-11 **GDA Coordinates:** 250018mE 6543563mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 200 m

Site description: WM-IF21-11 consists of an isolated hatchet reworking flake (**Plate 46 & Plate 47**). The flake is located in a cleared, ploughed paddock on the property 'Shar', approximately 70 m due east of an unnamed 2nd order stream and 500 m due south of the Kamilaroi Highway. The flake, which measures 39.7 x 54.8 x 13.1 mm, has been struck from the cutting edge of the hatchet-head in question and retains two portions of this edge (20.7 mm and 13 mm respectively). In the absence of more detailed analysis, positive raw material identification is not possible. However, andesite is suggested (Jan Wilson, pers. comm. May 2011). GSV on site is fair (31-50%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, soil erosion and ploughing. Remnant vegetation to the west of the site on 'Demeter' has been mapped as Poplar Box Woodland.

Plates:

Plate 46: WM-IF21-11: hatchet reworking flake (plan)	Plate 47: WM-IF21-11: hatchet reworking flake (cross-section view)

Site name: WM-IF-22-12 **GDA Coordinates:** 246662mE 6540929mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 130 m

Site description: WM-IF22-12 comprises an isolated chert/tuff flake on the south-eastern edge of a sizeable ant nest exposure c.130 m east of Watermark Gully on the property 'Watermark' (**Plate 48 & Plate 49**). GSV on-site is excellent but poor in the immediate vicinity. No other artefacts were observed on the exposure. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, ongoing ant activity, stock trampling and erosion. Remnant vegetation to the immediate south of the site has been mapped as Poplar Box Woodland.

Plates:

	
Plate 48: WM-IF22-12: complete chert/tuff flake.	Plate 49: View across WM-IF22-12, facing northwest.

Site name: WM-IF-23-12 **GDA Coordinates:** 251307mE 6542767mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 20 m

Site description: WM-IF23-12 comprises a complete chert/tuff flake (35 x 21 x 8 mm) on an east-west trending contour bank on the property 'Demeter' (**Plate 50 & Plate 51**). The site is located approximately 150 m north of WM-AS17-12. The flake has been exposed by the construction of the contour bank and is not *in-situ*. Roworth Road lies approximately 240 m due east of the site. Visibility on the crest of the contour bank is excellent (91-100%) but very poor (0-10%) either side of it. No other artefacts were observed on the contour bank in question. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction of the contour bank, native vegetation clearance, stock trampling and ploughing. Existing native vegetation to the east of the site along Roworth Road has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 50: WM-IF23-12: complete chert/tuff flake.	Plate 51: View across WM-IF23-12, facing east.

Site name: WM-AS1-11 **GDA Coordinates:** 256859mE 6536525mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 20,795m² (2.08 ha)

Survey landform: Gently inclined footslope **Slope Class:** <1-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 115 m

Site description: WM-AS1-11 comprises a large open artefact scatter on a footslope and fluvial terrace surface on the western side of the Mooki River on the property 'Boondah' (**Plate 52**). The site, as mapped, is located approximately 120 m west of the river and extends parallel to it for a distance of around 475 m. The terrace component of the site is bounded to the west and south by a gently inclined (3-10%) slope that forms a broadly convex spur. The main homestead on 'Boondah' lies approximately 685 m northwest of the northernmost artefacts recorded during survey. An unsealed vehicle track bisects the site in a NE-SW direction. Two ephemeral drainage depressions crosscut the site in a roughly east-west direction. GSV on site is, on average, poor (11-30%) due to grass cover (**Plate 53**). The site's northern boundary marks the limit of the current survey area whilst the southern boundary reflects a decline in visibility. All but two artefacts are located on the terrace and spur, with a notable concentration towards the southern end of the site in association with one of the two drainage gullies. This concentration reflects higher GSV in this area. Two artefacts were identified on the river's active floodplain. However, both appear to have been washed into their current positions from the spur above. Vegetation on site is limited to grasses and a few mature trees, one of which has been identified as a potential Aboriginal scarred tree (WM-ST2-11) on the grounds that it exhibits a possible post-contact 'possum hole'.

A total of 105 stone artefacts were recorded during survey, providing an average artefact density of 0.005 artefacts per m². The maximum density of artefacts observed on site was three artefacts per m². Flake and non-flake debitage accounts for 84.8% of the site assemblage, with recorded types comprising 58 complete flakes, eight broken flakes, five redirecting flakes, 10 flake shatter fragments and eight angular shatter pieces. Nine cores were also identified. Two are single-platform, five multiple-platform and two bifacial. Retouched and edge-ground implements consist of a geometric microlith (**Plate 55**), a scraper, three miscellaneous retouched flakes and two edge-ground hatchet-heads (**Plate 54**), both of which appear to have been made on non-cobble (i.e., quarried stone) blanks. One of the hatchet-heads was discarded following an episode of unifacial retouch that has removed one side of the cutting edge. The second hatchet, in contrast, is complete and in good condition. No reason for discard is apparent. Slight waisting towards the butt may relate to hafting. Chert/tuff is dominant raw material (n = 76, 72.4%) overall followed by 'other' materials (n = 13, 12.4%), quartz (n = 9, 8.6%), quartzite (n = 6, 5.7%), and basalt (n = 1, 0.9%). Overall site condition can be characterised as fair. Relevant disturbance factors include native vegetation clearance, vehicle traffic, stock trampling and soil erosion. The area does not appear to have been ploughed.

Plates:

	
Plate 52: View across central portion of WM-AS1-11, facing southeast. Scarred tree WM-ST2-11 is located to the immediate left of the vehicle.	Plate 53: Flagged artefacts on WM-AS1-11. Note poor GSV due to grass cover and drainage depression in background.



Plate 54: WM-AS1-11: edge-ground hatchet-heads.



Plate 55: WM-AS1-11: geometric microlith (broken).

Site name: WM-AS2-11 **GDA Coordinates:** 249752mE 6538102mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 50,344 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 455 m

Site description: WM-AS2-11 comprises a large open artefact scatter on the properties 'Flakenhoe' and 'Hill 60'. The site is located approximately 20 m north of The Dip Road and extends - parallel to it - for a distance of approximately 670 m. Artefacts on 'Flakenhoe' are concentrated along the southern boundary of the property on an unsealed vehicle track running parallel to The Dip Road (**Plate 56**). GSV on this track is, on average, very good (71-90%). To the east, artefacts are more widely distributed and extend northwards for a distance of approximately 370 m. Land to the south of the site (i.e., on the property *The Dip*) is reported to retain water during periods of high rainfall, forming a marsh-like environment (George Sampson, pers. comm. June 2011). A total of 70 artefacts were recorded during survey, providing an average artefact density of 0.001 artefacts per m². The maximum density of artefacts observed on site was three artefacts per m². Flake and non-flake debitage accounts for 80% of the site assemblage, with recorded types comprising 32 complete flakes, three redirecting flakes, 12 flake shatter fragments and eight angular shatter pieces. Eleven cores were also identified: three single-platform, seven multiple-platform (**Plate 59**) and one bifacial. Retouched implements comprised two miscellaneous retouched flakes (**Plate 58**) and a broken Bondi point (**Plate 57**). Chert/tuff is dominant raw material (n = 44, 62.8%) overall followed by quartz (n = 17, 24.3%), 'other' materials (n = 6, 8.6%) and quartzite (n = 3, 4.3%). Overall site condition can be characterised as fair. Relevant disturbance factors include native vegetation clearance, contour bank construction, vehicle traffic, ploughing and stock trampling. Remnant native vegetation bordering The Dip Road to the immediate south of the site has been mapped as Fuzzy Box Woodland. So too that along on the border between 'Flakenhoe' and 'Hill 60'.

Plates:

	
Plate 56: View across WM-AS2-11 on 'Flakenhoe', facing west. Note excellent GSV associated with vehicle track.	Plate 57: WM-AS2-11: broken chert/tuff Bondi point.



Plate 58: WM-AS2-11: miscellaneous retouched quartzite flake



Plate 59: WM-AS2-11: multiple platform chert/tuff core

Site name: WM-AS3-11 **GDA Coordinates:** 250817mE 6541132mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 1 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 310 m

Site description: WM-AS3-11 consists of two complete chert/tuff flakes on an unsealed vehicle track on the property 'Demeter', approximately 500 m due west Roworth Road (**Plate 60 & Plate 61**). The flakes, which measure 31 x 20 x 12 mm and 20 x 25 x 11 mm respectively, lie less than one metre apart and have been exposed by gully erosion associated with native clearance vegetation and the use of the track. GSV on the track is excellent (91-100%) but very poor (0-10%) either side of it. No other artefacts were observed on the track in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, ongoing gully erosion and sporadic vehicle traffic. Remnant vegetation to the east of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 60: View across WM-AS3-11, facing west.	Plate 61: WM-AS3-11: chert/tuff flakes.

Site name: WM-AS4-11 **GDA Coordinates:** 251011mE 6540853mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 42 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 380 m

Site description: WM-AS4-11 consists of two chert/tuff artefacts - a broken flake and multiple platform core - on the western edge of a large (c.50x45 m) erosion scald on the property 'Demeter', approximately 270 m due west Roworth Road and 340 m southeast of WM-AS3-11 (**Plate 62 & Plate 63**). The artefacts, which measure 15.4 x 11.6 x 4.1 mm and 36.5 x 21.8 x 24.2 mm respectively, lie approximately 8 m apart and have been exposed by a combination of sheet and rill erosion associated with native vegetation clearance. Topographically, the site is situated on a gently inclined lower slope with an easterly aspect. The site is bordered to the north and southeast by stands of pine, possibly white cypress. GSV on the scald is excellent (91-100%) but very poor (0-10%) off it. No other artefacts were observed on the scald. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and ongoing rill/sheet erosion. Remnant native vegetation to the southwest of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 62: View across WM-AS4-11, facing southwest.	Plate 63: WM-AS4-11: broken flake (left) and multiple platform core (right).

Site name: WM-AS5-11 **GDA Coordinates:** 248403mE 6539344mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 3,707 m²

Survey landform: Gently inclined footslopes & Undulating to rolling hills **Slope Class:** 1-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 60 m

Site description: WM-AS5-11 comprises an open artefact scatter on the eastern side of an unnamed 1st order stream on the property 'Flakenhoe' (**Plate 64**). The site is located on the western edge of a ploughed paddock approximately 720 m due east of Court Road and 1.1 km due north of The Dip Road. Artefacts have been exposed by a combination of sheet and gully erosion associated with native vegetation clearance as well as ploughing and contour bank construction. A total of 60 artefacts were recorded on site during survey, providing an average artefact density of 0.016 artefacts per m². The maximum density of artefacts observed was three artefacts per m². Flake and non-flake debitage accounts for 80% of the site assemblage, with recorded types comprising 28 complete flakes, three broken flakes, a single redirecting flake, 10 flake shatter fragments and six angular shatter pieces. Five cores were also identified: two single-platform and three multiple-platform examples. Retouched implements comprised two backed artefacts (**Plate 65**), two scrapers (**Plate 66**), one miscellaneous retouched flake and a bifacially flaked hatchet-head (**Plate 67**). Cherty-argillite is the suggested raw material for this blank (Jan Wilson, pers. comm. July 2011), which does not appear to have been used and was likely discarded following an unsuccessful attempt to remove an area of high mass from its butt end. Chert/tuff is dominant raw material (n = 44, 73.3%) overall followed by quartz (n = 9, 15%), 'other' materials (n = 4, 6.7%) and quartzite (n = 3, 5%). GSV on site is, on average, very good (71-90%). Remnant native vegetation bordering the unnamed stream to the immediate west of the site comprises a combination of Inland Grey Box Grassy Woodland and Poplar Box Woodland. Overall site condition can be characterised as fair.

Plates:

	
Plate 64: View across WM-AS5-11, facing south.	Plate 65: WM-AS5-11: broken chert/tuff Bondi point



Plate 66: WM-AS5-11: quartzite scraper.



Plate 67: WM-AS5-11: unground bifacially flaked hatchet-head.

Site name: WM-AS6-11 **GDA Coordinates:** 250349mE 6538686mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 95 m²

Survey landform: Gently inclined footslope **Slope Class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 1150m

Site description: WM-AS6-11 consists of two artefacts - a bifacial quartz core and complete chert/tuff flake - on the eastern edge of a cleared paddock on the property 'Hill 60' (**Plate 68 & Plate 69**). The artefacts, which measure 34 x 30 x 15 mm and 31 x 21 x 12 mm respectively, lie approximately 15 m apart. The core is located on an unsealed N-S running vehicle track whilst the chert/tuff flake rests on a fenced contour bank to the east. GSV on the track and contour bank is excellent (91-100%) but very poor (0-10%) between them. No other artefacts were observed on the track or contour bank. Overall site condition can be characterised as poor. Relevant disturbance factors include the construction and ongoing erosion of the contour bank, native vegetation clearance and vehicle traffic. A patch of remnant native vegetation approximately 275 m southeast of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 68: View across WM-AS6-11, facing east.	Plate 69: WM-AS6-11: bifacial quartz core (left) and chert/tuff flake (right)

Site name: WM-AS7-11 **GDA Coordinates:** 251823mE 6539447mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 155 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 235 m

Site description: WM-AS7-11 comprises an open artefact scatter on an unsealed vehicle track on the property 'Cloveneden' (**Plate 70**). The track in question runs along the western edge of cleared, contour-banked paddock. A total of five artefacts was recorded during survey, all of which were manufactured out of chert/tuff. These comprise two complete flakes (**Plate 71**), one single platform core, one miscellaneous retouched flake and one flake shatter fragment. The artefacts occur in two groups separated by a distance of approximately 80 m. One group contains three artefacts, the other, two. The maximum artefact density observed was two artefacts per m². Isolated find WM-IF5-11 is located approximately 105 m northwest of the most northerly of artefacts in the site. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, stock trampling, vehicle traffic and soil erosion. Remnant native vegetation to the west of the site has been mapped as White Box Grassy Woodland.

Plates:

	
Plate 70: View across northern portion of WM-AS7-11, facing south.	Plate 71: WM-AS7-11: chert/tuff flakes.

Site name: WM-AS8-11 **GDA Coordinates:** 252559mE 6538098mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 133 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 905m

Site description: WM-AS8-11 consists of two chert/tuff flakes on the southern edge of a cleared and ploughed paddock on the property 'Carinya' (**Plate 72 & Plate 73**). The flakes, which measure 38 x 20 x 11 mm and 28 x 13 x 11 mm respectively, lie approximately 12 m apart. GSV on and immediately surrounding the site is very good (71-90%), due partly to extensive ant activity. No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, ploughing and stock trampling. Remnant native vegetation bordering The Dip Road to the immediate south of the site has been mapped as Poplar Box Woodland.

Plates:

	
Plate 72: View across WM-AS8-11, facing south-southwest.	Plate 73: WM-AS8-11: chert/tuff flakes.

Site name: WM-AS9-11 **GDA Coordinates:** *Centroid:* 246353mE 6540893mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 98,163 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain & gently inclined footslope

Slope class: <1-3% **Vegetation community (current):** Low diversity grassland & exotic pasture

Distance to nearest water: 10 m

Site description: WM-AS9-11 comprises a large open artefact scatter on the western bank and associated proximal drainage plain of Watermark Gully on the property 'Watermark'. The site extends along the creek for a distance of approximately 1.4 km, with the most westerly of artefacts in the site lying c.180 m from the creek's active channel. Site boundaries have been defined on the basis of GSV. The majority (i.e., >95%) of artefacts are located to the north of the southern extent of the main homestead complex on 'The Watermark', with a notable concentration occurring to the east of these structures adjacent to the creek. Artefacts at WM-AS9-11 are visible for a variety of reasons including: 1) the creation of a bank - now heavily deflated - along the western edge of the creek, presumably as a flood-prevention measure (**Plate 74 & Plate 75**); 2) the creation of east/west and northeast/southwest trending contour banks on the creek's proximal drainage plain; and 3) widespread sheetwash erosion linked to the removal of native vegetation and ploughing. Erosion scalds are common (**Plate 76**). Saline soils are indicated by the presence of salt-tolerant vegetation. GSV across the site is, on average, fair.

A total of 358 artefacts have been identified at WM-AS9-11, with a maximum observed density of five artefacts per m². Flake and non-flake debitage accounts for 84.6% of the site assemblage, with recorded types comprising 193 complete flakes, five redirecting flakes, 36 broken flakes, 46 flake shatter fragments and 23 angular shatter pieces. Thirty-seven cores are also present including 19 multiple platform, 11 single platform and seven bifacial examples. Retouched and edge-ground implements include an edge-ground hatchet-head (**Plate 77**), eight miscellaneous retouched flakes, a probable tula 'slug' (**Plate 78**), three backed artefacts (**Plate 79**) and five scrapers. The axe is complete (104.6 x 52.9 x 36.3 mm) and appears to have been manufactured on a cobble derived from a conglomerate or fluvial context. It is in very good condition with no reason for discard apparent. A small chip on the cutting blade is almost certainly post-depositional, as is an adjacent c.25 mm furrow. The axe may have been hammer dressed though further analysis would be required to confirm this. Chert/tuff is the dominant raw material (n = 169, 47.2%) overall, followed by quartz (n = 109, 30.4%), 'other' unidentified raw materials (n = 56, 15.6%), quartzite (n = 17, 4.7%), chalcedony (n = 3, 0.8%), petrified wood (n = 2, 0.6%), and dolerite (n = 1, 0.3%). Overall site condition can be characterised as poor. Relevant disturbance factors include ploughing (J. Bailey, pers. comm, April 2012), the construction of contour banks, native vegetation clearance, erosion and stock trampling. Native vegetation bordering Watermark Gully to the immediate east of the site comprises a mixture of Weeping Myall Woodland and Poplar Box Woodland.

Plates:

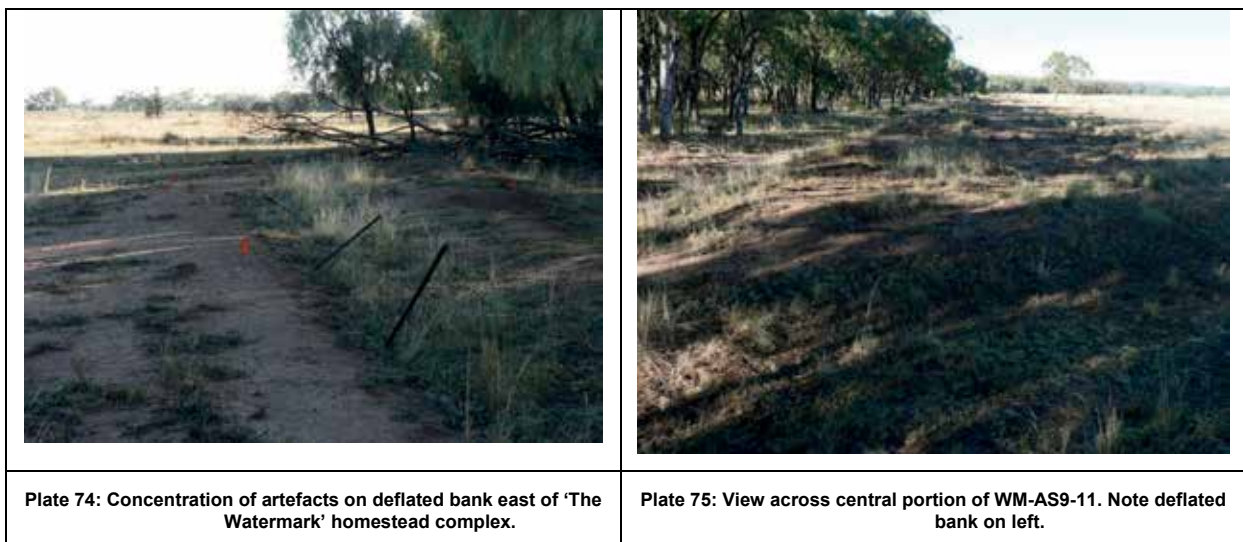


	
Plate 76: Scald on proximal drainage plain of Watermark Gully. Note excellent GSV within exposure and presence of salt tolerant vegetation.	Plate 77: WM-AS9-11: edge-ground hatchet-head.
	
Plate 78: WM-AS9-11: chert/tuff tula adze 'slug' (ventral surface)	Plate 79: WM-AS9-11: chert/tuff backed artefacts.

Site name: WM-AS10-11 **GDA Coordinates:** *Centroid:* 245987mE 6535638mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 194 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 840 m

Site description: WM-AS10-11 comprises an open artefact scatter on the eastern edge of a ploughed paddock on the property 'Urubula' (**Plate 80**). The site is located approximately 25 m southwest of a fenced area containing two large piles of hay. Relevant exposure factors include vehicle traffic - an unsealed vehicle track runs through the site in a north-south direction - and ant activity. A total of eleven artefacts were identified and recorded on site during survey. These comprised four flakes, one redirecting flake, one flake shatter fragment, four multiple platform cores (**Plate 81**) and one core fragment. All but one artefact - a complete quartz flake - was manufactured out of chert/tuff. GSV on site is excellent (91-100%). Remnant native vegetation to the immediate east of the site has been mapped as Poplar Box Woodland. Overall site condition can be characterised as fair.

Plates:

	
Plate 80: View across WM-AS10-11, facing north-northwest.	Plate 81: WM-AS10-11: multiple platform chert/tuff cores.

Site name: WM-AS11-11 **GDA Coordinates:** *Centroid:* 248554mE 6543437mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 1645 m²

Survey landform: Gently inclined footslope **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 50 m

Site description: WM-AS11-11 comprises an open artefact scatter on the eastern edge of a ploughed paddock on the property 'Kalmína' (**Plate 82**). The site is located approximately 15 m west of Court Road and extends, parallel to it, for a distance of approximately 250 m. Exposure factors include sporadic vehicle traffic, ant activity and ploughing. A total of thirteen artefacts was identified and recorded during survey. These comprised six flakes, one hatchet reworking flake (**Plate 83**), one single platform core, three multiple platform cores (**Plate 84**), one scraper (**Plate 85**) and one miscellaneous retouched flake. The maximum density of artefacts observed was one artefact per m². GSV on site is highly variable, ranging from excellent (91-100%) to very poor (0-10%). Remnant native vegetation bordering Court Road to the immediate east of the site has been mapped as Poplar Box Woodland. Overall site condition can be characterised as fair.

Plates:

	
Plate 82: View across WM-AS11-11, facing north.	Plate 83: WM-AS11-11: hatchet reworking flake (raw material unknown)
	
Plate 84: WM-AS11-11: multiple platform chert/tuff core.	Plate 85: WM-AS11-11: quartzite scraper

Site name: WM-AS12-11 **GDA Coordinates:** *Centroid:* 240919mE 6542229mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 118 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 50 m

Site description: WM-AS12-11 comprises an open artefact scatter on the property 'Wattle Vale' (**Plate 86**). WM-AS12-11 is located approximately 265 m west-northwest of the homestead complex on this property. A powerline traverses the site in a NW-SE direction. Three artefacts were identified during survey: one on a contour bank and two in erosional exposures associated with the formation of this bank. These comprised one complete chert/tuff flake, one broken chert/tuff flake and one single platform chert/tuff core (**Plate 87**). GSV on site is, on average, very good (91-100%). Remnant native vegetation to the north of the site has been mapped as Yellow Box Grassy Woodland. Overall site condition can be characterised as poor.

Plates:



Plate 86: View across WM-AS12-11, facing north-northwest.



Plate 87: WM-AS12-11: single platform chert/tuff core

Site name: WM-AS13-11 **GDA Coordinates:** *Centroid:* 243766mE 6544874mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 3254 m²

Survey landform: Gently inclined footslope **Slope Class:** 10-32%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 15m

Site description: WM-AS13-11 comprises an open artefact scatter on the southern edge of a cleared, contour-banked paddock on the property 'Gleneyre' (**Plate 88**). Steep, forested terrain borders the site to the south. Conglomerate-derived quartz pebbles and cobbles are locally abundant. Four artefacts were identified and recorded during survey, with a maximum distance of 85 m between individual artefacts. These comprised one complete chert/tuff flake, two multiple platform chert/tuff cores and an unground, bifacially-flaked hatchet-head (**Plate 89**) manufactured out of a green-grey rock macroscopically consistent with the andesitic greywacke outcropping at the "Daruka" axe quarry, north of Tamworth. The implement measures 89.3 x 59.7 x 28.3 mm and may have been discarded on the grounds of size. GSV on site is, on average, very good (91-100%). Bordering remnant native vegetation has been mapped as Tumbledown Red Gum Grassy Open Woodland. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and extensive rill erosion. The area may also have been ploughed.

Plates:

	
Plate 88: View across WM-AS13-11, facing southwest.	Plate 89: WM-AS13-11: unground bifacially-flaked hatchet-head.

Site name: WM-AS14-11 **GDA Coordinates:** *Centroid:* 243800mE 6543896 mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 267 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 90m

Site description: WM-AS14-11 comprises an open artefact scatter in a cleared mid-slope context on the properties 'Tilbrook' and 'Springhurst'. A total of four artefacts were identified during survey. Two of these - a complete chert/tuff flake (24 x 23.3 x 8.7 mm) and chert/tuff flake shatter fragment (MLD = 26.9 mm) - are located on an unsealed N-S running vehicle track on 'Tilbrook' (**Plate 90 & Plate 91**). A fenceline comprising the eastern boundary of 'Tilbrook' runs parallel to the track approximately 5m to the east. The remaining two artefacts - a multiple platform chert/tuff core (58.2 x 44.3 x 36.2 mm, **Plate 92**) and miscellaneous retouched chert/tuff flake (42.3 x 41 x 17 mm, **Plate 93**) - are located to the east of the fenceline in a cleared, contour-banked paddock on 'Springhurst'. The most-easterly of these artefacts lies approximately 90 m east of the track. Terrain to the north of the site is steep and forested. GSV on site is, on average, poor (11-30%). Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, vehicle traffic, soil erosion and ploughing.

Plates:



Plate 90: View across western portion of WM-AS14-11, facing south. Pin-markers denote artefact locations.



Plate 91: WM-AS14-11: chert/tuff flake (left) and broken flake (right).



Plate 92: WM-AS14-11: multiple platform chert/tuff core.



Plate 93: WM-AS14-11: miscellaneous retouched chert/tuff flake.

Site name: WM-AS15-11 **GDA Coordinates:** *Centroid:* 246891mE 6543204mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 10 m²

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 95 m

Site description: WM-AS15-11 consists of two artefacts - a complete chert/tuff flake (17.6 x 20.1 x 4.2 mm) and complete quartzite flake (26.4 x 29.5 x 10.4 mm) - on a unsealed north-south running vehicle track on the eastern edge of a cleared paddock on the property 'Inverness' (**Plate 94 & Plate 95**). The site is located approximately 70 m northwest of a large farm dam and is bordered to the east by a c.30 m wide strip of remnant native vegetation mapped as Weeping Myall Woodland. The main homestead is located approximately 685 M west of the site. GSV on the track is, on average, very good (71-90%) but poor (11-30%) to very poor (0-10%) in the immediate vicinity. No other artefacts were observed on the track to the north or south. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and vehicle track construction and use.

Plates:

	
Plate 94: View across WM-AS15-11, facing south.	Plate 95: WM:AS15-11: chert/tuff flake (left) and quartzite flake (right).

Site name: WM-AS16-11 **GDA Coordinates:** *Centroid:* 245053mE 6536936mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 17m²

Survey landform: Undulating to rolling hills **Slope class:** 10-32%

Vegetation community (current): Derived native grassland

Distance to nearest water: 18 m

Site description: WM-AS16-11 consists of two chert/tuff artefacts - a broken flake (MLD = 39.5 mm) and complete flake (33.9 x 21.1 x 10.1 mm) - on the western edge of steep forested terrain on the property 'Birrawa' (**Plate 96 & Plate 97**). The artefacts lie approximately 8 m apart; one is located on an unsealed N-S running vehicle track, the other, in an exposure (c.20x10 m) directly adjacent to it. GSV on the track and within the exposure is excellent (71-90%). No other artefacts were observed in the vicinity. Non-artefactual conglomerate-derived pebbles and cobbles are locally abundant. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, ongoing sheet and gully erosion and the construction and use of the vehicle track. Remnant native vegetation to the west has been mapped as Tumbledown Red Gum Grassy Open Woodland.

Plates:

	
Plate 96: View across WM-AS16-11, facing south-southwest.	Plate 97: WM-AS16-11: chert/tuff flakes.

Site name: WM-AS17-12 **GDA Coordinates:** *Centroid:* 251307mE 6542612mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 4,483 m²

Survey landform: Undulating to rolling hills **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 0 m

Site description: WM-AS17-12 consists of a small artefact scatter in a near-fully cleared paddock on the property 'Demeter' approximately 130 west of Roworth Road and 950 m south of the Kamilaroi Highway. Demeter homestead is located approximately 1.2 km northwest of the site. A total of six artefacts have been identified within WM-AS17-12, with the majority (n = 4) occurring in a linear exposure (c.30x5 m) to the immediate rear of an east-west trending contour bank (**Plate 98**). A large, active ant nest is present within this exposure. Visibility within the exposure is excellent (91-100%) but very poor (0-10%) outside of it. Recorded artefacts include three complete flakes, one broken flake, one flake shatter fragment and one multiple-platform core (**Plate 99**). Raw materials include chert/tuff (n = 3), quartz (n = 1), quartzite (n = 1) and chalcedony (n = 1). WM-AS17-12 is bisected by an unnamed 1st order stream flowing northwards towards the Kamilaroi Highway. A slight but noticeable rise on the eastern side of this stream is bordered to the west by another unnamed 1st order stream. In topographic terms, the site is located on a very gently inclined mid-slope (1-3%). Grasses excluded, native vegetation in the vicinity of WM-AS17-12 is limited to four mature paddock trees. A planted row of trees approximately 90 m northwest of the site is almost certainly recent (i.e., less than 15 years old). Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, erosion, stock trampling and ploughing.

Plates:

	
Plate 98: View across WM-AS17-12, facing northwest.	Plate 99: WM-AS17-12: Multiple-platform quartz core

Site name: Bacon Hill 1 (29-1-0154) **GDA Coordinates:** 246971mE 6537159mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 300 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 355 m

Site description: Open artefact scatter 'Bacon Hill 1' (29-1-0154) was first identified and recorded in August 2010 by archaeologist Patrick Gaynor and Walhollow LALC field representatives. The site is located to the immediate east of a large, partially-deflated contour bank on the property 'Linavardi', approximately 300 m west of Clift Road and 650 m southeast of the main homestead complex (**Plate 100**). Bacon Hill 1 has been registered on AHIMS (29-1-0154) and is currently fenced. Conglomerate-derived quartz pebbles and cobbles are abundant within and surrounding the site. The site card for Bacon Hill 1 reports an artefact scatter containing three rotated quartz cores, a rotated siltstone core and a broken sandstone muller. Despite excellent GSV, none of these items could be relocated during the current survey. Aboriginal stakeholder representatives have requested that this site be recorded as 'unverified'.

Plates:



Plate 100: View across Bacon Hill 1 (29-1-0154), facing southeast.

Site name: Bacon Hill 2 (29-1-0155) **GDA Coordinates:** 246150mE 6538276mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 168 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 185 m

Site description: Open artefact scatter 'Bacon Hill 2' (29-1-0155) was first identified and recorded in August 2010 by archaeologist Patrick Gaynor and Walhollow LALC field representatives. The site has been registered on AHIMS (29-1-0155) and is currently fenced (**Plate 101**). Bacon Hill 2 is located approximately 175 m northeast of AHIMS registered site Bacon Hill 3 (29-1-0156). The site card for Bacon Hill 2 reports two "non-rotated" (i.e., single-platform) quartz cores and a broken muller "among a large background of quartz pebbles and other material". All three items were re-identified during the current survey owing to the presence of original marker flags. *Contra* Gaynor's original assessment, it is AECOM's opinion that these items are not Aboriginal objects, as defined under the NPW Act, but rather naturally occurring stones. None exhibit any convincing evidence for human manufacture or use. Attention is also drawn to the presence of large quantities of conglomerate-derived quartz within the fenced boundaries of this 'site', as well as several angular fragments of sandstone (**Plate 102**). In view of this evidence, it is AECOM's opinion that Bacon Hill 2 is not an Aboriginal archaeological site. Aboriginal stakeholder representatives present on the day agreed with AECOM's reassessment of this 'site'.

Plates:

	
Plate 101: View across Bacon Hill 2, facing south-southwest.	Plate 102: Angular sandstone fragments at Bacon Hill 2.

Site name: Bacon Hill 3 (29-1-0156) **GDA Coordinates:** 245993mE 6538200mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 4m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 330 m

Site description: Open artefact scatter 'Bacon Hill 3' (29-1-0156) was first identified and recorded in August 2010. The site, which is located on the property 'Linavardi', has been registered on AHIMS (29-1-0156) and is currently fenced (**Plate 103**). The site card for Bacon Hill 3 reports two "rotated" (i.e., multiple-platform) quartz cores on an erosion scald exhibiting a "background of many pebbles and other material". Neither core could be relocated during the current survey. Conglomerate-derived quartz pebbles are abundant within and surrounding the site. However, none were observed to exhibit attributes indicative or suggestive of human manufacture. A previously unrecorded chert/tuff flake (25 x 23 x 4 mm) was identified within the fenced area (**Plate 104**). GSV on and immediately surrounding the site is excellent (91-100%). No other artefacts were observed in the vicinity. Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance, ongoing sheet erosion and ploughing. An area of remnant native vegetation c.75 m west of the site has been mapped as Whitebox Grassy Woodland.

Plates:

	
Plate 103: View across Bacon Hill 3, facing southwest.	Plate 104: Chert/tuff flake.

Site name: Cloveneden 1 (29-1-0157) **GDA Coordinates:** 251069mE 6538705mN GDA 94 (Zone 56)

Site type: Isolated find **Site area:** 1 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 470 m

Site description: Isolated find 'Cloveneden 1' (29-1-0157) was first identified and recorded in August 2010 by archaeologist Patrick Gaynor and Walhollow LALC field representatives. The site is located on the northern edge of a stand of immature trees (*acacia* sp.) on the property 'Cloveneden', approximately 80 m due east of an unsealed, northeasterly trending vehicle track. The site has been registered on AHIMS (29-1-0157) and is currently unfenced. The site card for 'Cloveneden 1' reports an isolated sandstone muller measuring 147 x 74 x 25 mm. This item was relocated during the current survey (**Plate 105**). However, *contra* Gaynor's original assessment, it is AECOM's opinion that this item is not an Aboriginal object, as defined by the NPW Act, and that Cloveneden 1 is thus not an Aboriginal archaeological site. The item does not, as one would expect of an Aboriginal muller, exhibit any convincing evidence of use (e.g., Smith 1985) and would appear simply to be a naturally-occurring angular fragment of sandstone, several other pieces of which were identified in the vicinity (**Plate 106**). Aboriginal stakeholder representatives present on the day agreed with AECOM's reassessment of this 'site'.

Plates:



Plate 105: Cloveneden 1: putative sandstone 'muller'.



Plate 106: Angular sandstone fragments in the vicinity of Cloveneden 1.

Site name: Tudgleys Hill 1 (29-1-0158)

GDA Coordinates: 250638mE 6540077mN GDA 94 (Zone 56)

Site type: Open artefact scatter

Site area: 165 m²

Survey landform: Undulating to rolling hills

Slope class: 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water:

Site description: Open artefact scatter 'Tudgleys Hill 1' (29-1-0158) was first identified and recorded in August 2010 by archaeologist Patrick Gaynor and Walhollow LALC field representatives. The site, which has been registered on AHIMS (29-1-0154) and is currently fenced, is located in an exposure created by gully erosion on the property 'Hill 60', approximately 65 m east of an unsealed north-south running vehicle track and 700 m north-northwest of the main homestead (**Plate 107**). Conglomerate-derived quartz pebbles and cobbles are abundant within this exposure. The site card for Tudgleys Hill 1 reports an artefact scatter containing six quartz flakes, one quartz flaked piece and one quartz core. None of these items could be relocated during the current survey. GSV on site is, on average, very good (71-90%). Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and gully erosion. Bordering remnant native vegetation has been mapped as Whitebox Grassy Woodland. Aboriginal stakeholder representatives have requested that this site be recorded as 'unverified'.

Plates:



Plate 107: View across Tudgleys Hill 1, facing south-southeast.

Site name: The Wilgas 1 (29-1-0159) **GDA Coordinates:** 251517mE 6541051mN GDA 94 (Zone 56)

Site type: Open artefact scatter **Site area:** 175 m²

Survey landform: Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 680 m

Site description: Open artefact scatter 'The Wilgas 1' (29-1-0159) was first identified and recorded in August 2010 by archaeologist Patrick Gaynor and Walhollow LALC field representatives. The site, which has been registered on AHIMS (AHIMS ID #29-1-0159) and is currently fenced, is located in an exposure (c.35 x 5 m) created by gully erosion on the property 'The Wilgas', approximately 40 m south of an unsealed east-west running vehicle track, 240 m east of Court Road and 75 m north-northwest of a large farm dam. The site card for 'The Wilgas 1' reports "a scatter of quartz artefacts along a small eroded scalded area". No further information is available, with artefact data for Tudgleys Hill 1 (29-1-0158) erroneously attached. Conglomerate-derived quartz pebbles are abundant within the fenced exposure. However, no definitive or probable stone artefacts - quartz or otherwise - were identified during the current survey. GSV on site is, on average, fair (31-50%). Overall site condition can be characterised as poor. Relevant disturbance factors include native vegetation clearance and ongoing gully erosion. Surrounding remnant native vegetation has been mapped as Whitebox Grassy Woodland. Aboriginal stakeholder representatives have requested that this site be recorded as 'unverified'.

Site name: WM-ST1-11 **GDA Coordinates:** 255931mE 6537381mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform unit(s): Undulating to rolling hills **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 490 m

Site description: WM-ST1-11 is a potential Aboriginal scarred tree located in a sparsely treed paddock on the property 'Boondah', approximately 500 m east-southeast of the main homestead on adjoining 'Elsdon'. The tree, a dead fallen Eucalypt, exhibits a single elongated oval scar on its trunk (**Plate 108**). The scar has a maximum length of 134 cm and maximum width of 28 cm. The estimated height of the base of the scar above the ground is 110 cm. The maximum depth of the regrowth is around 12 cm. No axe marks are evident. The size of the tree suggests that it was at least 100 years old at death (H.Taylor, Australian Tree Consultants, pers. comm. May 2011). The trunk is internally hollow indicating that the tree has been dead for a considerable period of time.



Plate 108: WM-ST1-11, facing southwest.

Site name: WM-ST2-11 **GDA Coordinates:** 2568882mE 6536604mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Gently inclined footslope **Slope class:** 3-10%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 165 m

Site description: WM-ST2-11 is a potential Aboriginal scarred tree located approximately 165 m west of the Mooki River on the property 'Boondah'. The tree, an over mature (100+ years) specimen of *Eucalyptus populnea* (Bimble Box), falls within the mapped boundaries of open artefact scatter WM-AS1-11 and exhibits a possible resource extraction hollow below the bifurcation of the main stem on the western side of the tree (**Plate 109**). The hollow, which extends into the innermost part of the tree, exhibits multiple (10+) steel axe marks, is oriented WNW, has a maximum length of 55 cm, maximum width of 28 cm and is located 2.2 m above the ground (**Plate 110**). The origin of this feature is open to question. As highlighted by Long (2005: 27), Aboriginal and European people alike are known to have lived (albeit partially) off the land during the Depression and it is probable that many such 'access holes' were created during this period. Significantly, two of the cut marks in the hollow appear too large to have been created by a metal axe - modern or otherwise - and are atypically 'clean'. It is highly likely that both result from the use of a chainsaw. Regarding the potential Aboriginal origin of the scar on this tree, attention is drawn to the fact that Aboriginal people are known to have worked as station hands on local properties throughout the 20th century (J.Delaney John, pers. comm. May 2012). The spatial context of the site (i.e., its presence within the mapped boundaries of artefact scatter WM-AS1-11) is likewise worthy of note as is the fact that Kamilaroi-speaking peoples living in the North Western Slopes and Plains of NSW are known to have been in possession of metal axes as early as 1832 (Mitchell 1839: 63). Durrant and Roworth's (1973: 42) reference to an Aboriginal camp site on adjoining 'Breeza Station' is also noted. The scar is in fair condition. A modern survey scar is present on the opposing side of the tree.



Plate 109: WM-ST2-11: potential 'possum hole'.



Plate 110: Wm-ST2-11: close-up showing steel axe and chainsaw marks.

Site name: WM-ST3-11 **GDA Coordinates:** 247829mE 6538553mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Gently inclined footslope **Slope class:** 3-10%

Vegetation community (current): Poplar Box Woodland

Distance to nearest water: 360 m

Site description: WM-ST3-11 consists of an over mature White Box (*Eucalyptus albens*) tree with a large curved scar on the northeastern-facing portion of its trunk (**Plate 111**). The tree is located on the property 'Flakenhoe', approximately 295 m due east of Court Road and 100 m west of a large storage shed. Several other mature trees are present in the surrounding area. Australian Tree Consultants have advised that the tree is at least 100 years old and that the depth of scarring indicates that it was wounded at least 50 years ago (Hugh Taylor, Australian Tree Consultants, pers. comm. May 2011). The scar, facing north-northeast, has a maximum length of 2.35 m and maximum width of 29 cm. The base of the scar is 80 cm above the ground. Two potential hatchet/axe marks are visible on the lower right hand side of the scar, c.45 cm from the base (**Plate 112**). The marks are parallel to each other and orientated at an oblique angle to the scar lengthwise. Both are partially obscured by regrowth. Australian Tree Consultants have assessed the tree as being in very poor condition. The scar itself is in fairly poor condition, with evidence of burning across most of the exposed scar face.

Plates:

	
Plate 111: WM-ST3-11: scar with potential axe marks.	Plate 112: Close up of potential hatchet/axe marks near base of scar.

Site name: WM-ST4-11 **GDA Coordinates:** 252771mE 6538179mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Level to gently undulating/inclined flood/drainage plain **Slope class:** <1%

Vegetation community (current): White Box Woodland

Distance to nearest water: 940 m

Site description: WM-ST4-11 consists of a potential Aboriginal scarred tree. The tree, a mature Blakleys Red Gum (*Eucalyptus blakelyi*), is located on the property 'Carinya', approximately 35 m north of The Dip Road and 115 m east of isolated find WM-IF8-11. The tree itself is approximately 25 m high and has a maximum estimated crown width of around 20 m. Several other mature trees are present in the surrounding area. The size and general condition of the tree suggest that it is at least 100 years old (H.Taylor, Australian Tree Consultants, pers. comm. May 2011). A regular, square-ended scar on the trunk of the tree likely comprises a bark slab removal scar and may be either Aboriginal or European in origin (**Plate 113**). The scar, facing southwest, has a maximum length of 1.52 m and maximum width of 70 cm. The base of the scar is 28 cm above the ground. No axe marks are visible. The scar face exhibits three former twig/branch protrusions, one of which has had a steel nail hammered into it. Australian Tree Consultants have advised that the tree was wounded at least 50 years prior to inspection and have assessed the tree as being in generally fair condition (ATC 2011: 23). The scar, in contrast, is in excellent condition.



Plate 113: WM-ST4-11: bark slab removal scar.

Site name: WM-ST5-11 **GDA Coordinates:** 247685mE 6542715mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Gently inclined footslope **Slope class:** 1-3%

Vegetation community (current): Low diversity grassland & exotic pasture

Distance to nearest water: 150 m

Site description: WM-ST5-11 consists of a potential Aboriginal scarred tree. The tree, a mature White Box (*Eucalyptus albens*), is located in a sparsely treed paddock approximately 110 m south of Colley Road and 425 m west-southwest of the intersection of Court and Colley Roads. The tree itself is approximately 20 m high and has a maximum crown width of around 20 m. The size and general condition of the tree suggest that it is at least 100 years old (H.Taylor, Australian Tree Consultants, pers. comm. May 2011). The tree exhibits a lenticular scar on its lower trunk (**Plate 114**). The scar, facing north-northwest, has a maximum length of 1.38 m and maximum width of 19 cm. The base of the scar is 60 cm above the ground. No axe marks are visible on the exposed scar face. Australian Tree Consultants have advised that the tree was wounded at least 50 years prior to inspection and have assessed the tree as being in declining condition (ATC 2011: 23). The scar is in good condition.



Plate 114: WM-ST5-11

Site name: WM-ST6-11

GDA Coordinates: 246990mE 6543787mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Level to gently undulating/inclined flood/drainage plain

Slope class: 1-3%

Vegetation community (current): Poplar Box Woodland

Distance to nearest water: 265 m

Site description: WM-ST6-11 consists of a potential Aboriginal scarred tree. The tree, a mature Bimble Box (*Eucalyptus populnea*), is located in a discontinuous strip of remnant native vegetation separating the properties 'Inverness' and 'Kalmia', approximately 865 m northeast of the main homestead on the former and 585 m north-northeast of open artefact scatter WM-AS15-11. The tree itself is approximately 15 m high and has a maximum crown width of around 25 m. The trunk divides into three stems approximately 50 cm above the ground. The size and general condition of the tree suggest that it is at least 100 years old (H. Taylor, Australian Tree Consultants, pers. comm. May 2011). Two large scars are visible on separate stems. The irregularly-shaped scar on the upper part of the northern stem is almost certainly natural in origin. However, that on the southern stem (**Plate 115**) is noticeably more regular and almost certainly anthropogenic in origin. The scar, facing west-southwest, has a maximum length of 1.52 m and maximum width of 40 cm. The base of the scar is 50 cm above the ground. No axe marks are visible on the scar face. Australian Tree Consultants have advised that the tree was wounded at least 50 years prior to inspection and have assessed the tree as being in declining health (ATC 2011: 23). The scar is in good condition.



Plate 115: WM-ST6-11: potential Aboriginal scarred tree

Site name: WM-ST7-11

GDA Coordinates: 246732mE 6541087mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform: Level to gently undulating/inclined flood/drainage plain

Slope class: <1%%

Vegetation community (current): Poplar Box Woodland

Distance to nearest water: 175 m

Site description: WM-ST7-11 comprises a potential Aboriginal scarred tree. The tree, a mature living bimple box (*Eucalyptus populnea*), is located on the eastern proximal drainage plain of Watermark Gully and exhibits a single ovoid scar measuring 1.88 x 0.8 m (**Plate 116**). Patterned steel axe marks are present at both ends of the scar: cross-diagonal or 'zig-zag' marks at the top and parallel horizontal marks at the bottom (**Plates 117 & Plate 118**). Consultation of Long's (2005) *Aboriginal Scarred Trees in New South Wales: A Field Manual* suggests that this scar is likely European in origin, being an excellent example of what is known as a "roofing scar". Roofing scars generally conform to a standardised length (1.5-2.5 m), reflecting the primary usage of the removed bark for building cladding, though the width of panels varied according to the girth of the tree. Long (2005: 33) suggests that roofing scars can be readily distinguished from Aboriginal shelter scars by their relatively recent age, the presence of cross-diagonal 'zig-zag' steel axe marks and the use of full size axes (10-15 cm blade). This evidence notwithstanding, there remains a possibility that the scar on WM-ST8-11 was, in fact, created by an Aboriginal person or persons. Aboriginal people are known to have worked as station hands on local properties throughout the 20th century (J.Delaney-John, pers. comm. May 2012). The proximity of the tree to a major Aboriginal camp site (WM-AS9-11) is also of note in this respect as is the fact that Aboriginal people living in the North West Slopes and Plains of NSW are known to have been in possession of metal axes as early as 1832 (see Mitchell 1839: 63). Accordingly, a precautionary approach is adopted here.

Plates:

	
Plate 116: Scar on WM-ST7-11	Plates 117 & 118 : Close-ups of steel axe marks on WM-ST7-11.

Site name: WM-ST8-11

GDA Coordinates: 246682mE 6541177mN GDA 94 (Zone 56)

Site type: Scarred tree

Survey landform(s): Level to gently undulating/inclined flood/drainage plain

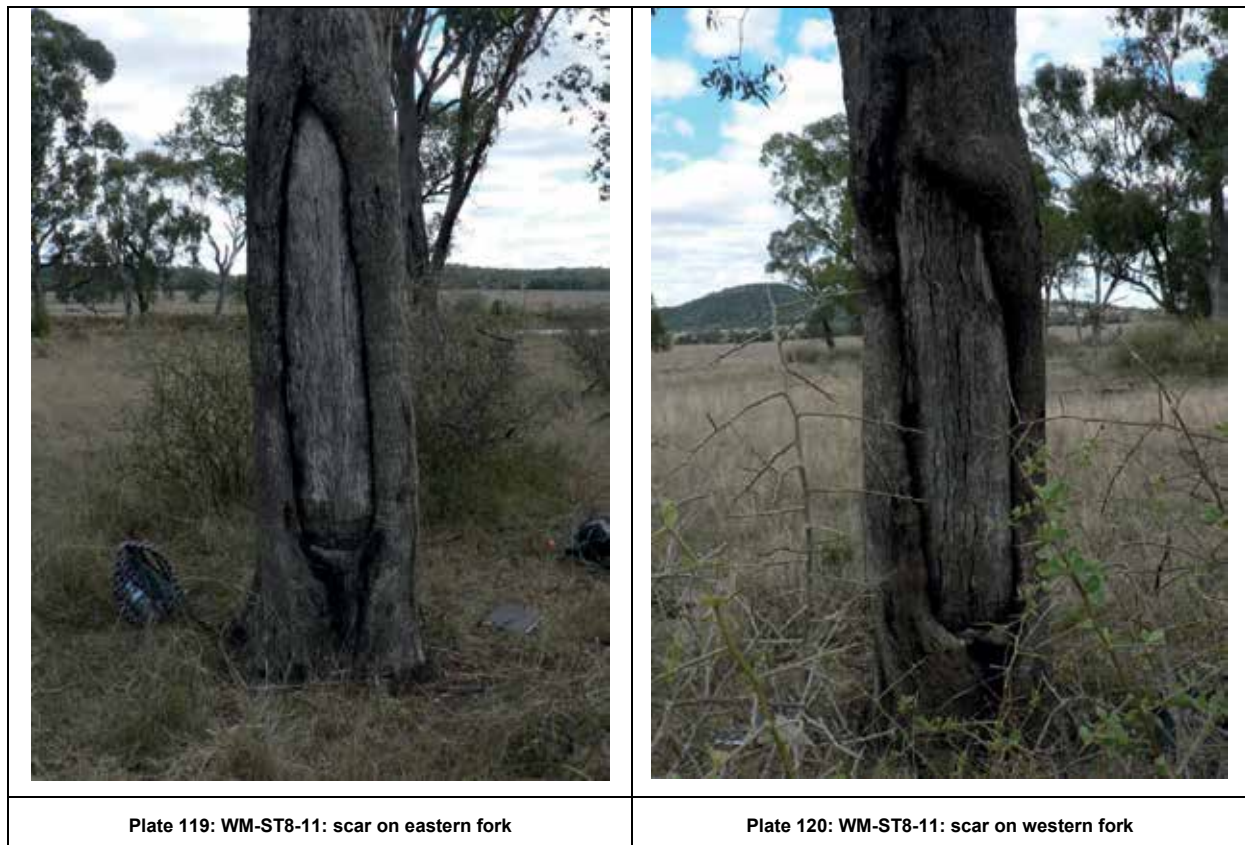
Slope class: <1%%

Vegetation community (current): Poplar Box Woodland

Distance to nearest water: 45 m

Site description: WM-ST8-11 comprises a potential Aboriginal scarred tree. The tree, a mature forked bumble box (*Eucalyptus populnea*), is located on the eastern proximal drainage plain of Watermark Gully approximately 100 m north-west of WM-ST7-11. Two scars are present on this tree, one on either fork (**Plate 119 & Plate 120**). The scar on the eastern fork of the tree is 1.73 m high and 0.36 m wide and terminates 0.55 m from the ground. Patterned steel axe marks are present at both ends of this scar: cross-diagonal or 'zig-zag' marks at the top and parallel horizontal marks at the bottom. The scar on the western fork of the tree is 1.89 m high and 0.50 m wide. Cross-diagonal hatching is not visible at the top of this scar though extent of regrowth precludes definitive comment on its presence/absence. However, horizontal steel axe marks across the bottom of scar are identical in form to those on the eastern scar. As with WM-ST8-11, consultation of Long's (2005) *Aboriginal Scarred Trees in New South Wales* suggests that both scars on WM-ST8-11 are likely European in origin and comprise "roofing scars". However, for the reasons outlined above, an Aboriginal origin cannot be ruled out.

Plates:



Site name: WM-GG1-11

GDA Coordinates: Centroid: 243723mE 6540617mN GDA 94 (Zone 56)

Site type: Grinding grooves **Site area:** 5,000 m² (approx)

Survey landform unit(s): Gently inclined footslope **Slope class:** 1-3%

Vegetation community (current): Regenerating Blakely's Red Gum Grassy Woodland

Site description: WM-GG1-11 consists of a large grinding groove site in a lower slope context on the property 'Molonga'. The site, which covers an area of *at least* 5,000 m², is located approximately 550 m southeast of the main homestead. Grinding grooves within WM-GG1-11 occur on exposed sandstone bedrock and blocks (i.e. 'floaters'), with the latter concentrated in the northern portion of the site. Two main groups of grooves are apparent, with a few examples occurring in-between. Both groups are associated with ephemeral, unnamed drainage lines, neither of which is depicted on the 1:25,000 topographic map for the area (Watermark 8935-I-S). The southern group comprises a minimum of 50 (max = 60) grooves on a non-continuous (i.e., due to grass cover) linear outcrop of sandstone bordered, to the south, by a dense stand of white cypress pine (*Callitris glaucophylla*) (**Plate 121, Plate 122 & Plate 123**). The outcrop is located in a shallow, SW-NE trending drainage depression. Recorded grooves in this cluster are concentrated at the southwestern end of the outcrop, with over 40 grooves in a c.25m² area. This would appear to relate to natural water flow and pooling, with slight but noticeable depression in the sandstone in this area. The northern cluster is located approximately 85 m to the north of the southern outcrop in an area of heavily fractured sandstone bedrock (**Plate 124, Plate 125 & Plate 126**). A total of fourteen potential grooves was recorded in this cluster, with most occurring on the western edge of a slight but noticeable drainage depression. Natural furrowing is evident in this area and it possible that some of the grooves recorded are natural in origin. Groove definition across WM-GG1-11 is highly variable. However, the majority of grooves are well-defined. GSV surrounding the sandstone outcrops within the site is very poor (0-10%) due to thick native and introduced grass and weed cover. Overall site condition is good. Surrounding native vegetation has been mapped as Regenerating Blakely's Red Gum Grassy Woodland.

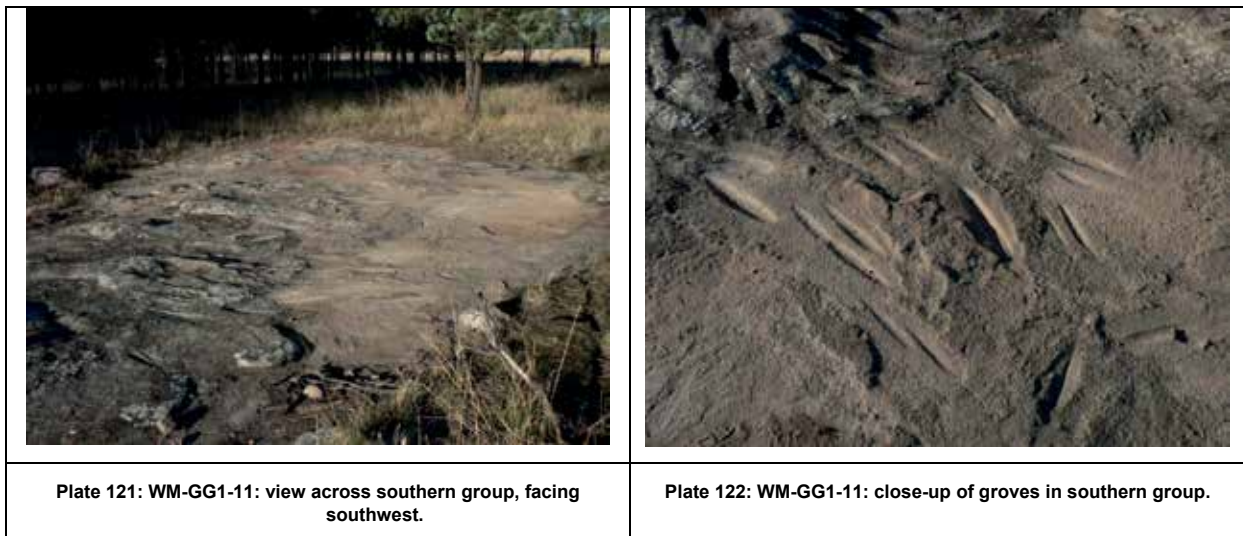


	
Plate 123: WM-GG1-11: close-up of grooves in southern group.	Plate 124: WM-GG1-11: view across northern group area, facing north-northeast. Note ephemeral drainage depression in background.
	
Plate 125: WM-GG1-11: fractured sandstone bedrock in northern group.	Plate 126: WM-GG1-11: close-up of grooves in northern group.

Site name: WM-GG2-11

GDA Coordinates: 249376mE 6541372mN GDA 94 (Zone 56)

Site type: Grinding grooves

Survey landform: Level to undulating hills on plateau surfaces

Slope class: 10-32%

Vegetation community (current): White Box Grassy Woodland

Distance to nearest water: 295 m

Site description: WM-GG2-11 comprises an isolated axe grinding groove on a block of exposed sandstone on the north-western edge of Mount Watermark, approximately 15 to 20 m east of the mountain's western cliff face (**Plate 127 & Plate 128**). The block in question, which may be a 'floater', is located in a much larger (c.2,500-3,000 m²) discontinuous exposure of sandstone bedrock, with multiple detached blocks and slabs present. No other grooves were observed in this exposure during survey. The groove itself measures 30 x 6.5 x 1.5 cm, is oriented SW-NE and has tapered ends. WM-GG2-11 has a panoramic view of lands of to the west and northwest. Overall site condition can be characterised as good. Surrounding vegetation has been mapped as Whitebox Grassy Woodland.



Plate 127: View across WM-GG2-11, facing west-southwest.



Plate 128: WM-GG2-11: isolated grinding groove.

Site name: WM-GG3-12 **GDA Coordinates:** *Centroid:* 251721mE 6540020mN GDA 94 (Zone 56)

Site type: Grinding grooves **Site area:** 35 m²

Survey landform unit(s): Undulating to rolling hills **Slope class:** 3-10%

Vegetation community (current): White Box Grassy Woodland

Site description: WM-GG3-12 comprises a grinding groove site on an exposed bench of sandstone bedrock (c.7x4 m) on the property 'Cloveneden' (**Plate 129 & Plate 130**). The site is located on a gently inclined (3-10%) vegetated upper slope approximately 130 m northeast of a unnamed 1st order stream. A north-south trending fenceline is located around 30 m to the west of the site. Twenty grooves are present on the bench in question, with all but two clustered in an area of around 3 m² (**Plate 131 & Plate 132**). This patterning likely reflects natural water flow across the exposed bedrock, with no obvious differences in sandstone quality evident. No depressions or holes capable of holding water for an extended period are present on-site. Most grooves are well-defined. Groove orientations include N-S, NE-SW, NW-SE, NNW-SSE and SSE-NNW. Overall site condition can be characterised as good. However, bedrock cracking is apparent. GSV surrounding the outcrop is very poor (0-10%), with large quantities of fallen tree matter (i.e., leaves, twigs and branches) present.

Plates:

Plate 129: View across WM-GG3-12, facing northeast.	Plate 130: WM-GG3-12: close-up of sandstone bench, facing west.
Plate 131: WM-GG3-12: close-up of main cluster of grooves within WM-GG3-12.	Plate 132: WM-GG3-12: close-up of groove located outside of main cluster.

Appendix D

Arboricultural Assessment Report



AUSTRALIAN TREE CONSULTANTS Pty Ltd
ABN 38 104 636 535
P.O. Box 276 Parramatta NSW 2124

Telephone (Office): 1300 737 674
Mobile (Hugh) : 0418 474 796

E-mail: admin@australiantreeconsultants.com.au
www.australiantreeconsultants.com.au

Mr. Andrew McLaren
AECOM
Level 8, 17 York St.
Sydney
NSW 2000

Re: Arboricultural Assessment of potential Aboriginal scarred trees on the Watermark site , Gunnedah (NSW).

Reference is made to your recent request for an arboricultural assessment of potential Aboriginal scarred trees on the proposed Watermark site at Gunnedah, NSW.

Australian Tree Consultants Pty Ltd undertook A site inspection on Tuesday, 10th May 2011. As a result of this inspection we are pleased to supply you with the attached report.

Should you have any questions or require any further information in relation to this report, please contact our office on 1300 737 674 or myself on 0418 474 796.

Hugh Taylor
Director
Registered Consulting Arborist No 1268
Director Arboriculture Australia
BA (L) Major in Wilderness Management/Outdoor Education
Diploma Horticulture – Arboriculture (Level 5)
Arborist/ Tree Surgeon/ Horticulturist
Certificate IV Occupational Health & Safety
QTRA No 2650

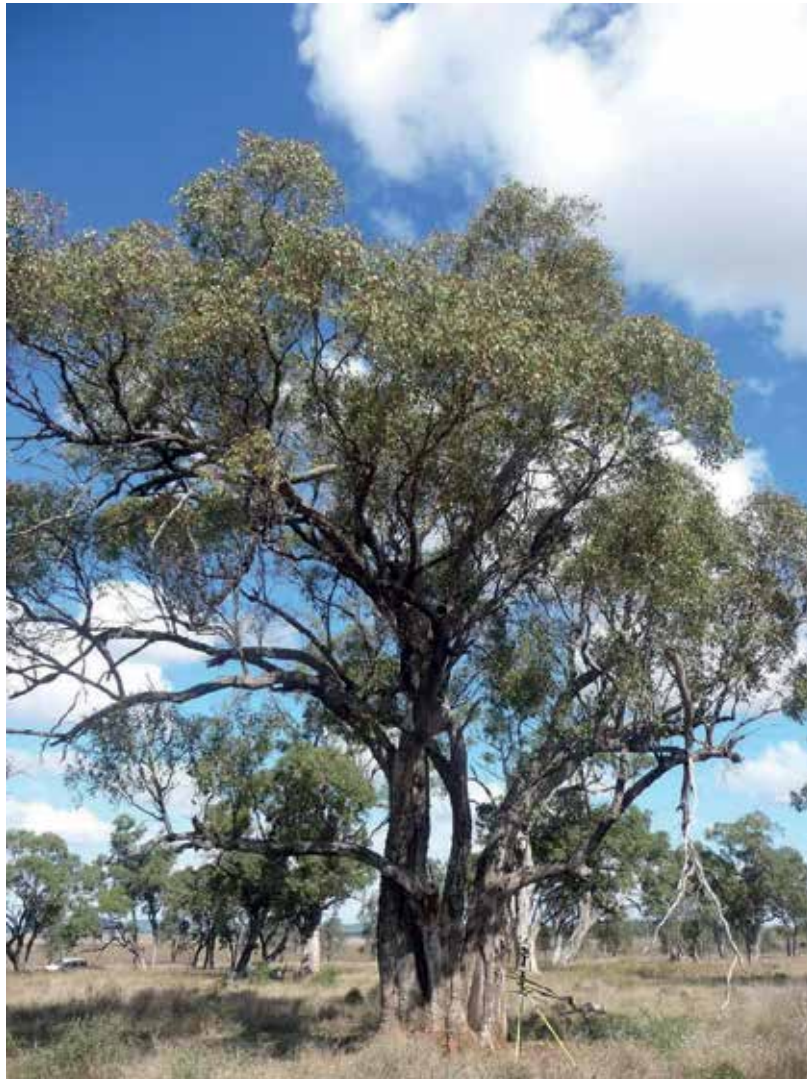


ATC 11-101

Watermark Gunnedah, NSW

Page 1 of 36

AECOM



SITE ADDRESS	Watermark Gunnedah
CLIENT	AECOM
PREPARED BY	Australian Tree Consultants Pty Ltd
DATE	18 TH May 2011



ATC 11-101

Watermark Gunnedah, NSW

Page 2 of 36

AECOM

INTRODUCTION / METHODOLOGY

AECOM has commissioned Australian Tree Consultants Pty Ltd to provide a report on potential Aboriginal scarred trees within the Watermark precinct at Gunnedah (NSW).

The inspection was undertaken by Australian Tree Consultants to determine if markings on the trees were likely to be of Aboriginal origin.

A Visual Tree Assessment (VTA) was conducted from ground level. No aerial inspections, root mapping or diagnostic equipment was used. Tree heights and canopy spreads were visually estimated. Trunk diameter was measured at 1.4m above ground level. Each tree inspected was plotted using a GPS system. Google maps of the inspection sites are attached as appendices. Each tree inspected has been plotted and marked on the maps.

For the purpose of this report the trees inspected are numbered in the order of our inspection and also referenced as per the AECOM identification.

AIM

The aim of the inspection was to attempt to determine the approximate age of the trees and the origin of the markings / scars on each tree.



ATC 11-101

Watermark Gunnedah, NSW

Page 3 of 36

AECOM

OBSERVATIONS



Tree 1 WM ST-11-11
Eucalyptus populnea (Bimble Box)

Tree Identification No.	Species	Dimensions
1 WM ST-11-11	<i>Eucalyptus populnea</i> (Bimble Box)	H: 15m W: N/S= 20m E/W: = 25m Ø: 700mm N/E Ø: 600mm N/W Ø: 435mm S/W
- Over mature tree probably 100 - 200 years of age. Trunk divides into three main stems. - Tree health in decline, multiple limb failures throughout the canopy. Canopy structure consists of mature and semi mature epicormic growth only. - Scar on lower inside of N/E stem 1.53 m long .55m wide. - Scar on N/W stem 2m above ground level extends 2m upwards..		



ATC 11-101

Watermark Gunnedah, NSW

Page 4 of 36



Scars on N/W and N/E stems.

DISCUSSION

The tree is a specimen of *Eucalyptus populnea* (Bimble Box) a common Eucalypt species of the western plains of NSW. Its size and general condition, (health and structure) suggests that it is of a mature to over mature age, at least 100 - 200+ years of age. The general decline in canopy condition and structure is typical of a tree of this mature age and location, (in open exposed area).

The scar on the lower N/E trunk has been produced by cutting through the outer bark into the cambium layer and removing the outer bark. A scar that is permanent is caused by killing the cambium where wounding has occurred, (such as scars formed by the removal of bark to make canoes or other smaller objects). The cambium contains meristematic tissue, (tissue that contains actively dividing cells) which produces a new layer of vascular tissue each year or growing period. This means that new wood tissue is constantly produced after wounding, rolling inwards on all sides of the wound. Eventually the original wound may disappear over an extended period of time. In this case the original wound face is still clearly visible although the amount of new tissue around the extremities of the wound produced after wounding is of a substantial depth suggesting that the tree was originally wounded at least 50 - 100+ years previously.

The scar on the N/W stem is irregular in shape and appears most likely to have resulted from impact wounding from a part of this tree or another damaging and tearing the outer bark.



ATC 11-101

Watermark Gunnedah, NSW

Page 5 of 36

AECOM

CONCLUSIONS

The scar on the N/W stem is high above ground level and appears to have resulted from an impact such as branch failure from this or another adjacent tree.

In our opinion the scar on the lower N/E trunk has been produced by some form of mechanical wounding. It is too symmetrical to have been produced from grazing animals, (eg. cattle, sheep) or from any impacts from adjacent tree failures. The scar may, therefore, be Aboriginal in origin.

Due to the size of the tree it can be assumed that it is at least 100 – 200 + years of age and that it was wounded at least 50 – 100+ years earlier to inspection.



ATC 11-101

Watermark Gunnedah, NSW

Page 6 of 36



Tree 2 WM ST-10-11
***Eucalyptus melliodora* (Yellow Box)**

Tree Identification No.	Species	Dimensions
2 WM ST-10-11	<i>Eucalyptus melliodora</i> (Yellow Box)	H: 20m W: N/S= 20m E/W: = 20m Ø: 875m
• Mature tree probably 100+ years of age located on outside of cattle yard perimeter adjacent to fence. • Tree in fair health and structural condition. • Scar on lower trunk 1.2 m long .73m wide, 1.3m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 7 of 36

AECOM



Scar on lower trunk

DISCUSSION

The tree is a specimen of *Eucalyptus microcorys* (Yellow Box) a commonly found in association with other woodland Eucalypt species *E. albens*, *E. blakelyi* and *E. populnea* within the surrounding area. Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100+ years of age. The general condition of the tree is fair with little decline in canopy condition and structure.

The scar on the lower trunk is slightly irregular in shape. The bark at the top of the scar has torn at the time the trunk of the tree was wounded. The formation of the callusing tissue around the sides of the wound suggests that the tree was originally wounded at least 50 + years previously.

As tree is located adjacent to a cattle yard, the height of the scar is suggestive of a mechanical injury that has occurred as a result of activities associated with handling cattle, (eg, loading cattle trucks etc.).



ATC 11-101

Watermark Gunnedah, NSW

Page 8 of 36

CONCLUSIONS

In our opinion the scar on the lower trunk is likely non-Aboriginal in origin, having been produced as a result of activities associated with handling cattle.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 + years of age and that it was wounded at least 50 years earlier to inspection.



ATC 11-101

Watermark Gunnedah, NSW

Page 9 of 36

AECOM



Tree 3 WM ST-9-11
***Eucalyptus albens* (White Box)**

Tree Identification No.	Species	Dimensions
3 WM ST-9-11	<i>Eucalyptus albens</i> (White Box)	H: 20m W: N/S= 20m E/W: = 20m Ø: 840m
• Mature tree probably 100 - 200 years of age located in open cleared paddock. • Tree in declining condition. Majority of original canopy structure has failed, mature epicormic re growth only. • Oblong scar on lower trunk 1.4 m long .22m wide, .5m above ground level. Second oval shaped scar on trunk approx. 5m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 10 of 36

DISCUSSION

The tree is a specimen of *Eucalyptus albens* (White Box) commonly found in association with other woodland Eucalypt species *E. melliodora* *E. blakelyi* and *E. populnea* within the surrounding area. Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 - 200+ years of age. The general condition of the tree is declining.

The scar on the lower trunk is narrow and regular in shape. The formation and thickness of the callusing tissue around the sides of the wound suggests that the tree was originally wounded at least 50 - 100 years previously.

The oval shaped scar above is relatively recent in age. It is suggestive of an impact wound where the outer bark has been torn as a result of another tree or object impacting heavily upon the trees trunk.



Narrow oblong scar on lower trunk



CONCLUSIONS

In our opinion the scar on the lower trunk has been produced by some form of mechanical wounding, (cutting or removal of the bark). Because it is such a symmetrical wound it may be Aboriginal in origin. The wound closely resembles the shape of a coolamon.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 - 200 years of age and that it was wounded at least 50 - 100 years earlier to inspection.

The second, higher scar appears to be the result of impact damage to the outer trunk from another tree or object coming into heavy contact. This is not cultural in origin. It would also appear that bird browsing damage has added to the wound site.



ATC 11-101

Watermark Gunnedah, NSW

Page 12 of 36



Tree 4 WM ST-8-11
***Eucalyptus albens* (White Box)**

Tree Identification No.	Species	Dimensions
4 WM ST-8-11	<i>Eucalyptus albens</i> (White Box)	H: 22m W: N/S= 20m E/W: = 20m Ø: 78m
• Over mature tree with main trunk and two lesser trunks. Most probably 100 – 200+ years of age, located on top of ridge. • Tree in very poor declining condition of health and structure. Majority of original canopy structure has failed, mature epicormic re growth only. • Scar on inner side of lower main trunk 2.1m long .48m wide, .5m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 13 of 36

AECOM

DISCUSSION

The tree is an over mature specimen of *Eucalyptus albens* (White Box) located on the top of a ridge in a population of other mature White Box . Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 - 200+ years of age in severe decline. The remaining mature tree population in this immediate vicinity appears to have been repeatedly severely damaged by storms and fires. The surrounding area had a heavy loading of fallen branches most likely resulting from multiply storm events.

The scar on the lower trunk has an irregular shape of callus formation around the wound face. The formation and thickness of the callusing tissue around the sides of the wound suggests that the tree was probably originally wounded at least 50 - 100 years previously. There were no indication of axe or other cutting implement marks on the wound face.



CONCLUSIONS

In our opinion the scar on the lower trunk has been produced by some form of impact damage most probably the result of a severe impact onto the lower trunk from an adjacent tree during a storm or fire event.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age and that it was wounded at least 50 - 100 years earlier to inspection.



ATC 11-101

Watermark Gunnedah, NSW

Page 14 of 36



Tree 5 WM ST-6-11
***Eucalyptus albens* (White Box)**

Tree Identification No.	Species	Dimensions
5 WM ST-6-11	<i>Eucalyptus albens</i> (White Box)	H: 24m W: N/S= 22m E/W: = 20m Ø: 1.245m
• Over mature tree located in open, cleared paddock. Trunk divides at 1.5m above ground level. Most probably 100 – 200+ years of age,. • Tree in very poor declining condition of health and structure. Majority of original canopy structure has failed, mature epicormic re growth only. • Scar on inner side of lower main trunk 2.4m long .48m wide, .5m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 15 of 36

AECOM

DISCUSSION

The tree is an over mature specimen of *Eucalyptus albens* (White Box) located in cleared open paddock. Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 - 200+ years of age in severe decline.

The scar on the lower trunk has a reasonably regular outline of callus formation around the wound face. The formation and thickness of the callusing tissue around the sides of the wound suggests that the tree was probably originally wounded at least 50 - 100 years previously. There were axe or other cutting implement marks on the lower end of the wound face.



Long vertical scar on lower trunk.

CONCLUSIONS

In our opinion the scar on the lower trunk has most probably been produced by some form of bark removal with a sharp implement. The markings at the lower end of the wound face that bark removal was undertaken with an axe or similar object and that the scarring is potentially Aboriginal in origin.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age and that it was wounded at least 50 - 100 years earlier to inspection.





Tree 6 WM ST-5-11
***Brachychiton populneus* (Kurrajong)**

Tree Identification No.	Species	Dimensions
6 WM ST-5-11	<i>Brachychiton populneus</i> (Kurrajong)	H: 15m W: N/S= 12m E/W: = 12m Ø: .685m
• Mature tree located in open, cleared paddock. Trunk divides at 1.5m above ground level. Approx. 100 years of age,. • Tree in good condition of health and structure. • Small feint elliptical scar / indentation on lower trunk 2.4m long .48m wide, 1.3m above ground level.		



DISCUSSION

The tree is a mature specimen of *Brachychiton populneus* (Kurrajong) located in a cleared open paddock. Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 years of age in a generally good condition of both health and structure.

The small, feint scar or indentation is located on the lower trunk 1.3m above ground level. This scar appears to be a result of branch loss and the wound is the callusing wound wood. An expert in Brachchitions has indicated that the wound on this tree would be less than 20 – 30 years old.



Elliptical scar on lower trunk.

CONCLUSIONS

In our opinion the scar on the lower trunk has most probably been from a branch failure site.





Tree 7 WM ST-7-11
***Eucalyptus populnea* (Bimble Box)**

Tree Identification No.	Species	Dimensions
7 WM ST-7-11	<i>Eucalyptus populnea</i> (Bimble Box)	H: 15m W: N/S= 12m E/W: = 12m Ø: .85m Ø: .8m Ø: .3m
• Mature tree located in open, cleared paddock. Trunk divides at ground into two large and a small trunk. Approx. 100 – 200+ years of age, • Tree in very poor declining condition of health and structure. Majority of original canopy structure has failed, mature epicormic re growth only. • Large, long scar on largest trunk stretches approx. 3m up trunk from ground level. • Smaller scar on other large trunk 1.4m long .3m wide, .3m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 19 of 36

AECOM

DISCUSSION

The tree is an over - mature specimen of *Eucalyptus populnea* (Bimble Box) located in a cleared open paddock. The soil at the base of the tree is heavily compacted and soil surface bare suggesting that the tree has provided shade and shelter for grazing animals such as cattle.

Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 – 200+ years in a generally poor and declining condition of both health and structure.

Two scars are present on each of the larger of the three trunks. The largest scar stretches from ground level for a length of approximately 3m. The edges of the scar undulate and follow the natural curve of the trunk ending in a very pointed tip. This type of scar is typical of a tear wound created by the failure of a limb in the upper canopy which tears off the bark attached to the trunk below as it falls.

The smaller scar is also pointed in shape. Being so close to the ground it most probably has been created by damage to the lower trunk from direct contact by cattle or horses.



Scars on both large trunks.



ATC 11-101

Watermark Gunnedah, NSW

Page 20 of 36

CONCLUSIONS

In our opinion the larger scar has been produced by some form of impact damage most probably the result of a branch failure in the upper canopy that resulted in tearing off the attached trunk bark below the failure site.

The smaller scar appears to have resulted from constant rubbing or disturbance from direct animal, (cattle, horses) contact.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age and that it was wounded at least 50 - 100 years earlier to inspection.



ATC 11-101

Watermark Gunnedah, NSW

Page 21 of 36

AECOM



Tree 8 WM ST-12-11
***Eucalyptus blakelyi* (Blakleys Red Gum)**

Tree Identification No.	Species	Dimensions
8 WM ST-12-11	<i>Eucalyptus blakelyi</i> (Blakleys Red Gum)	H: 23m W: N/S= 20m E/W: = 22m Ø: .425
• Mature tree with single trunk located in open, cleared paddock. Approx. 100 - 150 years of age, • Tree in generally fair condition of health and structure. Several branch failures in top of crown. • Scar on lower trunk 1.5m long .76m wide, .28m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 22 of 36

DISCUSSION

The tree is a mature specimen of *Eucalyptus blakelyi* (Blakleys Red Gum) located in a cleared open paddock. Its size and general condition, (health and structure) suggests that it is of a mature age, at least 100 – 150 years in a generally fair condition of both health and structure.

The scar is regularly shaped. The top and bottom of the scar are squared with no axe or other cut marks visible on the wound face. The depth of the callus tissue development suggests that the scarring occurred approximately 50+ years earlier.



Square shaped scar on lower trunk.

CONCLUSIONS

In our opinion the scar on the lower trunk has most probably been produced by some form of bark removal with a sharp implement and that the scarring is likely cultural in origin. The scar may relate to Aboriginal activity but equally could be European (colonial) in origin. This pattern of a square shaped scar is not consistent with the shape of a wound produced from other types of damage and appears to have been undertaken carefully and deliberately.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 years of age and that it was wounded at least 50 years earlier to inspection.





Tree 9 WM ST-1-11
***Eucalyptus populnea* (Bimble Box)**

Tree Identification No.	Species	Dimensions
9 WM ST-1-11	<i>Eucalyptus populnea</i> (Bimble Box)	H: 23m W: N/S= 20m E/W: = 22m Ø: 1.3m
• Mature tree with single trunk located in open, cleared paddock. Approx. 100 – 200+ years of age, • Tree in generally declining condition of health and structure. Original canopy structure failed canopy consists of mature epicormic growth only. • Trunk divides at 4m above ground level. • Small triangular scar on lower trunk .57m long .14m wide, .28m above ground level. Axe marks visible on top of wound face.		



ATC 11-101

Watermark Gunnedah, NSW

Page 24 of 36

DISCUSSION

The tree is a mature specimen of *Eucalyptus populnea* (Bimble Box) located in a cleared open paddock. Its size and general condition, (health and structure) suggests that it is of an over mature age, at least 100 – 200+ years in a generally declining condition of both health and structure.

The scar is triangularly shaped with axe marks visible on the top of wound face. The depth of the callus tissue development suggests that the scarring occurred approximately 50 - 100 years earlier.

When this tree and scar is viewed in conjunction with the trees location (directly adjacent to property entrance) the wound was considered to be most likely European in origin, probably as a property survey mark.



Small pointed scar on lower trunk.

CONCLUSIONS

In our opinion the scar on the lower trunk has most probably been produced by some form of bark removal with a sharp implement

This pattern of scar is not consistent with the shape of a wound produced from other types of damage and appears to have been undertaken carefully and deliberately. Steel Axe marks are clearly visible at the top of the wound face forming a distinct '^' shape.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age and that it was wounded at least 50 - 100 years earlier to inspection.





Tree 10 WM ST-3-11
Dead tree

Tree Identification No.	Species	Dimensions
10 WM ST-3-11	Dead tree	Ø: 3m
• Dead tree located in open, cleared paddock. Approx. 100 – 200+ years of age, • Tree dead on ground, only trunk remains. • Scar on lower trunk 1.34m long .28 wide, 1.1m above original ground level. Inside of trunk hollow. • Lower trunk of tree ring barked below scar level.		

DISCUSSION

The tree is a dead Eucalypt specimen located in a cleared open paddock. The size and general condition of the trunk and callus tissue development around the scar suggests that it was an over mature age, at least 100 – 200+ years when the tree died. The trunk is internally hollow which indicates that it has been dead for a considerable amount of time.

The scar is an even shape with a rounded top and bottom. The depth of the callus tissue development suggests that the scarring occurred approximately 50 - 100 years earlier to death of the tree.



ATC 11-101

Watermark Gunnedah, NSW

Page 26 of 36



Scarred, hollow, dead tree

CONCLUSIONS

In our opinion the scar on the lower trunk has most probably been produced by some form of bark removal with a sharp implement and that the scarring is possibly Aboriginal in origin.

This pattern of scar is not consistent with the shape of a wound produced from other types of damage and appears to have been undertaken carefully and deliberately.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age when it died and that it was wounded at least 50 - 100 years earlier to its death. As it appears to have been dead for a considerable amount of time the age of the scar could be greater than 100 years.



ATC 11-101

Watermark Gunnedah, NSW

Page 27 of 36

AECOM



Tree 11 WM ST-2-11
***Eucalyptus populnea* (Bimble Box)**

Tree Identification No.	Species	Dimensions
11 WM ST-2-11	<i>Eucalyptus populnea</i> (Bimble Box)	H: 20m W: N/S= 18m E/W: = 15m Ø: .93m
• Over mature tree with single trunk located in open, cleared paddock. Approx. 100 – 200+ years of age, • Tree in generally declining condition of health and structure. Original canopy structure failed, little canopy structure remaining. • Trunk divides at 7m above ground level. • Scar on northern side of lower trunk 1.37m long, .1m wide and 1.14m above ground level. • Scar on southern side 1.1m long, .1m wide and extending 1.14m above ground level.		



ATC 11-101

Watermark Gunnedah, NSW

Page 28 of 36

DISCUSSION

The tree is an over mature specimen of *Eucalyptus populnea* (Bimble Box) located in a cleared open paddock. Its size and general condition, (health and structure) suggests that it is of an over mature age, at least 100 – 200+ years in a generally declining condition of both health and structure.

Both wounds are very narrow and callusing tissue has almost covered the original wound faces. This suggests that the tree was wounded at least 50 – 100 years previously. There is a remnant branch stub at the top of the wound on the northern side which suggests that the wound could have resulted from the failure of the branch above and the tearing of the connected bark tissue below. The wound on the southern side is the much the same type although there are no branch failure sites above.



Scar on northern side.



Scar on southern side.



ATC 11-101

Watermark Gunnedah, NSW

Page 29 of 36

AECOM

CONCLUSIONS

In our opinion the two scars on the lower trunk may have resulted from damage sustained from the failure of branches. It is highly unlikely that these scars are cultural in origin.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 – 200+ years of age and that it was wounded at least 50 – 100+ years earlier to inspection.



ATC 11-101

Watermark Gunnedah, NSW

Page 30 of 36



Tree 12 WM ST-4-11
***Eucalyptus populnea* (Bimble Box)**

Tree Identification No.	Species	Dimensions
12 WM ST-4-11	<i>Eucalyptus populnea</i> (Bimble Box)	H: 14m W: N/S= 15m E/W: = 15m Ø: .93m
• Mature tree with single trunk located in open, cleared paddock currently used for cattle grazing. Approx. 100 – 200 years of age, • Tree in generally declining structural condition. Trunk divides at 2m above ground level. • Scar / hollow on north western side of lower trunk. Decayed through to opposite side of trunk into dead stem. Cut marks on wound face of hollowed scar.		



ATC 11-101

Watermark Gunnedah, NSW

Page 31 of 36

AECOM

DISCUSSION

The tree is an over mature specimen of *Eucalyptus populnea* (Bimble Box) located in a cleared open paddock. Its size and general condition, (health and structure) suggests that it is of an over mature age, at least 100 – 200+ years in a generally declining structural condition.

A decayed hollow section is located below the bifurcation of the main stem. The decay extends through to the opposite side of the trunk and into a dead decayed stem. An internal section has been deliberately cut away into the decay. The top of the hollow has been squared off. Axe marks are present within the hollowed area.



Decayed hollow on lower trunk.



Squared cut marks in hollow



ATC 11-101

Watermark Gunnedah, NSW

Page 32 of 36

CONCLUSIONS

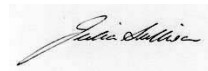
In our opinion the internal hollow has been deliberately enlarged with a sharp instrument to access a food source such as a bee hive within the decayed section of the trunk. When this disturbance has occurred cannot be accurately estimated and wound could be either Aboriginal or European in origin.

Due to the size of the tree and depth of scarring it can be assumed that the tree it is at least 100 -200 years of age and that it may have been wounded at least 50 – 100+ years earlier to inspection.

If you require any further information in relation to this report, please contact us on 1300 737 674 or 0418 474796.



Director Australian Tree Consultants Pty Ltd
Registered Consulting Arborist No 1268
Director Arboriculture Australia
BA (L) Major in Wilderness
Management/Outdoor Education
Diploma Horticulture – Arboriculture (Level 5)
Arborist/ Tree Surgeon/ Horticulturist
Certificate IV Occupational Health & Safety
QTRA No 2650



Julia Sullivan – Senior Consultant
Registered Consulting Arborist No 1984
Director Arboriculture Australia
Advanced Certificate – Urban Horticulture
Diploma Horticulture – Arboriculture (Level 5)
Arborist / Horticulturist



ATC 11-101

Watermark Gunnedah, NSW

Page 33 of 36

AECOM

LIMITATION OF LIABILITY

Australian Tree Consultants Pty Ltd (ATC) and their employees are tree specialists who use their qualifications, education, knowledge, training, diagnostic tools and experience to examine trees, recommend measures to enhance the beauty and health of trees, and attempt to reduce the risk of living near trees. Clients may choose to accept or disregard the recommendations of this assessment and report.

ATC and its employees cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that sometimes fail in ways the arboriculture industry does not fully understand. Conditions are often hidden within trees and below ground. Unless otherwise stated, observations have been visually assessed from ground level. ATC cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specified period of time. Likewise, remedial treatments cannot be guaranteed. The limit of our Professional Indemnity is \$10,000.00.

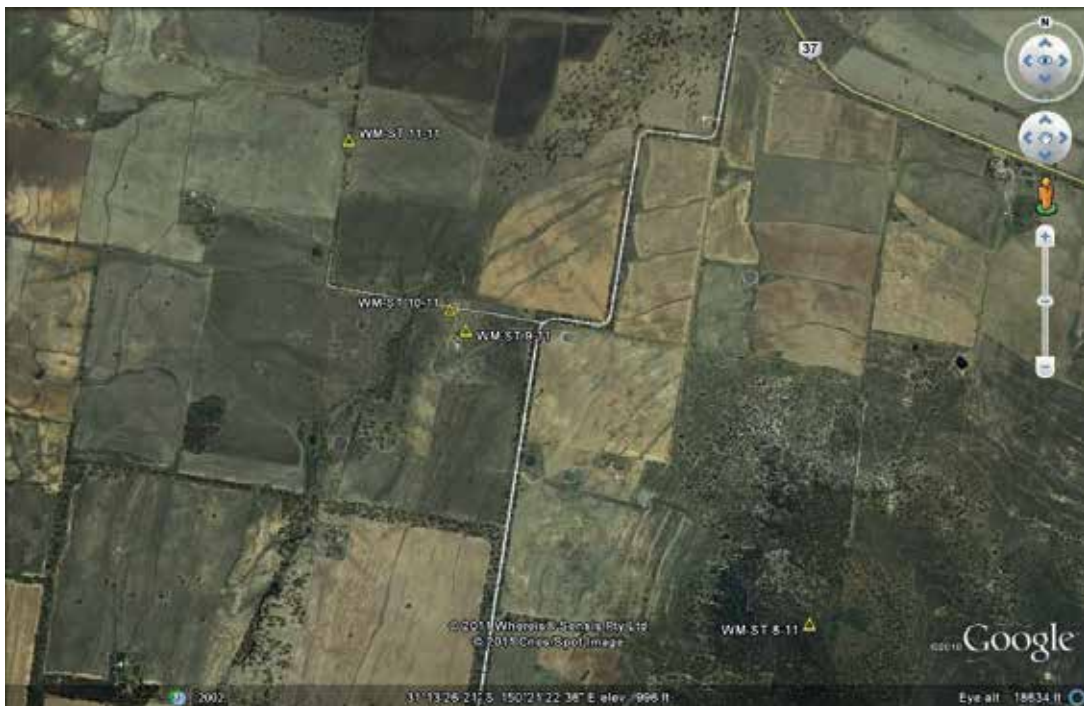
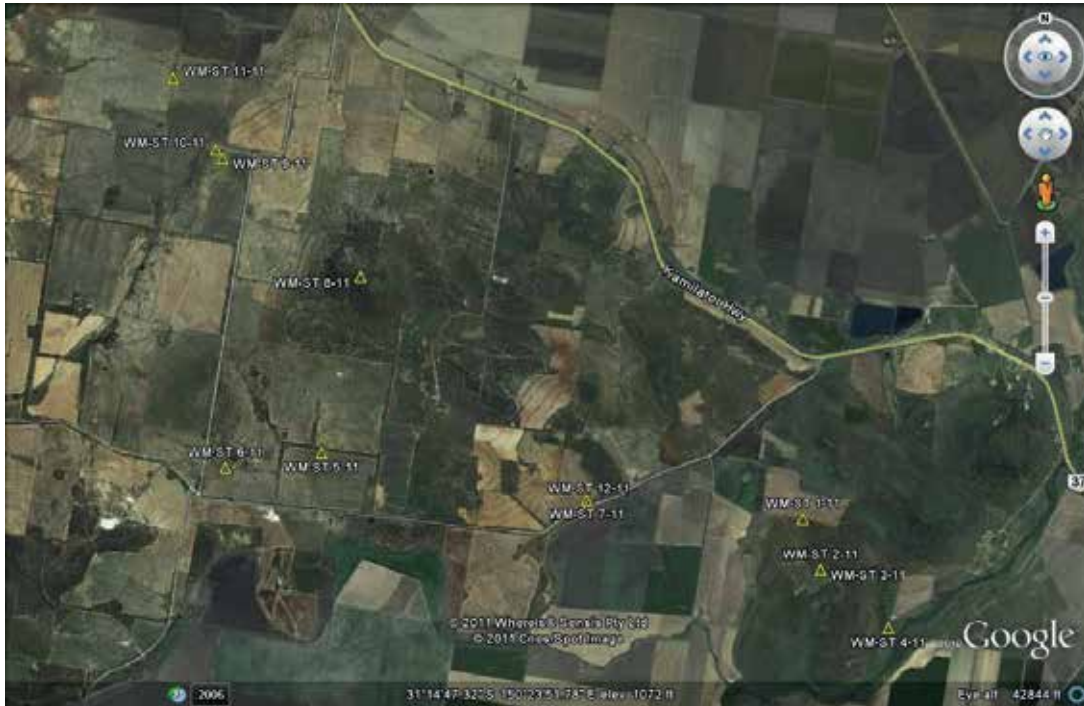
Treatment, pruning and removal of trees may involve considerations beyond the scope of ATC Pty Ltd services, such as property boundaries and ownership, disputes between neighbours, sight lines, landlord-tenant matters, and related incidents. ATC Pty Ltd cannot take such issues into account unless complete and accurate information is given prior or at the time of the site inspection. Likewise ATC Pty Ltd cannot accept responsibility for the authorisation or non-authorisation of any recommended treatment or remedial measures undertaken.

In the event that ATC recommends retesting or inspection of trees at stated intervals or installs any cable/s, bracing systems and support systems, ATC must inspect the system installed at intervals not greater than 12 months unless otherwise specified in written reports. It is the client's responsibility to make arrangements with ATC to conduct the re-inspection.

Trees can be managed, but they cannot be controlled. To live or work near a tree involves a degree of risk. The only way to eliminate all risks associated with a tree is to eliminate the tree.

All written reports must be read in their entirety, at no time shall part of the written assessment be referred to unless taken in full context of the whole written report.



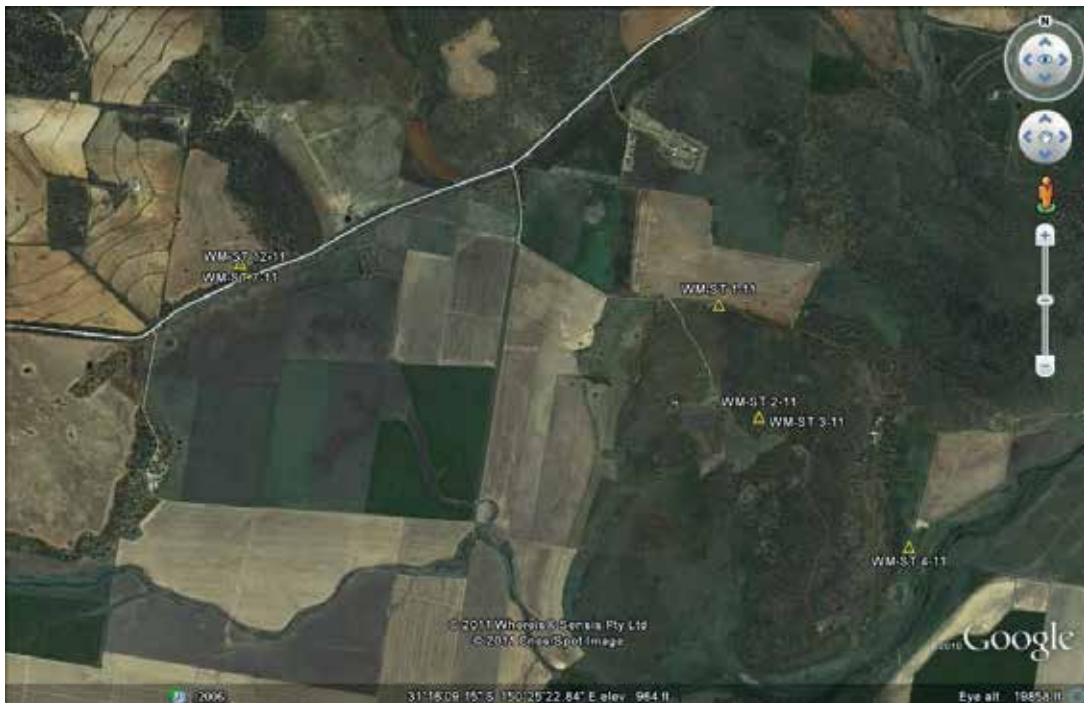


ATC 11-101

Watermark Gunnedah, NSW

Page 35 of 36

AECOM



ATC 11-101

Watermark Gunnedah, NSW

Page 36 of 36

AECOM

Hansen Bailey

Environmental Impact Statement February 2013

WATERMARK
COAL PROJECT

D-36

Appendix E

Geomorphological Assessment report



ACCESS MACQUARIE LIMITED
ABN 59 003 849 198

WATERMARK COAL PROJECT
GEOMORPHOLOGICAL
ASSESSMENT OF SELECTED
ARCHAEOLOGICAL SITES
REPORT

PREPARED FOR:

MS MELISSA WALKER
SENIOR ENVIRONMENT SCIENTIST

HANSEN BAILEY PTY LTD
6/127 – 129 JOHN STREET
SINGLETON, NSW 2330

PREPARED BY:

A/PROF PATRICIA C. FANNING

MAY 2012



Watermark Coal Project

Geomorphological Assessment of Selected Archaeological Sites

Associate Professor Patricia C. Fanning, *BA(Hons); MSc; PhD, MEIANZ*,
Geomorphologist/Geoarchaeologist

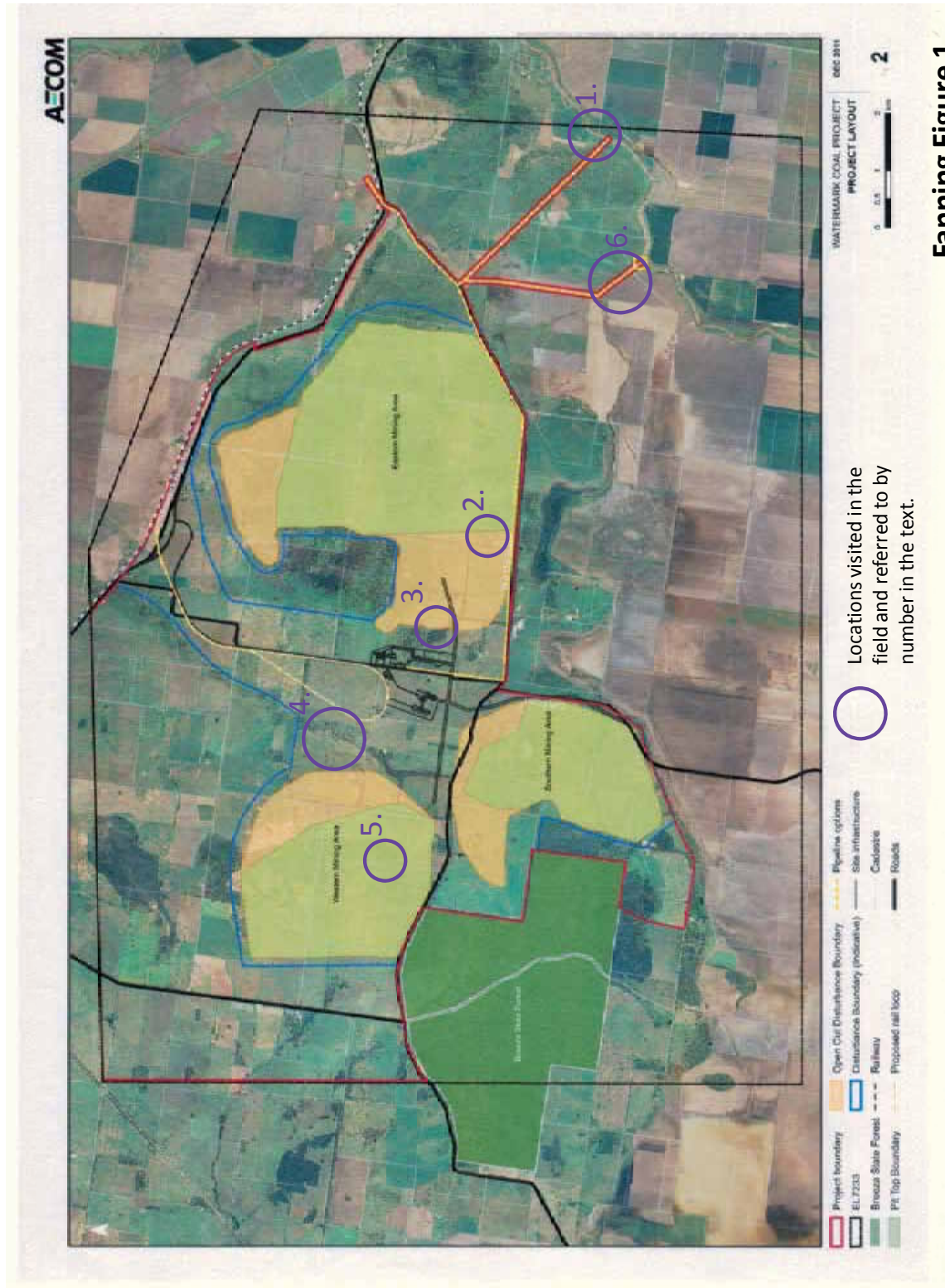
1 Introduction

AECOM Australia Pty Ltd was commissioned by Hansen Bailey, on behalf of Shenhua Watermark Coal Pty Ltd, to undertake an Aboriginal archaeological investigation for the Watermark Coal Project (the Project), located approximately 35 km southeast of the township of Gunnedah in northeastern NSW (Figure 1). Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of the *Environmental Planning and Assessment Act 1979* for the construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum of coal for a 30 year period.

This report presents the results of a geomorphological assessment of identified archaeological sites within the boundaries of the Project area, commissioned by AECOM on behalf of Hansen Bailey. The primary aim of the assessment is to determine the subsurface archaeological potential (SAP) at selected sites. A secondary aim is to determine the landscape context of the selected sites, in particular the past, present and future impacts of geomorphological processes on the sites and their contained archaeological materials.

Subsurface archaeological potential is the likelihood of archaeological materials being present at a location, based on an assessment of the extent to which archaeological materials, if present, might be preserved beneath the landsurface. The potential for preservation is highest on depositional landsurfaces and lowest on erosional landsurfaces, which in turn is determined by landform, topographic position and dominant geomorphic processes.

Fieldwork was undertaken on 12th and 13th March 2012, under the direction of AECOM archaeologist, Dr Andrew McLaren. Four of 16 artefact scatter (AS) sites were visited, together with one axe grinding groove (GG) site, all previously recorded by AECOM between March 2011 and March 2012. A potential water supply easement along the lower reaches of Native Dog Gully was also visited. These locations are shown in Figure 1 and are discussed below. AECOM provided digital historical aerial photography from 1954, 1967, 1976, 1989, 1998 and 2003 as well as the current 2010 image, and a range of background material including the draft archaeological report prepared by AECOM. The assessments contained in this report are based on this background material, plus field observations of landscapes, current landsurface stability, and subsurface materials exposed in creek banks, gully walls and shallow pits dug by hand using a spade.



Fanning Figure 1

2. Location, Geology and Topography

The Watermark Coal Project is located approximately 35 km south-east of the town of Gunnedah and immediately west of the village of Breeza in the Gunnedah Local Government Area (Shenhua Watermark Coal Pty Ltd, 2011). It falls wholly within the Gunnedah Basin of north-eastern NSW, comprising rocks of Permian and Triassic age unconformably overlying metamorphosed Ordovician to Devonian Lachlan Fold Belt strata in the west and Devonian to Carboniferous New England Fold Belt strata in the east (Broughton 1994 in AECOM Australia Pty Ltd 2011). Rocks of the Late Permian Black Jack Group (Pub), specifically sandstone, shale, chert, conglomerate, coal and limestone, dominate the surface geology. However, Quaternary alluvium (Qa), comprising clay, silt, sand and gravel, and undifferentiated volcanics of Tertiary age are also represented. The latter are concentrated in the eastern half of the Project area, with limited though widely distributed occurrences in the west. Dominant lithologies include basalt and dolerite. Conglomerate-rich sandstone strata belonging to the Triassic Digby Formation are largely restricted to the south of the Dip Road in the southwestern portion of the Project area but are also represented by the prominent sandstone cliff line formations of Mount Watermark (AECOM Australia Pty Ltd 2011: 12).

Banks (1995) identifies two physiographic regions in the Project area, the Curlewis Hills and a limited expanse of the Liverpool Plains region along the margins of the Mooki River on the eastern boundary of the Project area. The topography of the Project area ranges from the plateau surfaces with bounding cliffs of Mount Watermark (512 m AHD) and Black Jack Mountain (393 m AHD), through long and moderate to gently sloping colluvial slopes, to limited areas of relatively flat alluvial terraces and flood/drainage plains associated with Watermark Gully, Native Dog Gully and the Mooki River. The majority of the Project area comprises slopes of between 1 and 10% (very gently to gently inclined – Speight 2009), with minor areas of steeper (up to 32%) slopes bordering Mt Watermark and Black Jack Mountain, and flat (<1%) landsurfaces bordering the rivers and streams.

3. Soil Landscapes, Land Use and Landscape Integrity

The bulk of the Project area comprises the Curlewis Hills physiographic region, and includes the following soil landscapes: Battery Hill, Black Jack, Booloocooroo, Carinya, East Lynne, Fullwoods Road, Goscombes Road, Long Mountain, Mount Wilga, Pit Hill, Ponderosa, Stafford Gap and Watermark (after Banks 1995). The Liverpool Plains physiographic region includes all of the deep Quaternary alluvium of the Mooki River floodplain on the eastern boundary of the Project area. It includes the soil landscapes Conadilly and Mooki River. These Soil Landscapes are described in Table 1, along with past and present land use, and landscape integrity as reflected by the former and present extent of land degradation processes such as erosion. Landscape integrity is a pointer to whether or not any archaeological materials within the Project area might remain intact or have been disturbed by present and past erosion.

Table 1 General description of Soil Landscapes, Land Use, and Landscape Integrity in the Project area (summarised from Banks 1995).

Soil Landscape	General Description	Vegetation & Land Use	Landscape Integrity
Battery Hill	Isolated residual volcanic plugs and necks forming steep hills on Tertiary basalt. Very shallow lithosols on crests, with shallow, stony gradational profiles on sideslopes.	Woodland and open woodland largely cleared for grazing on native pasture.	Severe sheet erosion on sideslopes and footslopes. Compacted soils through stock trampling. Deep soil pockets upslope of obstructions indicates sheet erosion has been severe on unprotected slopes.
Black Jack	Undulating hills on Tertiary basalt plateaux; infrequent bedrock benches. Shallow lithosols on steepest slopes and crests, with deeper fine grained Black Earths on sideslopes and deep uniform fine grained soils on footslopes and in drainage lines.	Mid- to dense woodland and open forest, <50% cleared. Cleared portions are used predominantly for grazing on native pasture, with timbered country unused or used lightly for grazing or private forestry.	Moderate gully erosion has occurred along drainage lines in cleared country, with sheet erosion occurring particularly in areas of dense white cypress pine regrowth. Compaction by stock with subsequent sheet erosion in areas of shallow soils over bedrock benches. Feral pig and goat damage leading to localised sheet and rill erosion.
Booloocooroo	Very broad, level to gently undulating complex drainage plains comprised of coalescing alluvial fans on Quaternary alluvium derived from mixed sandstone/conglomerate and basaltic catchments. Very deep (>150 cm) red-brown earths, red podsols, and brown clays.	Mostly cleared open woodland and grassland used for cropping and pasture. Mixed grazing and summer and winter cereal cropping, with occasional legume rotations.	Areas of red-brown earths have been cultivated for at least 80 years and show evidence of extensive sheet erosion and structural decline. Since the 1950s the heavier soils have been cultivated and also show signs of structural decline. Gully erosion along major drainage lines. Salt outbreaks in and adjacent to some gullies.
Carinya	Broad, gently inclined undulating low hills	Predominantly grazing with some cropping on	Minor to moderate sheet erosion is

	with benched sideslopes on Tertiary dolerite. Shallow, stony red-brown earths on sideslopes, with moderately deep Black Earths on benches and alluvial fans along lower sideslopes.	lower sideslopes where rock is absent.	widespread, with gullying on sideslopes. Loamy topsoils directly over bedrock on crests and benches are severely compacted by stock trampling.
Conadilly	Broad level floodplains of the Mooki River on Quaternary alluvium. Very deep black earths and grey cracking clays.	Mostly cleared closed grassland with isolated trees, used for intensive dryland and irrigated cropping.	Large scale moderate to severe sheet erosion where channelization of sheetflow from adjacent footslopes or through culverts has occurred. Increased flooding and waterlogging where water pools behind banks, roads, etc. Soil compaction due to stock trampling on stock routes and around water points. Saline outbreaks evident around margins of the plain; rising saline watertables.
East Lynne	Moderately to steeply inclined midslopes below sandstone escarpments. Variable soil types ranging from shallow sandy lithosols through yellow earths to yellow and red podsolics (duplex profiles).	Largely uncleared open forest and woodland. Mostly unused due to soil constraints.	Largely uncleared. Feral animals (rabbits, pigs, goats) are common and put pressure on ground cover resulting in localised sheet and gully erosion.
Fullwoods Road	Extremely long pediment footslopes comprised of coalescing alluvial fans below Permian and Triassic lithic sandstone hills. Gradational (Red Earths) to Duplex (Red-Brown Earths) soil profiles, degraded.	Mostly cleared open woodland, originally cleared for cultivation, though mostly now used for grazing on improved pastures.	Severe gullying associated with previous cultivation, now relatively stable; severe sheet and rill erosion locally. Structural decline (plough pans). Saline outbreaks on lower slopes and in association with

			structural locations such as roads.
Goscombes Road	Broad, very gently inclined drainage plains and alluvial fans below Permian and Triassic quartzose and lithic sandstone hills. Predominantly deep Yellow Solodic Soils, Red-Brown Earths and Earthy Sands, and Alluvial Soils on the drainage plains.	Woodland and open forest, about 50% cleared for grazing and occasional cultivation. Generally poor quality soils, with about 20% State Forests, and the remainder under improved pasture with some occasional continuous cropping	Severe erosion and discontinuous gullies occur even in relatively undisturbed parts of the landscape. Structural decline has occurred in areas of continuous cultivation.
Long Mountain	Undulating plateau surfaces on Triassic lithic and quartzose sandstones and conglomerates. Soils highly variable depending on lithology, but include very shallow (<20cm) lithosols and moderately deep (50-150cm) yellow podzolics on sideslopes and in drainage lines.	Open and closed woodlands partially cleared for grazing. Moderately timbered land used for light grazing or timber, or unused.	Regeneration of white and black cypress pine following clearing has resulted in large amounts of localised sheet erosion. Some gully and rill erosion has occurred along access tracks. Feral animals such as pigs and goats have caused localised severe soil disturbance, and subsequent erosion.
Mooki River	River banks and floodplains of the Mooki River and its larger tributaries. Brown Soils developed on recent alluvium derived from Tertiary basalts in the Liverpool Range beds.	Closed grassland with isolated trees mostly used for grazing.	Bank erosion accelerated by increased volumes of water from post-cultivation period. Some areas are subject to excessive trampling by stock.
Mount Wilga	Slopes below Permian sandstone escarpments forming steep to precipitous sideslopes on Permian-Carboniferous basalts and basic volcanics of the Werri Formation. Narrow incised drainage lines. Shallow to moderately deep Rendzina, Black Earths, Red Clays and Red-Brown Earths,	Previously cleared eucalypt woodland, now with dense shrub/pine regrowth. Predominantly unused, with a few areas lightly grazed.	Very severe sheet and gully erosion when cleared in the past. Current dense regrowth with sparse ground cover allows erosion to persist.

	depending on lithology.		
Pit Hill	Steep hummocky colluvial slopes on steep hills, with mixed Tertiary basalt and Triassic/Permian sandstone and shale. Rocky outcrop and scree up to 40%. Open woodland mostly uncleared. Soils extremely variable depending on lithology, and ranging from shallow lithosols to moderately deep Black Duplex soils, Chocolate Soils and Prairie Soils.	Mostly uncleared light grazing, or unused.	Small areas of soil erosion along access tracks. Weed infestation.
Ponderosa	Gently inclined footslopes on Tertiary dolerite, tuff and basalt. Moderately deep (50-150cm) euchrozems on upper to mid-slopes, and deep (>150cm) Black Earths on mid and lower footslopes.	Open woodland and grassland mostly cleared for grazing and cultivation. Mixed grazing, and summer and winter cereal cropping. Some grazing on plains grassland vegetation.	Moderate gully erosion and moderate to severe sheet erosion are common, especially in areas with a long cropping history and no soil conservation works.
Stafford Gap	Undulating rises to rolling hills on Triassic lithic and quartzose sandstones and conglomerates. Soils highly variable due to extreme variation in parent material, but include shallow to moderately deep (40-150 cm) Red Earths, and Earthy Sands and Yellow Podsollic Soils on crests and upper sideslopes, with shallow to moderately deep (60-200 cm) Red-brown Earths, Yellow Podzolic Soils and yellow Solodic Soils on lower sideslopes and	Native and improved pastures for grazing, and occasional cropping. Some quarries.	Cleared land has suffered severe gully erosion under previous cultivation, often leaving no topsoil at all or a gravel lag. Some rill and gully erosion is evident around drainage lines.

along drainage lines.			
Watermark	Broad gently undulating to rolling hills with gentle to moderately steep sideslopes. Soils extremely variable, including shallow to moderately deep Earthy Sands and yellow Solodics, deep Red-Brown Earths and Chocolate Soils, and shallow to moderately deep Red Earths on sideslopes.	Open woodland originally cleared for cultivation but now predominantly used for grazing.	Sporadic severe gullying and sheet erosion. Structural decline where cultivated too frequently. Soil compaction is common in areas of heavy stocking.

It is clear from Table 1 that almost all of the Project area has been more or less continuously grazed and/or cropped for a long period. European land use commenced in the 1830s, with cropping becoming widespread in the 1880s. Agriculture intensified with soldier settlement subdivisions in the between-wars period, and the introduction of new technology in the 1950s which allowed the heavy clay soils of the basalt slopes and the floodplains to be cultivated (Banks, 1995: 1). Severe land degradation has been the result, including soil erosion, structural decline, and increased intensity and frequency of flooding. Clearing of native vegetation, combined with increased rainfall in the second half of the twentieth century (Riley, 1988, and Hird, 1976, in Banks 1995), has resulted in a general rise in saline watertables and problems with dryland salinity (Banks, 1995: 1).

The extensive construction of contour banks still evident in the Project area today was no doubt a response by the NSW Soil Conservation Service, in partnership with landholders, to try to slow down soil erosion. Extensive sheet erosion scars are clearly visible on the 1954 aerial image. By 1967, contour banks had been constructed on the “Watermark” property and elsewhere. In many places, it appears to have worked, with active gully erosion relatively rare. However, the legacy of severe sheet erosion and of dryland salinity remains, with many areas still exhibiting bare soil surfaces, especially on the lower slopes (see Section 4). These surfaces have high ground surface visibility, giving rise to numerous isolated finds (IF) and artefact scatters (AS) being visible during the archaeological survey conducted by AECOM. However, given the extent and severity of land degradation in the past, it is unlikely that any archaeological deposits remain undisturbed across most of the Project area (see Section 5).

4. Detailed Descriptions of Archaeological Sites

1. **Site name:** WM-AS1-11 **GDA Coordinates:** 256859mE 6536525mN GDA 94
(Zone 56)

Soil Landscape: Ponderosa

Archaeological site WM-AS1-11 is a large open artefact scatter on a footslope and fluvial terrace surface of <1% slope on the western side of the Mooki River on the property “Boonah” (Plate 1). The terrace is bounded to the west and south by a smoothly inclined slope of between 3 and 10%, forming a broadly convex spur to the south. Two ephemeral drainage gullies traverse the site in a west to east direction, with the northernmost gully marking the southernmost extent of the terrace. To the east, the terrace is bounded by a short, relatively steep (>10%) slope leading down to the active floodplain of the Mooki River. A shallow depression hugs the base of the floodplain/terrace boundary, and may be a former channel of the Mooki River now only active during floods. A higher convex linear surface separates the flood channel from the main channel. Minor slumping is evident on the steep river banks.



Plate 1: View to northeast looking over the WM-AS1-11 site in the middle ground. Its approximate western limit is marked by the two trees on the left of the image, while the eastern limit of the terrace is marked by a line of low shrubs. During the archaeological survey, artefacts were visible on the cattle track in the foreground.

Native vegetation on the site is limited to grasses and a few mature trees, one of which has been identified as a potential Aboriginal scarred tree (WM-ST2-11) on the grounds that it exhibits a potential 'possum hole (AECOM Australia Pty Ltd 2011)'. Overall site condition has been characterised as fair. Relevant disturbance factors include native vegetation clearance, vehicle traffic, stock trampling, and fluvial erosion. Ground surface visibility (GSV) on the site is, on average, poor (11-30%) due to dense grass cover. All but two artefacts were located on the terrace and adjacent hillslope, with a notable concentration on the spur at the southern end of the site in association with one of the two drainage gullies, reflecting higher GSV in this area. Two artefacts were identified on the floodplain. However, both appeared to have been washed into their current positions from the terrace above (AECOM Australia Pty Ltd 2011).

No exposures of subsurface sediments/soil profiles beneath the terrace were visible at the time of the site visit, but are likely to comprise clay-rich alluvium derived from the Tertiary volcanics of the Liverpool Range (Banks, 1995), with a relatively deep organic biomantle¹ developed within the upper part of the profile. A shallow depression within the flood channel on the floodplain revealed grey/black cracking clays typical of distal floodplain deposition. The hillslopes are underlain by volcanic rocks of Tertiary age, most likely dolerite, which give rise to relatively moderately deep (50-150 cm), stony, clay rich (Uf to Gn) soil profiles (Banks, 1995).

Apart from visibility differences, the presence of artefacts on the terrace surface is likely to reflect higher preservation potential for archaeological material on this landform, relative to the floodplain which is subject to much more frequent inundation and hence the potential for removal of artefacts. It may also reflect the preference of Aboriginal people for occupation of the higher, and potentially better drained, terrace surface. The artefacts located on the spur at the southern end of the site, on the other hand, are likely to be visible because of the predominance of erosion processes on this landform.

2. Site name: WM-AS2-11 **GDA Coordinates:** 249752mE 6538102mN GDA 94
(Zone 56)

Soil Landscape: Goscombes Road

The site WM-AS2-11 comprises a large open artefact scatter on the properties 'Flakenhoe' and 'Hill 60', approximately 20 m north of The Dip Road and extending parallel to it for a distance of approximately 670 m. Visible artefacts are concentrated along an unsealed vehicle track running parallel to The Dip Road. GSV on this track is, on average, very good (71-90%). To the east, visible artefacts extend northwards for a distance of approximately 370 m from the track. Land to the south of the site (i.e., on the property *The Dip*) is reported

¹ The "biomantle" is the zone of organic matter accumulation and bioturbation located immediately beneath the ground surface in a soil profile. It can range in thickness from a few to many tens of centimetres. It is common for stones or clasts, including artefacts, to be worked vertically down to the base of the biomantle, forming stone lines or artefact concentrations, by the action of soil micro- and macrofauna.

to retain water during periods of high rainfall, forming a wetland area on Native Dog Gully which may have been in existence well before European settlement. Active gully headcuts are visible on the aerial imagery at the downstream end of the wetland.

Remnant native vegetation, mapped as Fuzzy Box Woodland, borders The Dip Road to the immediate south of the site. A narrow 'avenue' of trees with grassy understory also runs in a north-south direction, bisecting the site. The presence of a relatively intact duplex soil profile (Plate 2) suggests this area may not have been ploughed. Elsewhere, disturbance is widespread due to native vegetation clearance, contour bank construction, vehicle traffic, ploughing and stock trampling. A patch of planted 'Old Man Saltbush' on the western side of the avenue suggests that saline seepage may have been a problem in the past. Bare patches (most likely saline scalds - Plate 3) are still present, with artefacts visible at the surface.

This location is underlain by Late Permian Black Jack Group (Pub) rocks, comprising quartzose and lithic sandstones, conglomerates, shales, limestones and coal. The soils are highly variable, but in the vicinity of the site, they comprise grey, shallow (to 5cm), hardsetting, sandy loam topsoils over yellow, stony clay-rich B horizons (Plate 2). Where erosion is dominant, the bare surfaces comprise a gravel lag over a crusted subsoil surface. Artefacts are visible at the surface but the potential for subsurface archaeological materials is low due to erosion.

Downslope, along the northern edge of the remnant woodland, the soil profile is deeper, consisting of up to 25cm of sandy loam over the yellow clayey B horizon. This is most likely due to run-on and sediment deposition. Relatively large ant mounds are present, indicating bioturbation is active at this location. The potential for subsurface archaeological materials is therefore higher in these footslope locations, protected by sediment deposition and down-profile movement of the artefacts.



Plate 2: Shallow duplex (Yellow Podsollic) soil profile exposed in a gully wall at the WM-AS2-11 site. A stone line is visible to the left of the geological hammer, marking the boundary between the biomantle and the subsoil. Any artefacts discarded at the surface are likely to be buried by bioturbation.



Plate 3: Saline seepage scald at the WM-AS2-11 site. Stone artefacts are visible on the surface everywhere that the surface is scalded.

3. Site name: WM-AS5-11 **GDA Coordinates:** 248403mE 6539344mN GDA 94 (Zone 56)

Soil Landscape: Watermark (upper slope) and Fullwoods Road (lower slope)

The WM-AS5-11 site comprises an open artefact scatter on the eastern side of an unnamed discontinuous 1st order channel on the property 'Flakenhoe'. Artefacts have been exposed by a combination of sheet and gully erosion associated with native vegetation clearance, as well as ploughing and contour bank construction. Shallow incipient gullying on either side of the channel (Plate 4) approximately 350 m south-southeast of WM-AS5-11 exposes a duplex soil profile, consisting of a shallow (to 5cm), loose, stony loam topsoil over brown clay-rich B horizon. Artefacts within the mapped boundaries of WM-AS5-11 occur on gravel-rich scalds. GSV within the site is, on average, very good (71-90%) due to topsoil erosion accelerated by ploughing and stock trampling. Subsurface archaeological potential is therefore very low.

Remnant native vegetation bordering the unnamed stream to the immediate west of the site comprises a combination of Inland Grey Box Grassy Woodland and Poplar Box Woodland. A shallow duplex soil profile is present, similar to that observed in the gully to the south-southeast of the site. Bare surfaces are present along cattle tracks, frequently enlarged by ant activity. However, the generally shallow depth of the topsoil (5-10 cm)

indicates that the potential for subsurface archaeological materials in this area is reasonably low.



Plate 4: Shallow gully headcuts adjacent to the WM-AS5-11 site.

4. Site name: WM-AS9-11 **GDA Coordinates:** 246353mE 6540893mN GDA 94
(Zone 56)

Soil Landscape: Booloocooroo

The WM-AS9-11 site comprises a large open artefact scatter on the western side of Watermark Gully on the property 'The Watermark'. The site extends along the creek for a distance of approximately 1 km, with the most westerly of artefacts in the site lying c.180 m from the active channel (AECOM Australia Pty Ltd 2011). Artefacts have, for the most part, been exposed by the creation of a bank - now heavily deflated – parallel to the left (western) bank of the creek, presumably as a flood-prevention measure. A portion has also been exposed by the construction of east/west and northeast/southwest trending contour banks at right angles to the flow direction on the drainage plain on the western side of the creek.

Artefacts are also common on gravel-rich scalds² on the lower slopes on the western side of the creek. Saline soils are indicated by the presence of salt-tolerant vegetation on several scalds (Plate 5). The scalds are areas where the subsoil is exposed by erosion of topsoil following depletion of the vegetation cover. Thus, subsurface archaeological potential is low to nil and any artefacts present are deflated onto the subsoil surface.

²Saline scalds are a form of dryland salinization, which form when topsoil is removed to expose a subsoil that is naturally high in salts; while in part natural features, their incidence and extent has increased since the introduction of European land use practices (Charman & Murphy, 2000, p.62).



Plate 5: Saline seepage scald on the drainage plain at site WM-AS9-11, indicated by the presence of salt-tolerant vegetation (deep green).

Bank sections along the discontinuous channel of Watermark Gully reveal the presence of up to 35cm of dark brown clay-rich sediments abruptly overlying pale grey silt loam. The silt loam overlies gravelly clays in deeper exposures. However, these modern alluvial deposits are confined to a narrow band (to 5m wide) adjacent to the channel. A transect of shallow spade pits aligned at right angles to the channel near the upstream end of the site revealed hardsetting silty loam regolith up to 20 cm thick. It is likely that these materials are the result of a combination of slopewash and bioturbation, but since they are relatively thin they are unlikely to mask substantial subsurface deposits of archaeological materials, and the subsurface archaeological potential, while higher than on the scalds, is still relatively low.

Native vegetation bordering Watermark Gully to the immediate east of the site consists of a mixture of Weeping Myall Woodland and Poplar Box Woodland, with dense grassy understorey. African Box Thorn is beginning to invade this area. The GSV is very low due to dense grass cover. The only high visibility patches are ant nests, which all exhibit a gravelly band around the outer margin. The area exhibits shallow silty loam topsoil over gravelly clay-rich subsoil and, although it has never been ploughed, the likelihood of extensive subsurface archaeological materials is low.

A second transect of shallow spade pits was dug on the eastern side of the Watermark Gully channel, downstream of “The Watermark”. Here, up to 20 cm of dense, compact, dark brown fine sandy loam overlies brown light clay on the lower slopes, being replaced by brown heavy clays, with evidence of mottling, on the valley floor (mottles indicate fluctuating water tables). Given the likelihood that no ploughing/cultivation has occurred at this location, the potential for subsurface archaeological materials being preserved is higher

than at the upstream location previously described. However, the very low GSV means no artefacts were observed.

5. Site name: WM-GG1-11 **GDA Coordinates:** 243723mE 6540617mN GDA 94
(Zone 56)

Soil Landscape: Fullwoods Road

The WM-GG1-11 site consists of a large number of axe grinding grooves on the property 'Molonga'. The site, which covers an area of at least 5,000 m² in a midslope position, is located approximately 550 m southeast of the main homestead. Surrounding native vegetation has been mapped as Regenerating Blakely's Red Gum Grassy Woodland. Grinding grooves within WM-GG1-11 occur on exposed sandstone bedrock and on blocks (i.e. 'floaters'), with the latter concentrated in the northern portion of the site. Two main groups of grooves have been recorded (AECOM Australia Pty Ltd, 2011). Both groups are associated with ephemeral, unnamed drainage lines, neither of which is depicted on the 1:25,000 topographic map for the area (Watermark 8935-I-S). The southern group comprises 50 to 60 grooves on a non-continuous (due to grass cover) linear outcrop of sandstone bordered to the south by a dense stand of white cypress pine (*Callitris glaucophylla*). The outcrop is located in a shallow, SW-NE trending drainage depression. The northern cluster is located approximately 85 m to the north of the southern outcrop in an area of heavily fractured sandstone bedrock. Fourteen potential grooves were recorded in this cluster, with most occurring on the western edge of a slight but noticeable drainage depression. Natural furrowing is evident in this area and it possible that some of the grooves recorded are natural in origin.

The underlying geology is the Late Permian Black Jack Formation, comprising quartzose and lithic sandstones of marine origin, as well as conglomerates, shales, limestones and coal. Outcrops higher up the slope at this location consist of pebbly sandstone. The high proportion of rock outcrop on the upper slopes indicates the degraded nature of the regolith in this area, indicating that subsurface archaeological potential is low.

Ground surface visibility across the grinding groove site very poor (0-10%) due to thick native and introduced grass and weed cover. Observations made during the archaeological survey and subsequent site inspections suggested that there may be potential for additional grooves to be present at WM-GG1-11 in subsurface contexts. Therefore, a line of spade test pits was dug in a southerly direction away from the southern outcrop. These indicated that the bedrock surface is highly variable in depth below the surface, and that infilled former drainage lines may be present. A hole dug within a metre of the edge of the outcrop reached a depth of nearly 60 cm without reaching bedrock. The regolith is sandy, with increasing clay content with depth. There is high potential for preservation of any subsurface archaeological materials, but these are likely to be only isolated artefacts or low density artefact deposits, given the position in the landscape (mid-slope) and the absence of a recognisable water source other than the very small, shallow depressions on the limited area of outcrop.

6. Native Dog Gully below The Dip**Soil Landscape: Conadilly**

A proposed water pipeline easement along Native Dog Gully to its confluence with the Mooki River was inspected. Here, Native Dog Gully is deeply incised into thick floodplain sediments (Plate 6), and flows through a series of pools and constructed riffles lined with thick reeds, sedges, and native and exotic grasses. The floodplain is relatively narrow (up to 5m wide) and grades smoothly into the adjacent footslopes which appear to have been artificially drained. The slopes are cultivated, while the floodplain has a dense cover of grasses and sedges. GSV on the latter is effectively zero, and no artefacts were recorded during AECOM's archaeological survey (AECOM Australia Pty Ltd, 2011). The potential for preservation of any subsurface archaeological materials is high due to the protection afforded by thick deposits of alluvium. However, the artificial nature of the present channel suggests that any archaeological materials that may have been present are likely to have been disturbed by extensive channel modification.



Plate 6: Thick floodplain sediments exposed in the right bank of Native Dog Gully approximately 100 m upstream of the confluence with Mooki River. Rock weirs maintain the relatively high water level along the lower reaches of Native Dog Gully.

5. Discussion: potential for subsurface archaeological materials

Preservation, exposure and visibility of the archaeological record is largely a function of its geomorphic setting (Fanning *et.al.* 2009), along with disturbance factors such as cultivation, stock trampling, and engineering construction and excavation. Stone artefacts abandoned on a surface will, over time, be removed by erosion, or be buried either by sediment deposition or by bioturbation where there is an active biomantle. The impacts of these processes are, in turn, a function of landscape position, and the integrity of the landsurface, i.e. whether it is stable or degrading.

In Table 2, an assessment is made of the potential for preservation of archaeological materials beneath the surface at each of the six locations described above. The assessment is made on the basis of the position in the landscape of the site, whether the dominant geomorphic process is erosion or deposition or neither (i.e., relatively stable in the short term), and the degree of landscape integrity. For landscape integrity, a three-point relative scale is used – low, moderate, high – based on field evidence for erosion and other land degradation processes at the site, such as dryland salinity.

Table 2: Assessment of subsurface archaeological preservation potential for each location visited in the field (see Figure 1), based on landform type, dominant geomorphic process, and landscape integrity.

Site	Landform	Dominant geomorphic process	Landscape integrity	Subsurface archaeological preservation potential
1. WM-AS1-11	Terrace/footslope	Deposition	High	High
2. WM-AS2-11	Lower slope/footslope	Erosion/deposition	Low/moderate	Low/moderate
3. WM-AS5-11	Midslope	Erosion	Low	Low
4. WM-AS9-11	Footslope/drainage plain	Erosion/deposition	Low/high	Low/high
5. WM-GG1-11	Midslope bedrock bench	Erosion/deposition	Low/high	Low/high
6. Native Dog Gully	Incised drainage line	Erosion	Low (due to human modification)	Low

The assessment in Table 2 suggests that the potential for archaeological materials to be preserved beneath the surface is low for most of the study area. This is largely due to the prevalence of shallow soil profiles developed on the predominant sedimentary sandstones and conglomerates, and relatively limited alluvial (floodplain and terrace) surfaces. Hillslopes, where erosion is prevalent, are the most common landforms. In addition, erosion has been exacerbated by intensive cultivation and grazing for a long period of time over

most of the study area (see Section 2 and Table 1). Clearing of native vegetation in the nineteenth and twentieth centuries raised water tables in the shallow soils developed on predominantly marine sedimentary rocks, leading to saline seepage on lower slopes further reducing the vegetation cover and forming saline scalds. The extensive contour banks constructed in the 1950s and 1960s attest to runoff and soil loss being a major problem for landholders. While the landscape has largely returned to a state of relative stability, most likely due to conservation farming and grazing practices, bare surfaces are still evident, either as a legacy of the salinization (as at WM-AS9-11) or where stock is still concentrated near watering points (as at WM-AS5-11) or fencelines (as at WM-AS2-11).

Areas of sediment deposition afford the greatest likelihood for preservation of subsurface archaeological materials, but these are relatively limited in extent within the study area. River terraces have the highest potential because they are remnants of former floodplains, thus dominated by sediment deposition likely to bury and protect archaeological materials. They are also, by definition, located away from or above the currently active floodplain and therefore less likely to be inundated and eroded by floodwater. The only location where river terraces are present is along the Mooki River on the eastern boundary of the Project area.

Footslopes and drainage plains have moderate to high potential for preservation of subsurface archaeological materials because of the likelihood of burial by sediment deposition. In the study area, possible locations include the footslopes at the base of WM-AS2-11 and the drainage plains on either side of Watermark Gully in the vicinity and downstream of WM-AS9-11. Archaeological excavation located adjacent to surface finds would be required to establish the nature and extent of any subsurface materials.

Subsurface preservation potential is also high in the drainage depressions adjacent to the bedrock outcrop at WM-GG1-11. Spade test pits revealed that the soil cover is relatively deep in places over the bedrock bench. However, given the midslope location of the site, away from any persistent water source, it is unlikely that anything more than low density artefact deposits or isolated finds would be present.

6. Summary

The Watermark Coal Project area southwest of Gunnedah in northeastern NSW has had a long history of grazing, cultivation and timber extraction, extending back more than 150 years. This intensive land use, combined with extensive areas of relatively shallow, poor quality soils, resulted in severe soil erosion across most of the Project area prior to the 1960s. Gully, rill and sheet erosion are evident on the earliest air photos of the area (1954). Thus, any archaeological materials are likely to have been severely impacted by these geomorphic processes, resulting in a loss of integrity of artefact deposits, and the complete removal of the smallest items (<20 mm maximum dimension).

Notwithstanding the extent of severe erosion and soil loss in the past, as summarised in Table 1, there are several places in the Project area which have a relatively high potential for discovery of relatively intact artefact deposits. These include the terraces on the left (west) bank of the Mooki River on the eastern boundary of the Project area, and the valley floor immediately adjacent to Watermark Gully, especially within the unploughed area. The footslope at the southern end of the WM-AS2-11 site also has relatively high potential for buried archaeological materials since it is a run-on (i.e., depositional) area and there are artefacts visible at the surface where topsoil has been removed.

7. References

- AECOM Australia Pty Ltd. 2011. Watermark Coal Project Aboriginal Archaeological Report Draft 20 December, 2011.
- Banks, R.G. 1995. Soil Landscapes of the Curlewis 1:100,000 sheet.
- Charman, P.E.V. and Murphy, B.W. 2000. Soils: Their Properties and Management. OUP:Melbourne. Second edition.
- Fanning, P.C., Holdaway, S.J., Rhodes, E.J. and Bryant, T.G. 2009. The surface archaeological record in arid Australia: geomorphic controls on preservation, exposure and visibility. *Geoarchaeology: An International Journal*, 24 (2), 121-146.
- Shenhua Watermark Coal Pty Ltd. 2011. Watermark Coal Project Community Information Sheet No. 1. March, 2011.
- Speight, J.G. 2009. Australian Soil and Land Survey: Field Handbook. CSIRO, Canberra.

Appendix F

Regional review of grinding groove sites



AECOM Australia Pty Ltd
Level 8, 17 York Street
Sydney NSW 2000
Australia
www.aecom.com

+61 2 8023 9333 tel
+61 7 8023 9399 fax
ABN 20 093 846 925

24 May 2011

Melissa Walker
Senior Environmental Scientist
Hansen Bailey Environmental Consultants
PO Box 473 Singleton NSW 2330

Fax No: (02) 6575 2001

Dear Mel,

Briefing note: Aboriginal axe grinding groove site WM-GG1-11

1.0 Introduction

This brief note presents the results of a regional review of Aboriginal grinding groove sites within the North-West Slopes and Plains region of New South Wales and provides a synthesis of existing archaeological research concerning the character and formation of such grooves. This note addresses a request by Hansen Bailey, on behalf of Shenhua Watermark, to place recently identified grinding grooves site WM-GG1-11 in context and to better understand the processes responsible for its formation. WM-GG1-11 is an extensive grinding groove site comprising over sixty individual grooves within the western half of the Project boundary.

2.0 Aboriginal Heritage Information System (AHIMS) Review

On 18 May 2011, a search of the Office of Environment and Heritage's (OEH) Aboriginal Heritage Information Management System (AHIMS) was conducted for Aboriginal grinding groove sites in an area which roughly corresponds to the Australian Bureau of Meteorology's North-West Slopes and Plains forecast area. This area, hereafter referred to as the study region, stretches from Coonabarabran in the south to Moree in the north, and from Walgett in the west to Inverell in the east, and includes the Local Government Areas (LGAs) of Gunnedah, Tamworth, Liverpool Plains, Narrabri, Moree Plains, and Gwydir. A total of 153 grinding grooves sites was identified in the study region, with sites cards for 135 (88.2%) of these sites available/accessible for this review. A breakdown of site records by LGA is provided in **Table 1** below.

Table 1: AHIMS records for Aboriginal grinding groove sites by LGA.

Local Government Area (LGA)	Total records	Available records
Gunnedah	50	37
Tamworth	9	9
Liverpool Plains	21	21
Narrabri	43	38
Moree Plains	5	5
Gwydir	25	25
Total	153	135

A review of available/accessible site cards (n = 135) indicates that the most common sites, in terms of the quantity of grooves present, are those with 1-10 grooves (n = 55, 41%), followed by 11-50 grooves (n = 34, 25%), 50-100 (n = 10, 7.5%) and 100+ grooves (n = 10, 7.5%) (see **Table 2**). No quantitative data is available for the remaining 26 site cards. Sites with over 50 grinding grooves comprise only 15% of the total number of sites with data available.

This fax transmission is strictly confidential and intended solely for the person or organisation to whom it is addressed. If you are not the intended recipient, you must not copy or distribute it or take action in reliance on it. If you have received this fax transmission in error, please notify us and return it to us by post as soon as possible.

**Table 2: Breakdown of grinding groove sites by size (n = 135)**

Number of grinding grooves (range)	Number	%
1-10	55	41%
11-50	34	25%
50-100	10	7.5%
100+	10	7.5%
Unspecified	26	19%
Total	135	100%

Figure 1 shows the distribution of grinding groove sites with 50+ grooves (n = 20) in relation to WM-GG1-11. As indicated, of the twenty relevant sites, two (29-1-0069 & 29-1-0022) fall within a 20 km radius of WM-GG1-11, eight within 50 km, two within 100 km, one within 150 km, five within 200 km and two within 300 km.

3.0 Previous research on Australian Aboriginal grinding groove sites

Dickson's (1972, 1975, 1978, 1980a, 1980b, 1981) investigations into Australian Aboriginal stone hatchet technology remain the most comprehensive studies of their kind in Australian archaeology and contain information of direct relevance to this review. Salient points from Dickson's research are as follows:

- Grinding grooves are formed during the sharpening of stone hatchet-heads and wooden spears.
- Grinding grooves are most commonly found in sandstone and are typically 25 to 50cm in length, 5 to 8 cm in width, and 2 to 5 cm in depth, with rounded cross-sections. Along its length, the depth of a groove may vary nonlinearly, but does not usually exceed 4 cm.
- Grinding grooves are most often found in close proximity to water sources as the grinding process is only efficient when water is present to wash out the spent grains and other material abraded from the matrix.
- The best sandstone for grinding is uniformly fine-grained, argillaceous sandstone, where the grains are bound by clay and iron compounds which constitute about 15% of the weight of the stone. Grain size is ideally 0.3-0.5mm. This composition enables the grains to break out of the matrix and be washed away before they are blunted by the stone implement, so a fresh grinding surface is always present (Dickson 1978:274).
- There are known methods of grinding on substrates other than sandstone, some of which are slow and laborious and others quite efficient. These methods do not necessarily produce grooves that are recognisable today.
- Under good operating conditions, the process of grinding a stone hatchet head can usually be completed within a few hours.
- Individual grinding grooves were most likely single use. It is unlikely that they were reused multiple times, as when working with good quality sandstone it is more efficient to start the grinding process anew for each new tool being produced.
- The friable nature of sandstone makes it highly susceptible to erosion, spallation in the heat of bushfires, and damage from human activities. Due to our lack of definite information pertaining to the rates erosion may have operated in the past, it is impossible to determine the ages of exposed grinding grooves. In most areas, however, it is unlikely for grooves to be less than one hundred years of age.

4.0 Implications for WM-GG1-11

In consideration of the aforementioned review, the following conclusions can be made regarding newly identified grinding groove site WM-GG1-11:

- WM-GG1-11 is considered to be both locally and regionally rare, as there are a limited number of sites of comparable size and quality within the wider North-West Slopes and Plains region.



- WM-GG1-11 is considered to be an excellent example of its type, with multiple well-defined grooves in a relatively limited area. It is possible that additional grooves are present on-site but are currently obscured by native and introduced grasses.
- The area surrounding WM-GG1-11 is considered to have high subsurface archaeological potential.
- It is impossible to assign a date to WM-GG1-11 on the basis of groove morphology.
- WM-GG1-11 is considered to be of high archaeological significance on the basis of its rarity, representativeness, integrity and associated research potential.
- AECOM considers it extremely likely that WM-GG1-11 will be regarded as being of high cultural significance by Aboriginal stakeholder representatives.

5.0 References

Dickson, F.P (1972) "Ground Edge Axes". *Mankind*. Vol. 8, p. 206-211

Dickson, F.P (1975) "Design and Typology of Stone Hatchets". *Mankind*. Vol. 10, p.259-263

Dickson, F.P (1978) *Australian Ground Stone Hatchets*. Unpublished Ph.D Thesis, Macquarie University.

Dickson, F.P (1980a) "Of Grinding Grooves", *Archaeology and Physical Anthropology in Oceania*, Vol. 15, No. 3, p.157-161

Dickson, F.P (1980b) "Making Ground Stone Tools", *Archaeology and Physical Anthropology in Oceania*, Vol. 15, No. 3, p.162-167

Dickson, F.P (1981) *Australian Stone Hatchets: A Study in Design and Dynamics*. Academic Press: Sydney.

Kind regards,

Dr Andrew McLaren

Archaeologist

D +61 2 8023 9330

Andrew.McLaren@aecom.com

