METROPOLITAN COAL LONGWALLS 305-307

HERITAGE MANAGEMENT PLAN




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METROPOLITAN COAL

LONGWALLS 305-307

HERITAGE MANAGEMENT PLAN

ME-TSE-MNP-0081

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DPIE Approval Date
All	HMP-R01-A	Original	BCD, Aboriginal Stakeholders, DPIE	-
Section 9	HMP-R01-B	Minor amendment to reflect comments from the BCD.	BCD, Aboriginal Stakeholders, DPIE	16 March 2020

January 2020

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1 INTRODUCTION

Metropolitan Coal is a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (Peabody). Metropolitan Coal was granted approval for the Metropolitan Coal Project (the Project) under section 75J of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 22 June 2009. A copy of the Project Approval is available on the Peabody website (http://www.peabodyenergy.com).

The Project comprises the continuation, upgrade and extension of underground coal mining operations (Longwalls 20-27 and Longwalls 301-317) and surface facilities at the Metropolitan Coal Mine (Figure 1). Longwalls 305-307 are situated to the west of Longwalls 301-304, and define the next mining sub-domain within the Project underground mining area (Figures 1 and 2). Longwalls 308 on will be subject to future Extraction Plans.

1.1 PURPOSE AND SCOPE

In accordance with Condition 6, Schedule 3 of the Project Approval, this Heritage Management Plan (HMP) has been prepared as a component of the Metropolitan Coal Longwalls 305-307 Extraction Plan to manage the potential environmental consequences of the Extraction Plan on Aboriginal heritage sites or values.

The relationship of this HMP to the Metropolitan Coal Environmental Management Structure and to the Metropolitan Coal Longwalls 305-307 Extraction Plan is shown on Figure 3.

This HMP includes post-mining monitoring and management of Aboriginal heritage sites for Longwalls 20-22, 23-27, 301-303 and 304, subject to the previously approved Metropolitan Coal Longwall 304 HMP. Consistent with the recommended approach in the NSW Department of Planning and Environment (DP&E) and NSW Division of Resources and Energy (DRE) (2015) *Guidelines for the Preparation of Extraction Plans*, the Metropolitan Coal Longwall 304 HMP will be superseded by this document following the completion of Longwall 304.

In accordance with Condition 6, Schedule 3 of the Project Approval, this HMP has been prepared by Metropolitan Coal, with assistance from Niche Environment and Heritage and Mine Subsidence Engineering Consultants (MSEC).

1.2 STRUCTURE OF THE HERITAGE MANAGEMENT PLAN

The remainder of this HMP is structured as follows:

Section 2: Describes the review and update of this HMP.

Section 3: Outlines the statutory requirements applicable to this HMP.

Section 4: Provides a revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 305-307.

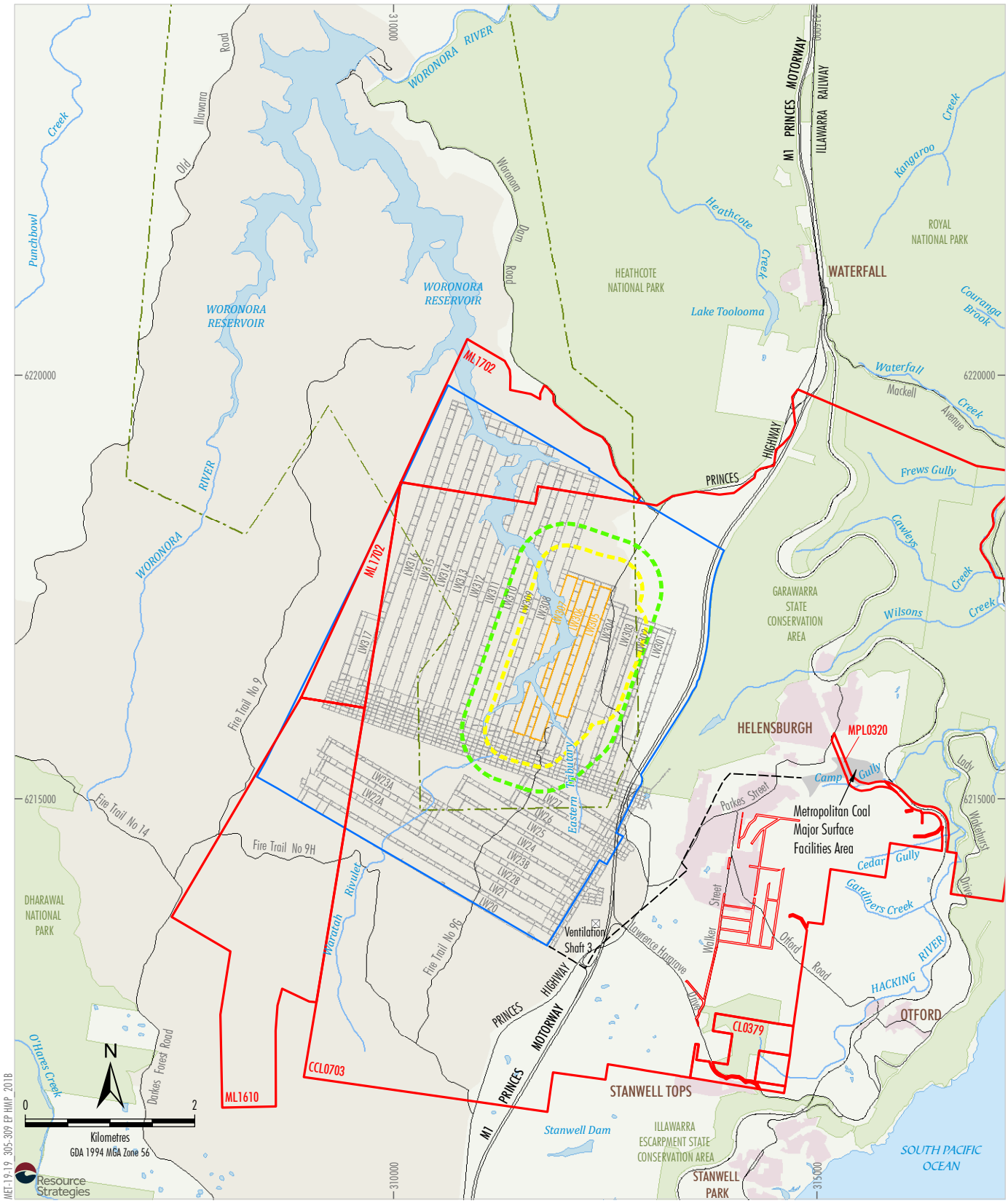
Section 5: Describes the consultation protocol.

Section 6: Details the performance measures and indicators that will be used to assess the Project.

Section 7: Outlines the baseline data for Aboriginal heritage sites.

Section 8: Describes supplementary fieldwork and pre-clearance surveys to be undertaken.

Section 9: Describes the monitoring program and provides the detailed Trigger Action Response Plan (TARP).



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

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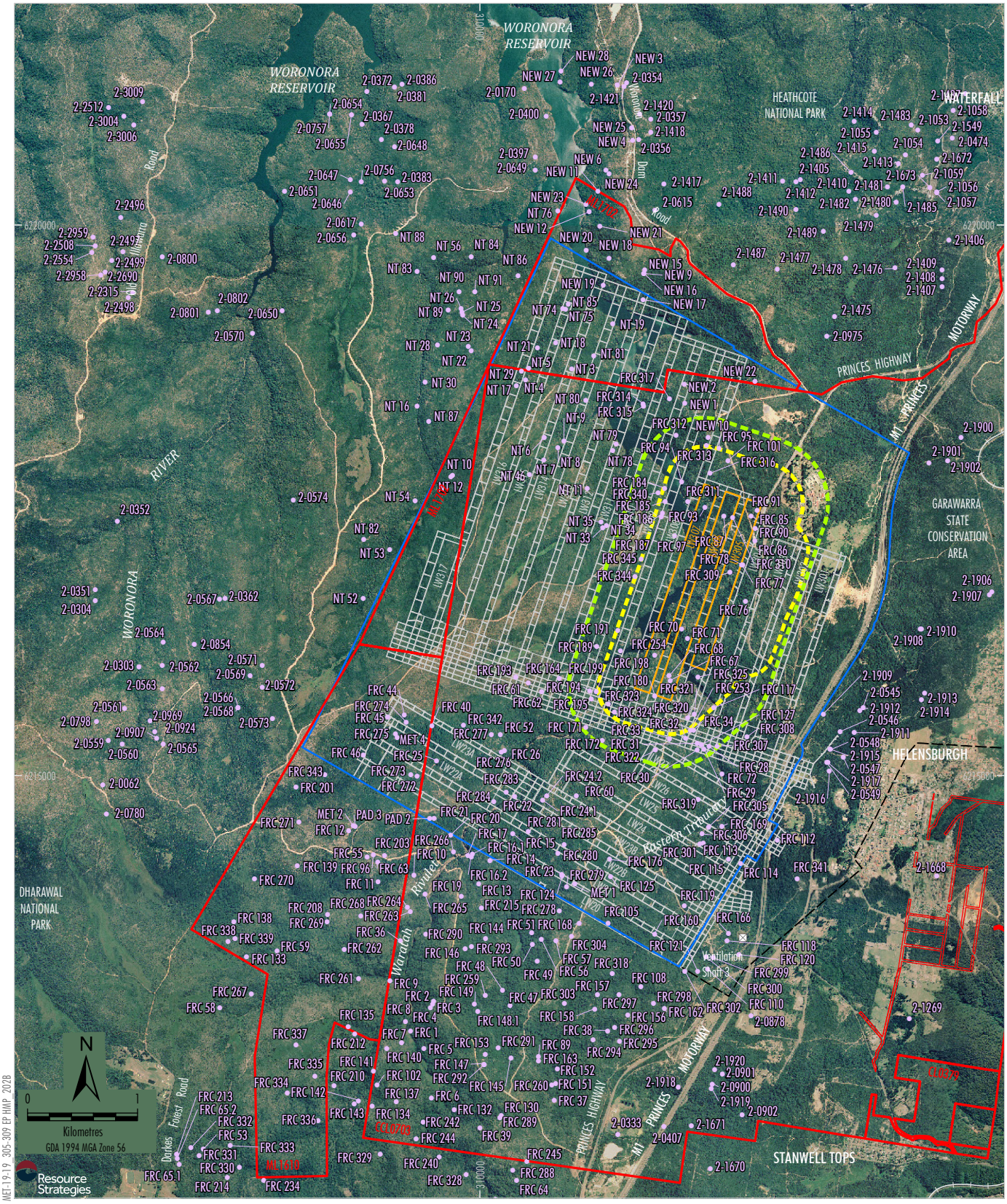
Longwalls 305-307 and Project Underground Mining Area

Figure 1



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Existing Underground Access Drive (Main Drift)
- Aboriginal Heritage Site

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); Illawarra Prehistory Group (2007; 2008); AHIMS (2007); Kayandel Archaeological Services (2006; 2007; 2008); Niche Environment and Heritage (2013)

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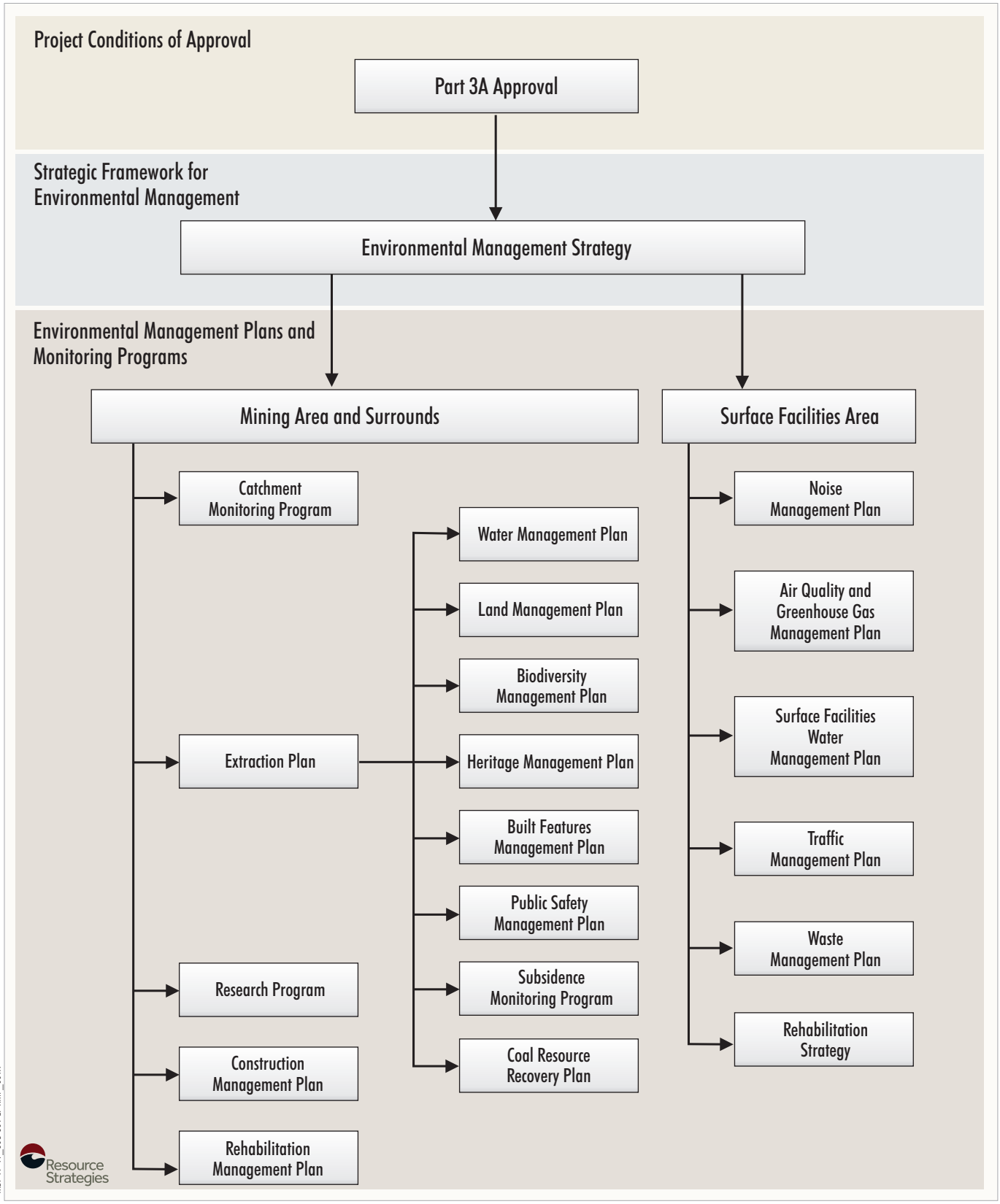
Known Aboriginal Heritage Sites Within Project Underground Mining Area and Surrounds

Figure 2



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Environmental Management Structure

Figure 3

Section 10: Describes the management, remediation and mitigation measures that will be implemented to reduce potential impacts on Aboriginal heritage.

Section 11: Provides a Contingency Plan to manage any unpredicted impacts and their consequences.

Section 12: Describes the program to collect baseline data for future Extraction Plans.

Section 13: Describes the annual review and improvement of environmental performance.

Section 14: Outlines the management and reporting of incidents.

Section 15: Outlines the management and reporting of complaints.

Section 16: Outlines the management and reporting of non-compliances with statutory requirements.

Section 17: Lists the references cited in this HMP.

2 HERITAGE MANAGEMENT PLAN REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this HMP will be reviewed within three months of the submission of:

- an audit under Condition 8, Schedule 7;
- an incident report under Condition 6, Schedule 7;
- an annual review under Condition 3, Schedule 7; and

if necessary, revised to the satisfaction of the Director-General (now Secretary) of the Department of Planning, Industry and Environment (DPIE) to ensure this HMP is updated on a regular basis and to incorporate any recommended measures to improve environmental performance.

This HMP will also be reviewed within three months of approval of any Project modification and if necessary, revised to the satisfaction of the DPIE.

The revision status of this HMP is indicated on the title page of each copy. The distribution register for controlled copies of this HMP is described in Section 2.1.

2.1 DISTRIBUTION REGISTER

In accordance with Condition 10, Schedule 7 of the Project Approval, 'Access to Information', Metropolitan Coal will make this HMP publicly available on the Peabody website. A hard copy of the HMP will also be maintained at the Metropolitan Coal Mine.

Metropolitan Coal recognises that various regulators have different distribution requirements, both in relation to whom documents should be sent and in what format.

An Environmental Management Plan and Monitoring Program Distribution Register has been established in consultation with the relevant agencies and infrastructure owners that indicates:

- to whom the Metropolitan Coal plans and programs, such as this HMP, will be distributed;
- the format (i.e. electronic or hard copy) of distribution; and
- the format of revision notification.

Metropolitan Coal will make the Distribution Register publicly available on the Peabody website.

Metropolitan Coal will be responsible for maintaining the Distribution Register and for ensuring that the notification of revisions is sent by email or post as appropriate.

In addition, Metropolitan Coal employees with local computer network access will be able to view the controlled electronic version of this HMP on the Metropolitan Coal local area network. Metropolitan Coal will not be responsible for maintaining uncontrolled copies beyond ensuring the most recent version is maintained on Metropolitan Coal's computer system and the Peabody website.

3 STATUTORY REQUIREMENTS

Metropolitan Coal's statutory obligations are contained in:

(i) the conditions of the Project Approval;

(ii) relevant licences and permits, including conditions attached to mining leases; and

(iii) other relevant legislation.

These are described below.

3.1 ENVIRONMENTAL PLANNING & ASSESSMENT ACT APPROVAL

Condition 6(f), Schedule 3 of the Project Approval requires the preparation of a HMP as a component of Extraction Plan(s) for second workings. Condition 6(f), Schedule 3 states:

> ***SECOND WORKINGS***
>
> ***Extraction Plan***
>
> *6. The Proponent shall prepare and implement an Extraction Plan for all second workings in the mining area to the satisfaction of the Director-General. This plan must:*
>
> *…*
>
> *(f) include a:*
>
> *…*
>
> - *Heritage Management Plan, which has been prepared in consultation with OEH[1] and the relevant Aboriginal groups, to manage the potential environmental consequences of the Extraction Plan on heritage sites or values;*

In addition, Condition 2, Schedule 7 and Condition 7, Schedule 3 of the Project Approval outline management plan requirements that are applicable to the preparation of this HMP. Table 1 indicates where each component of the conditions is addressed within this HMP.

[1] The NSW Office of Environment and Heritage (OEH) is now the Department of Planning, Industry and Environment – Biodiversity and Conservation Division (BCD).

Table 1
Management Plan Requirements

Project Approval Condition	HMP Section
Condition 2, Schedule 7	
2. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
a) detailed baseline data;	Section 7
b) a description of:	
• the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 3
• any relevant limits or performance measures/criteria;	Section 6
• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	Section 6
c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Sections 6, 9, 10 and 11
d) a program to monitor and report on the:	Sections 9, 10 and 13
• impacts and environmental performance of the project;	
• effectiveness of any management measures (see c above);	
e) a contingency plan to manage any unpredicted impacts and their consequences;	Section 11
f) a program to investigate and implement ways to improve the environmental performance of the project over time;	Sections 9 and 13
g) a protocol for managing and reporting any;	
• incidents;	Section 14
• complaints;	Section 15
• non-compliances with statutory requirements; and	Section 16
• exceedances of the impact assessment criteria and/or performance criteria; and	Sections 10, 11 and 16
h) a protocol for periodic review of the plan.	Sections 2 and 13
Condition 7, Schedule 3	
7. In addition to the standard requirements for management plans (see condition 2 of schedule 7), the Proponent shall ensure that the management plans required under condition 6(f) above include:	
a) a program to collect sufficient baseline data for future Extraction Plans;	Section 12
b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;	Section 4
c) a detailed description of the measures that would be implemented to remediate predicted impacts; and	Section 10
d) a contingency plan that expressly provides for adaptive management.	Section 11

3.2 LICENCES, PERMITS AND LEASES

In addition to the Project Approval, all activities at or in association with the Metropolitan Coal Mine will be undertaken in accordance with the following licences, permits and leases which have been issued or are pending issue:

- The conditions of mining leases issued by the NSW Division of Resources and Geoscience (DRG), under the NSW *Mining Act, 1992* (e.g. Consolidated Coal Lease [CCL] 703, Mining Lease [ML] 1610, ML 1702, Coal Lease 379 and Mining Purpose Lease 320).
- The *Metropolitan Coal Mining Operations Plan 1 October 2012 to 30 September 2019* approved by the DRG.
- The conditions of Environment Protection Licence (EPL) No. 767 issued by the NSW Environment Protection Authority under the NSW *Protection of the Environment Operations Act, 1997*. Revision of the EPL will be required prior to the commencement of Metropolitan Coal activities that differ from those currently licensed.
- The prescribed conditions of specific surface access leases within CCL 703 for the installation of surface facilities as required.
- Water Access Licences (WALs) issued by the Department of Industry – Water (now DPIE-Water) under the NSW *Water Management Act, 2000,* including WAL 36475 under the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and WAL 25410 under the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.
- Mining and workplace health and safety related approvals granted by the NSW Resources Regulator and WorkCover NSW.
- Supplementary approvals obtained from WaterNSW for surface activities within the Woronora Special Area (e.g. fire road maintenance activities).

3.3 OTHER LEGISLATION

Metropolitan Coal will conduct the Project consistent with the Project Approval and any other legislation that is applicable to an approved Part 3A Project under the EP&A Act.

The following Acts may be applicable to the conduct of the Project (Helensburgh Coal Pty Ltd [HCPL], 2008)[2]:

- *Biodiversity Conservation Act, 2016;*
- *Biosecurity Act, 2015;*
- *Contaminated Land Management Act, 1997;*
- *Crown Land Management Act, 2016;*
- *Dams Safety Act, 2015;*
- *Dangerous Goods (Road and Rail Transport) Act, 2008;*
- *Energy and Utilities Administration Act, 1987;*
- *Fisheries Management Act, 1994;*
- *Mining Act, 1992;*

[2] The list of potentially applicable Acts has been updated to reflect changes to the Acts that were in force at the time of submission of the Metropolitan Coal Project Environmental Assessment (Project EA) (HCPL, 2008).

- *Protection of the Environment Operations Act, 1997;*
- *Rail Safety (Adoption of National Law) Act, 2012;*
- *Roads Act, 1993;*
- *Water Act, 1912;*
- *Water Management Act, 2000;*
- *Water NSW Act, 2014;*
- *Work Health and Safety Act, 2011;* and
- *Work Health and Safety (Mines and Petroleum Sites) Act, 2013.*

Relevant licences or approvals required under these Acts will be obtained as required.

4 REVISED ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

4.1 LONGWALLS 305-307 EXTRACTION LAYOUT

Longwalls 305-307 and the area of land within 600 metres (m) of Longwalls 305-307 secondary extraction are shown on Figures 1, 2 and 4. Longwall extraction will occur from north to south. The Longwall 305 layout includes a 138 m panel width (void), a 45 m tailgate pillar width and a 70 m maingate pillar width. The longwall layout of Longwalls 306 and 307 includes 138 m panel widths (void) and 70 m pillars (solid) consistent with the PPL. The provisional extraction schedule for Longwalls 305-307 is provided in Table 2.

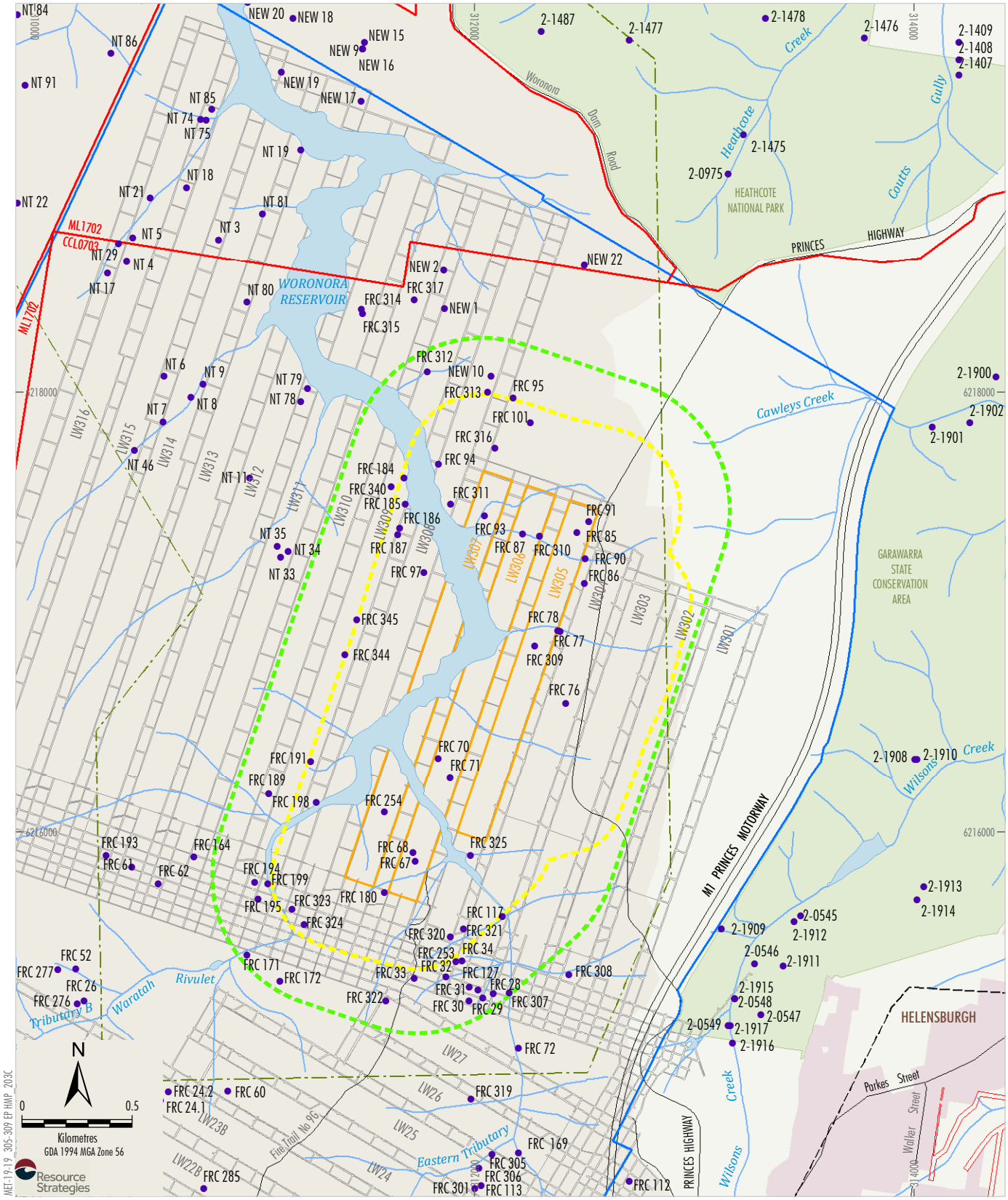
Table 2
Provisional Extraction Schedule

Longwall	Estimated Start Date	Estimated Duration	Estimated Completion Date
Longwall 305	March 2020	7 Months	October 2020
Longwall 306	November 2020	8 Months	July 2021
Longwall 307	August 2021	8 Months	April 2022

The total cumulative predicted subsidence effects, subsidence impacts and/or environmental consequences at the completion of the Project are considered in the Metropolitan Coal Project Environmental Assessment (Project EA) (HCPL, 2008) and the Preferred Project Report (HCPL, 2009), and the cumulative subsidence effects, subsidence impacts and/or environmental consequences on Aboriginal heritage will be assessed in future Extraction Plans.

4.2 RELEVANT INFORMATION OBTAINED SINCE PROJECT APPROVAL

Aboriginal heritage monitoring programs have been implemented at Metropolitan Coal for Longwalls 20-22 (from 2010 to 2014; Round 1, 2 and 3 surveys) (Kayandel Archaeological Services, 2012; Niche Environment and Heritage, 2013, 2015), Longwalls 23-27 (from 2015; Round 1, 2, 3, 4 and 5 surveys) (Niche Environment and Heritage, 2016a, 2016b, 2017a, 2017b, 2017c) and Longwalls 301-303 (Niche Environment and Heritage, 2019a) to monitor the impacts and environmental consequences of Project related subsidence on Aboriginal heritage sites. The monitoring programs have been undertaken by a suitably qualified archaeologist (with experience in rock art recording and management) and representatives of the Aboriginal stakeholders.



LEGEND

- Mining Lease Boundary
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- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
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- Existing Underground Access Drive (Main Drift)
- Aboriginal Heritage Site

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019); Illawarra Prehistory Group (2007; 2008); AHIMS (2007); Kayandel Archaeological Services (2006; 2007; 2008); Niche Environmental and Heritage (2013)

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Longwalls 305-307
Known Aboriginal Heritage Sites

Figure 4

Metropolitan Coal acknowledges that all Aboriginal heritage sites are culturally significant to the Aboriginal people who have a traditional connection to Country. All Aboriginal heritage sites have been monitored for subsidence impacts by the observation and recording of any and all changes at the sites over the monitoring period.

Of the 72 Aboriginal heritage sites that have been subject to monitoring for Longwalls 20-22, Longwalls 23-27 and/or Longwalls 301-303, 13 have been determined to have changes due to mining induced subsidence.

Five Aboriginal heritage sites (FRC 15, FRC 281, FRC 283, FRC 284 and MET 1) have been determined to have changes due to mining induced subsidence from Longwalls 20-22 (Figure 2). The observed impacts at each site were as follows:

- Site FRC 15 – vertical cracking, not coincident with any art.
- Site FRC 281 – multiple cracks running either through or adjacent to the motifs (although the majority of art showed no damage or changes).
- Site FRC 283 – cracking of the rear wall of the shelter, not coincident with any art.
- Site FRC 284 – cracking of the rear wall of the shelter and exfoliation of rock spalls, not coincident with any art.
- Site MET 1 – two vertical cracks along the rear wall and ceiling of the shelter, not coincident with any art.

Seven Aboriginal heritage sites (FRC 28, FRC 29, FRC 34, FRC 60, FRC 176, FRC 275 and FRC 301) have been determined to have changes due to mining induced subsidence from Longwalls 23-27 (Figure 2). The observed impacts at each site were as follows:

- Site FRC 28 – vertical cracking of the rear shelter wall, opening of bedding planes and joints and movement of the rock shelf that is part of the shelter floor, not coincident with any art.
- Site FRC 29 – horizontal crack along the back wall and a joining vertical crack, not coincident with any art.
- Site FRC 34 – horizontal cracking along the roof of the shelter and cracking coincident with the most southern hand stencil on the back panel.
- Site FRC 60 – three vertical cracks along the back wall of the shelter, this shelter contains no art and the archaeological deposit was unchanged.
- Site FRC 176 – vertical cracking along the northern and southern ends of the shelter, not coincident with art.
- Site FRC 275 – opening of horizontal bedding plane at rear of the shelter, five vertical hairline cracks along the back wall of the shelter, not coincident with any art.
- Site FRC 301 – surface cracking on the rock platform, not coincident with the grinding grooves.

One Aboriginal heritage site, FRC 76, was determined to have changes due to mining induced subsidence from Longwalls 301-303. The observed impacts were as follows:

- Site FRC 76 - opening of the horizontal bedding plane along the back wall, not coincident with any art.

The results of the monitoring program have been used to assess the Aboriginal heritage sites subsidence impact performance measure:

Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.

For the purpose of measuring performance against the Aboriginal heritage subsidence impact performance measure (Section 6), Aboriginal heritage sites are considered to be "affected by subsidence impacts" if they exhibit one or more of the following consequences that cannot be attributed to natural weathering or deterioration:

- overhang collapse;
- cracking of sandstone that coincides with Aboriginal art or grinding grooves; and/or
- rock fall that damages Aboriginal art.

Of the sites at which changes due to mining induced subsidence have occurred, only sites FRC 34 and FRC 281 have been affected by subsidence impacts as a result of cracking of sandstone that coincides with Aboriginal art. This means that less than 2% of sites within the mining area have been affected by subsidence impacts (Niche Environment and Heritage, 2017c; 2019a) (Section 6).

In addition to the changes recorded as a result of mining induced subsidence, natural weathering processes can also result in changes/deterioration of Aboriginal heritage sites in the Southern Coalfield (Reeves and Regal, 2017). For example, a large block fall was recorded at the southern end of site FRC 24.1 during the Round 2 monitoring for Longwalls 23-27. This change was observed to be due to increased natural water seepage during a large rain event and vegetation growth (including *Todea Barbara* and *Microsorum scandens*) along the bedding plane where it joins to the roof of the shelter (Niche Environment and Heritage, 2016b). Other examples of natural weathering include micro- and macro-vegetation growth, chemical erosion, fire damage and exfoliation of surfaces (Niche Environment and Heritage, 2016b).

The results of the monitoring to date are consistent with the potential subsidence impacts and environmental consequences predicted in the Project EA and the Preferred Project Report, where it was expected that the majority of identified Aboriginal heritage sites would experience no significant change, particularly when compared to natural weathering processes unrelated to mining and given the conservative nature of the subsidence predictions.

Aboriginal heritage sites surveyed by Longwalls 301-303 (i.e. sites FRC 28, FRC 29, FRC 34, FRC 60, FRC 76, FRC 117, FRC 176 and MET 1), which were observed by the survey to have continued change due to mining induced subsidence (Niche Environment and Heritage, 2019a) will be monitored within three months of the completion of Longwall 304 (Figure 4). None of the Aboriginal heritage sites showed continued change, however, one site, FRC 76 was observed to have changes due to mining induced subsidence. Aboriginal heritage sites with the potential to be impacted by subsidence related to the extraction of Longwall 304, namely, FRC 76, FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309 will be monitored within three months of the completion of Longwall 304 (Figure 4). At the time of HMP development, Longwall 304 had only recently commenced.

The potential for vehicle-generated dust in the Woronora Special Area or minor blasting underground (which is undertaken at significant depths) to impact on Aboriginal heritage sites in the underground mining area is very low. Vehicle access in the Woronora Special Area is via formed tracks and existing fire trails. Metropolitan Coal personnel and contractors are required to observe speed limits when using the fire trails, which limits the amount of dust generated. In most cases Aboriginal heritage sites are distant from the tracks and fire trails, and therefore are not subject to direct exposure to any dust generated by vehicles using the tracks and fire trails.

4.3 ENVIRONMENTAL RISK ASSESSMENT

An Environmental Risk Assessment (ERA) was conducted for four of the key component plans of the Metropolitan Coal Longwalls 305-307 Extraction Plan[3] *viz.* Water Management Plan, Biodiversity Management Plan, Land Management Plan and this HMP to give appropriate consideration to risk assessment and risk management in accordance with the DP&E and DRE (2015) *Guidelines for the Preparation of Extraction Plans*.

The suitably qualified and experienced experts endorsed by the Secretary of the DPIE for the preparation of the Metropolitan Coal Longwalls 305-307 Extraction Plan participated in the ERA[4]. The ERA process involved the key steps described below.

Review of Relevant Documentation and Risk Identification

In preparation for the ERA workshop, the ERA participants reviewed a number of documents relevant to the risk assessment. This included (but was not limited to):

- The 2008 *Environmental Risk Analysis* (SP Solutions, 2008) conducted for the Project EA (Appendix O of the Project EA).
- The Preferred Project Report (HCPL, 2009). During the NSW Government's assessment phase of the Project EA, and in recognition of concerns raised by key stakeholders during the formal Planning Assessment Commission assessment process, HCPL considered it appropriate to reduce the proposed extent of the original Project longwall mining area (i.e. Longwalls 20-44). This reduction in the extent of longwall mining resulted in a significant reduction to the extent of potential subsidence effects to the Waratah Rivulet and the Eastern Tributary and a reduction in the consequential potential environmental impacts.
- The Longwall 304 Environmental Risk Assessment Report (Operational Risk Mentoring, 2019a) (which included consideration of the Longwalls 301-303 Environmental Risk Assessment Report).
- Figures showing the Longwalls 305-307 layout in relation to key surface features.
- Subsidence predictions for Longwalls 305-307 (including subsidence contours, Eastern Tributary, Waratah Rivulet, Woronora Reservoir, other streams, cliff sites, upland swamps and Aboriginal heritage sites).

The participants were asked to identify any additional (specific) issues/risks and/or changes to previously assessed levels of risk in preparation for the ERA workshop.

[3] Risk assessments have been undertaken separately in relation to the Metropolitan Coal Longwalls 305-307 Built Features Management Plan and the Metropolitan Coal Longwalls 305-307 Public Safety Management Plan, and are reported in their respective documents.

[4] Participants included Mr Peter DeBono (Mine Subsidence Engineering Consultants, Subsidence and Land), Dr Noel Merrick (SLR Consulting, Groundwater), Mr Lindsay Gilbert (Hydro Engineering & Consulting, Surface Water), Associate Professor Barry Noller (The University of Queensland, Surface Water Quality), Dr David Goldney (Cenwest Environmental Services, Fauna), Ms Elizabeth Norris (Ecoplanning, Flora), Mr Jon Degotardi (Metropolitan Coal), Mr Stephen Love (Metropolitan Coal), Mr Shane Kornek (Metropolitan Coal), Ms Stacey Gromadzki (Resource Strategies), Mr Joe Flanagan (Resource Strategies) and Mr Sam Webber (Resource Strategies). Mr Jamie Reeves (Niche Environment and Heritage, Heritage) contributed to the risk assessment external to the workshop.

ERA Workshop

The ERA workshop for Longwalls 305-307 was conducted on 16 July 2019, with some participants attending via video conferencing and others attending in person at the Metropolitan Coal Mine. The ERA workshop was facilitated by an independent specialist, Dr Peter Standish of Operational Risk Mentoring and conducted in accordance with AS/NZS ISO 31000: *2009 Risk Management – Principles and Guidelines.*

The general consensus of the workshop participants was the additional (specific) issues/risks identified for Longwalls 305-307 were broadly assessed and ranked as part of the 2008 Environmental Risk Analysis, Longwalls 301-303 ERA and/or Longwall 304 ERA. However, additional (specific) issues were identified by the workshop participants relevant to Longwalls 305-307. Each of the issues/risks were explained systematically by the relevant workshop participants and each carefully reviewed.

Loss scenarios for the key potential environmental issues were identified for upland swamps, the Eastern Tributary, Waratah Rivulet and the Woronora Reservoir. The risk rankings are within the "low" range and consequently the potential outcomes can be integrated into the existing management systems for effective review and monitoring.

ERA Report Review

All ERA participants were asked to review the draft Longwalls 305-307 ERA report that was prepared to summarise the outcomes of the risk assessment. Participants' comments were incorporated into the final Operational Risk Mentoring (2019b) report.

This HMP has been prepared to provide for effective management of the identified subsidence risks.

4.4 ABORIGINAL HERITAGE SITES

The Aboriginal heritage sites identified within 600 m of Longwalls 305-307 secondary extraction are shown on Figure 4 and a summary is provided in Table 3[5].

A total of 58 Aboriginal heritage sites are located within 600 m of Longwalls 305-307 secondary extraction, and a total of 36 sites are located within the Longwalls 305-307 35 degree (°) angle of draw and/or predicted 20 mm subsidence contour (Figure 4).

Six sites within 600 m of Longwalls 305-307 secondary extraction (sites FRC 32, FRC 68, FRC 185, FRC 191, FRC 195 and FRC 322) are of high archaeological significance (Figure 4 and Table 3). Three of these sites are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour, namely, sites FRC 68, FRC 185 and FRC 191.

[5] Site 2-0346 (AHIMS 52-2-0346) was described and assessed for potential subsidence impacts in the Project EA (HCPL, 2008; Kayandel Archaeological Services, 2008) and was reported as being located over Longwall 302. During the baseline recording for Longwalls 301-303, Niche Environment and Heritage undertook a detailed site inspection. Despite searches of all possible locations (based on descriptions in the AHIMS site card and previous assessment reports) and the surrounding area, the site was unable to be relocated in the area described by its previous recorded location. Niche Environment and Heritage has assessed the site record and determined that it refers to the same site as site FRC 93.

Table 3
Aboriginal Heritage Sites within 600 m of Longwalls 305-307 Secondary Extraction

AHIMS No.	Site Code	Site Type	Archaeological Significance Rating[1]
52-2-0342 52-2-0539*	FRC 28	Sandstone overhang with art, artefacts, deposit and/or grinding groove	Moderate
52-2-0193 52-2-0155*	FRC 29	Sandstone overhang with art and PAD	Low
52-2-0200 52-2-0339*	FRC 30	Sandstone overhang with art and artefacts	Low
52-2-0722	FRC 31	Sandstone overhang with art, artefacts and deposit	Moderate
52-2-0194	FRC 32	Open site with grinding grooves only	High
52-2-0188 52-2-0325*	FRC 33	Open site with grinding grooves only	Low
52-2-0195	FRC 34	Sandstone overhang with art, artefacts and deposit	Low
52-2-0185	FRC 67	Sandstone overhang with artefacts and deposit	Low
52-2-0186 52-2-0326*	FRC 68	Sandstone overhang with art, artefacts and deposit	High
52-2-0192	FRC 70	Sandstone overhang with art, artefacts and deposit	Moderate
52-2-3510	FRC 71	Sandstone overhang with art only	Low
52-2-0887	FRC 76	Sandstone overhang with art only	Low
52-2-0330 52-2-0886*	FRC 77	Sandstone overhang with art, artefacts and deposit	Low
52-2-0885	FRC 78	Sandstone overhang with art only	Low
52-2-0883	FRC 85	Sandstone overhang with art, artefacts and deposit	Moderate
52-2-0207 52-2-0898*	FRC 86	Sandstone overhang with art only	Low
52-2-0899	FRC 87	Sandstone overhang with art, artefacts and deposit	Low
52-2-0869	FRC 90	Sandstone overhang with artefacts and deposit	Low
52-2-0870	FRC 91	Sandstone overhang with art, artefacts and deposit	Low
52-2-0198 52-2-0346* 52-2-0872*	FRC 93	Sandstone overhang with art only	Low
52-2-0873	FRC 94	Sandstone overhang with art only	Low
52-2-0347 52-2-0874*	FRC 95	Open site with grinding grooves only	Low
52-2-0220 52-2-0337*	FRC 97	Sandstone overhang with art only	Moderate
52-2-0875	FRC 101	Open site with grinding grooves only	Low
52-2-0739	FRC 117	Sandstone overhang with art and PAD	Low
52-2-0203 52-2-0414*	FRC 127	Sandstone overhang with art only	Low
52-2-0734	FRC 171	Sandstone overhang with art, artefacts and deposit	Low
52-2-0735	FRC 172	Sandstone overhang with art only	Low
52-2-0828	FRC 180[2]	Sandstone overhang with art only	Low
52-2-0222	FRC 184	Sandstone overhang with artefacts and deposit	Low
52-2-0223 52-2-0307*	FRC 185	Sandstone overhang with art, artefacts and deposit	High
52-2-0224	FRC 186	Sandstone overhang with art and deposit	Low

Table 3 (Continued)
Aboriginal Heritage Sites within 600 m of Longwalls 305-307 Secondary Extraction

AHIMS No.	Site Code	Site Type	Archaeological Significance Rating[1]
52-2-0225	FRC 187	Sandstone overhang with art only	Low
52-2-0180	FRC 189	Sandstone overhang with art only	Low
52-2-0183	FRC 191	Sandstone overhang with art only	High
52-2-0263 52-2-0308*	FRC 194	Sandstone overhang with art only	Low
52-2-0264	FRC 195	Sandstone overhang with art only	High
52-2-0268 52-2-0404*	FRC 198	Sandstone overhang with art only	Low
52-2-0265 52-2-0415*	FRC 199	Sandstone overhang with art only	Low
52-2-0738	FRC 253	Open site with grinding grooves only	Low
52-2-0829	FRC 254	Sandstone overhang with artefacts and deposit	Low
52-2-3498	FRC 307	Open site with grinding grooves only	Low
52-2-3501	FRC 309	Sandstone overhang with artefacts and deposit	Low
52-2-3500	FRC 310	Sandstone overhang with art only	Low
52-2-3502	FRC 311	Sandstone overhang with artefacts and deposit	Low
52-2-3503	FRC 312	Sandstone overhang with artefacts and deposit	Low
52-2-3444	FRC 313	Sandstone overhang with artefacts and deposit	Low
52-2-3447	FRC 316	Sandstone overhang with artefacts and deposit	Low
52-2-3451	FRC 320	Sandstone overhang with artefacts and deposit	Low
52-2-3452	FRC 321	Sandstone overhang with art, artefacts and deposit	Low
52-2-3453	FRC 322	Open site with petroglyphs only	High
52-2-3454	FRC 323	Sandstone overhang with artefacts and deposit	Low
52-2-3455	FRC 324	Sandstone overhang with artefacts and deposit	Low
52-2-3466	FRC 325	Sandstone overhang with art only	Low
52-2-3471	FRC 340	Sandstone overhang with art only	Low
52-2-3475	FRC 344	Sandstone overhang with artefacts and deposit	Low
52-2-3476	FRC 345	Sandstone overhang with artefacts and deposit	Low
52-2-0530	NEW 10	Sandstone overhang with art only	Moderate

[1] Sources include: Kayandel Archaeological Services (2006; 2007; 2008) and information available on the BCD Aboriginal Heritage Information Management System (AHIMS) Site Cards.

[2] Despite extensive searches, site FRC 180 was unable to be relocated during baseline recording.

* Single Aboriginal heritage site registered more than once on the AHIMS database (Illawarra Prehistory Group, 2007).

PAD – Potential Archaeological Deposit.

Cultural Significance

Metropolitan Coal acknowledges that all Aboriginal heritage sites are culturally significant to the Aboriginal people who have a traditional connection to Country.

An extract regarding the cultural significance of the wider Metropolitan Coal Mine area from the Project Aboriginal Cultural Heritage Assessment is provided below (Kayandal Archaeological Services, 2008):

> *Aboriginal heritage sites within the study area and surrounds that have previously been identified as being of specific cultural interest to some Aboriginal community representatives include FRC 3 and FRC 4 (both located outside the study area), FRC 12, FRC 22, FRC 24.1, FRC 24.2 and FRC 26 (located within the study area) (C. E. Sefton Pty Ltd, 2004; HCPL, 2006). During the various recent surveys and site inspections undertaken in 2006 and 2007 (Sections 3.4 and 4), FRC 12 was noted by members of the Aboriginal community (i.e. representatives of the Woronora Plateau Gundungara Elders Council, La Perouse Botany Bay Aboriginal Corporation, Wadi Wadi Coomaditchie Aboriginal Corporation, Northern Illawarra Aboriginal Collective, KEJ Tribal Elders Corporation, Tharawal Local Aboriginal Land Council, Cubbitch Barta, Illawarra Local Aboriginal Land Council and Mr Gary Caines) as being of particular cultural significance. It was indicated that all Aboriginal heritage sites (both known and unknown), when considered collectively as a 'bundle', are culturally significant.*
>
> *The Illawarra Local Aboriginal Land Council previously commented (in regard to part of the study area) that: "This Traditional Site is of great importance to Aboriginal people; this land that is visited by our Ancestors must be preserved and protected".*
>
> *The Northern Illawarra Aboriginal Collective previously commented indicated* [sic] *that "more than fifty documented traditional stories of country (some from this exact place)" had been recorded nearly a century ago, "making it clear the very landscape itself, its flora and fauna, its water and earth, are all Traditional Materials (as defined in S203FCA of the Native Title Act [Commonwealth] 1993) having spiritual cultural and heritage values for Traditional Owners".*
>
> *The Tharawal Local Aboriginal Land Council commented that "Aboriginal heritage sites provide evidence of our ancestry and links to past occupation. TLALC considers all Aboriginal heritage to be important to our people".*
>
> *In addition, it has previously been noted by representatives of Northern Illawarra Aboriginal Collective that some motifs within Aboriginal heritage sites FRC 4 (located outside the area) and FRC 11 (located within the study area) were of fish, molluscs and shells that may indicate a relationship between the previous Aboriginal inhabitants and the ocean. Northern Illawarra Aboriginal Collective representatives previously indicated that this connection was further exampled by the presence of shells and shell fragments within sites FRC 7 and FRC 265 (both located outside the study area) (ibid).*

The Project Aboriginal Cultural Heritage Assessment summarised all of the Aboriginal heritage sites specifically identified by the Aboriginal community representatives as having particular cultural significance as follows (Kayandal Archaeological Services, 2008):

> *Based on the above, the Aboriginal community consider all sites to be of some cultural significance. However, sites within the study area specifically identified by the Aboriginal community for their cultural significance include FRC 12, FRC 22, FRC 24.1, FRC 24.2, FRC 26, FRC 62, FRC 185, FRC 198, FRC 316, FRC 340, NT 8, NT 9, NT 35, NT 46, NEW 1, NEW 2 and NEW 17.*

Four sites identified as having particular cultural significance by the Aboriginal community representatives are located within 600 m of Longwalls 305-307 secondary extraction, namely sites FRC 185, FRC 198, FRC 316 and FRC 340. Three of these sites are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour, namely, sites FRC 185, FRC 198 and FRC 316. Notwithstanding, the broader cultural values described above are considered in relation to the monitoring and management of known Aboriginal heritage sites (e.g. when developing potential remediation or mitigation measures [Section 10]).

4.4.1 Revised Subsidence Predictions

The subsidence predictions for Longwalls 305-307 in relation to Aboriginal heritage sites within the 35°angle of draw and/or predicted 20 mm subsidence contour have been prepared by MSEC (2019). Table 4 compares the revised subsidence predictions for the Longwalls 305-307 Extraction Plan with the subsidence predictions for the Preferred Project Layout (at the completion of Longwall 307).

Of the 36 Aboriginal heritage sites within the Longwalls 305-307 35°angle of draw and/or predicted 20 mm subsidence contour, there is an increase in the maximum predicted vertical subsidence at six Aboriginal Heritage sites based on the Extraction Plan Layout. The predicted tilt increases at 13 Aboriginal heritage sites based on the Extraction Plan Layout, however the maximum tilt (3.0 mm/m) is the same as that predicted for the Preferred Project Layout after Longwall 307 (Table 4).

The hogging curvatures and sagging curvatures based on the Extraction Plan Layout increase at seven sites. All Aboriginal heritage sites are predicted to have hogging curvatures of 0.03 1/kilometres (km^{-1}) or less and sagging curvatures of 0.04 km^{-1} or less, consistent with the maximums for the Preferred Project Layout after Longwall 307, with the exception of sites FRC 309 (0.05 km^{-1} hogging curvature), FRC 85 (0.05 km^{-1} sagging curvature) and FRC 86 (0.09 km^{-1} sagging curvature).

Whilst the predicted subsidence parameters increase at a small number of Aboriginal heritage sites the maxima are similar to or less than the maxima predicted for other Aboriginal heritage sites located above the previously extracted longwalls at the Metropolitan Coal Mine.

Based on the revised subsidence predictions, Section 4.4.2 provides a revised assessment of predicted subsidence impacts and environmental consequences on Aboriginal heritage sites.

Table 4
Revised Subsidence Predictions for Longwalls 305-307 Aboriginal Heritage Sites

Aboriginal Heritage Sites[1]	Maximum Predicted Subsidence[2] (mm)		Maximum Predicted Tilt[3] (mm/m)		Maximum Predicted Hogging Curvature[4] (km^{-1})		Maximum Predicted Sagging Curvature[4] (km^{-1})		Maximum Predicted Conventional Tensile Strain[5] (mm/m)		Maximum Predicted Conventional Compressive Strain[5] (mm/m)	
	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]
FRC 67	425	225	1.0	1.5	0.03	< 0.01	0.03	0.03	< 0.5	< 0.5	< 0.5	< 0.5
FRC 68	450	275	1.0	1.5	0.02	< 0.01	0.04	0.03	< 0.5	< 0.5	1.0	0.5
FRC 70	425	350	1.0	< 0.5	0.01	0.03	0.02	0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 71	450	425	< 0.5	1.0	0.03	< 0.01	0.01	0.02	< 0.5	< 0.5	< 0.5	< 0.5
FRC 76	550	950	1.0	1.5	0.01	0.03	0.03	0.03	< 0.5	< 0.5	< 0.5	1.0
FRC 77	525	825	< 0.5	2.0	0.02	0.03	0.03	0.02	< 0.5	< 0.5	1.0	< 0.5
FRC 78	500	800	0.5	2.0	0.02	0.02	0.03	0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 85	525	425	1.0	2.5	0.03	< 0.01	0.03	0.05	< 0.5	< 0.5	< 0.5	1.0
FRC 86	575	800	0.5	1.5	0.03	0.03	0.04	0.09	< 0.5	< 0.5	1.0	1.5
FRC 87	400	325	1.0	1.0	0.03	0.03	0.01	0.02	< 0.5	< 0.5	< 0.5	< 0.5
FRC 90	575	675	1.0	2.0	0.01	0.02	0.01	0.02	< 0.5	< 0.5	< 0.5	< 0.5
FRC 91	600	325	1.0	3.0	< 0.01	0.03	0.03	0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 93	225	225	2.5	2.0	0.03	< 0.01	0.02	0.02	< 0.5	< 0.5	< 0.5	< 0.5
FRC 94	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 97	50	30	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 101	325	< 20	3.0	< 0.5	0.02	< 0.01	0.02	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 117	325	50	2.5	0.5	< 0.01	< 0.01	0.02	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 180[8]	200	80	2.0	1.0	0.02	0.02	< 0.01	0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 184	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 185	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 186	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 187	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5

Table 4 (Continued)
Revised Subsidence Predictions for Longwalls 305-307 Aboriginal Heritage Sites

Aboriginal Heritage Sites[1]	Maximum Predicted Subsidence[2] (mm)		Maximum Predicted Tilt[3] (mm/m)		Maximum Predicted Hogging Curvature[4] (km^{-1})		Maximum Predicted Sagging Curvature[4] (km^{-1})		Maximum Predicted Conventional Tensile Strain[5] (mm/m)		Maximum Predicted Conventional Compressive Strain[5] (mm/m)	
	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]	PPL (LW307)[6]	EPL (LW307)[7]
FRC 191	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 198	40	40	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 254	375	300	< 0.5	2.0	0.02	0.01	0.01	0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 309	475	650	1.0	3.0	0.01	0.05	0.02	0.04	< 0.5	1.0	< 0.5	1.0
FRC 310	475	400	1.0	1.5	< 0.01	0.01	0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 311	30	30	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 316	90	< 20	1.0	< 0.5	0.02	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 320	80	< 20	1.0	< 0.5	0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 321	125	< 20	1.5	< 0.5	0.02	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 323	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 324	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 325	450	150	< 0.5	0.5	0.03	< 0.01	0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 344	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5
FRC 345	< 20	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.5	< 0.5	< 0.5	< 0.5

Source: after MSEC (2019).

Site of High Archaeological Significance and/or Particular Cultural Significance.

1 Aboriginal heritage sites within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour.

2 Subsidence refers to vertical displacements of the ground.

3 Tilt is the change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the distance between those points.

4 Curvature is the second derivative of subsidence, the rate of change of tilt, and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by average length of those sections.

5 Conventional strain based on 15 times curvature. Strain is the relative differential horizontal movements of the ground. Tensile strains occur where the distance between two points increases and compressive strains occur when the distance between two points decreases.

6 PPL – after completion of Longwall 307 of the Preferred Project Layout.

7 EPL – after completion of Longwall 307 of the Extraction Plan Layout.

8 Despite extensive searches, site FRC 180 was unable to be relocated during baseline recording.

mm = millimetres; mm/m= millimetres per metre

4.4.2 Revised Assessment of Potential Subsidence Impacts and Environmental Consequences

The Project EA Subsidence Assessment (MSEC, 2008) provided a description of the general impacts on Aboriginal heritage sites (including open sites and sandstone overhang sites) in the Southern Coalfield as a consequence of longwall mining.

At some locations the predicted subsidence parameters are higher than the parameters for the Preferred Project Layout, however are similar to or less than the maxima predicted for other Aboriginal heritage sites located above the previously extracted longwalls at the Metropolitan Coal Mine. As such, the potential impacts to these sites based on the Extraction Plan Layout do not change the impact assessment provided in the Project EA or the Preferred Project Report.

The following provides a summary of potential impact mechanisms and any changes to the predicted subsidence impacts and environmental consequences due to the revised subsidence predictions for Longwalls 305-307.

Open Sites

One open site is located within the Longwalls 305-307 35^{o} angle of draw and/or predicted 20 mm subsidence contour, namely site FRC 101 (an open site with grinding grooves). Open sites have the potential to be impacted by the cracking of sandstone resulting from mine subsidence.

Based on the predicted subsidence parameters described in Section 4.4.1, potential subsidence impacts to site FRC 101 are considered unlikely (MSEC, 2019).

Sandstone Overhang Sites

There are 35 sandstone overhang sites located within the 35^{o} angle of draw and/or predicted 20 mm subsidence contour of Longwalls 305-307. Of the 35 sites with overhangs, 13 have art only and 22 have art and/or artefacts and/or a deposit/PAD. Overhang sites can potentially be impacted by the cracking of sandstone. Where cracking is coincident with an overhang, it is possible there could be cracking of art panels, isolated rock fall as the result of mining, or in extreme cases, overhang collapse.

The majority of the Aboriginal heritage sites are located above solid coal and based on the low magnitudes of the predicted subsidence parameters, impacts to these sites resulting from the extraction of Longwalls 305-307 are considered unlikely (MSEC, 2019). Surface fracturing of the bedrock can occur outside the longwall layouts, however such fracturing is minor and isolated and the likelihood of fracturing impacting the Aboriginal heritage sites outside the longwall layouts is considered to be low (MSEC, 2019).

Sites located above Longwalls 304 and 305 where pillar widths are narrower, and sites located above Longwalls 306 and 307, have a higher risk of impacts, similar to those assessed based on the Preferred Project Layout, including the potential for fracturing and rock falls within overhangs (MSEC, 2019).

In addition to the above, Section 10.2 provides an additional assessment (including tabulation of additional risk factors) for Aboriginal heritage sites of high archaeological significance and/or particular cultural significance. Notwithstanding the above and the assessments presented in Sections 4.2.2 and 10.2. Section 9 describes a monitoring program that will be implemented to monitor the impacts and consequences of Project related subsidence on Aboriginal heritage sites. The monitoring includes Aboriginal heritage sites of low, moderate or high archaeological significance and sites of particular cultural significance.

5 CONSULTATION PROTOCOL

5.1 IDENTIFICATION OF ABORIGINAL STAKEHOLDERS

For the purpose of this HMP, Aboriginal stakeholders are defined as being those Aboriginal groups/parties who have previously registered an interest in being consulted in relation to the Project or who have been involved on an ongoing basis at Metropolitan Coal. These Aboriginal stakeholders include the following:

- Cubbitch Barta Native Title Claimants;
- Illawarra Local Aboriginal Land Council;
- Korewal Elouera Jerrungurah Tribal Elders Corporation;
- Mr Gary Caines;
- La Perouse Botany Bay Aboriginal Corporation;
- Woronora Plateau Gundungara Elders Councils;
- Northern Illawarra Aboriginal Collective, including representatives from:
  - Wadi Wadi Coomaditchie Aboriginal Corporation;
- Tharawal Local Aboriginal Land Council; and
- Wodi Wodi Elders Corporation.

5.2 ABORIGINAL STAKEHOLDER PARTICIPATION

Metropolitan Coal is committed to maintaining ongoing consultation with Aboriginal stakeholders throughout the life of the Project; however, it is the responsibility of Aboriginal stakeholders to ensure that up-to-date contact details (full name, postal address, telephone number, and where possible, email address) are provided to Metropolitan Coal.

5.2.1 Involvement of Aboriginal Stakeholders in Fieldwork

The number of participants in an effective field team is governed by a number of safety, logistic and access considerations, including:

- **Safety:** a large group can be difficult to keep together when moving through dense vegetation in steep terrain as is the case across the majority of the Project underground mining area. Large groups move slowly (especially through dense vegetation and in steep terrain) and can prevent a rapid response (i.e. evacuation) to imminent dangers that can often be encountered in the Project underground mining area (e.g. bush fire warnings and electrical storms).
- **Logistics:** Participant numbers are limited by vehicle availability and safety restrictions. The isolated nature of the area above the Project underground mining area requires the use of vehicles for efficient field work.
- **Access Restrictions:** Areas within the Project underground mining area are located within a WaterNSW Schedule One special area. Public access is controlled in this area to protect water quality and ecological integrity (WaterNSW and OEH, 2015). Excessive access into this area is not consistent with the WaterNSW's *Special Areas Strategic Plan of Management* (WaterNSW and OEH, 2015).

Aboriginal stakeholders will be invited to attend relevant scheduled fieldwork in consideration of the above.

Scheduled fieldwork to which Aboriginal stakeholders may be invited to attend includes:

- Aboriginal heritage monitoring (Section 9);
- supplementary fieldwork (Section 8); and
- the planning for and/or implementation of management and mitigation measures (Section 10).

Invitations to attend scheduled fieldwork will be provided in writing with at least 5 business days' notice. Dates for undertaking fieldwork will be subject to consultation with Aboriginal stakeholders and archaeologists.

Prior to undertaking fieldwork, all participating Aboriginal stakeholders and archaeologists will be required to comply with Metropolitan Coal's workplace health and safety requirements. These requirements include the provision of copies of current relevant insurances (i.e. public liability and workers compensation) and appropriate personal protection equipment.

All Metropolitan Coal staff and contractors (including Aboriginal stakeholders and archaeologists) may be subject to random drug and alcohol testing. All Metropolitan Coal staff and contractors (including Aboriginal stakeholders and archaeologists) must be able bodied and fit to undertake the work required.

5.2.2 Ongoing Consultation with Aboriginal Stakeholders

Metropolitan Coal will maintain a consultation log to record all correspondence with Aboriginal stakeholders (e.g. emails, telephone calls, letters, meeting minutes, etc.).

Aboriginal stakeholders will be invited to comment on relevant draft documentation regarding the management of Aboriginal cultural heritage, if and when required.

Aboriginal stakeholders will be notified of any material changes to the HMP. In the context of this HMP, a material change would include any change that affects the management of Aboriginal cultural heritage associated with Metropolitan Coal. Examples of a material change in the context of this HMP include:

- Any change to the monitoring program methodology (e.g. monitoring frequency or parameters).
- Any change to the available remediation or mitigation measures (e.g. proposed use of a new engineering technology to reduce potential consequences).
- Any change to the surface disturbance protocol.

5.3 ABORIGINAL STAKEHOLDER ACCESS PROTOCOL

In addition to scheduled field activities, Aboriginal stakeholders may apply to WaterNSW or other landholders for access to Aboriginal heritage sites within the larger Project area (e.g. for personal, spiritual or cultural reasons). Metropolitan Coal will endeavour to facilitate the requested access, consistent with personnel workplace health and safety requirements and associated landholder requirements.

6 PERFORMANCE MEASURES AND INDICATORS

The Project Approval requires Metropolitan Coal to achieve the Aboriginal heritage sites subsidence impact performance measure outlined in Table 1 of Condition 1, Schedule 3 of the Project Approval:

Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.

Metropolitan Coal will assess the Project against the following performance indicator to allow early recognition of mining impacts:

Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.

Aboriginal sites are subject to ongoing natural deteriorating processes unrelated to mining, including impacts from tree roots, natural weathering or deterioration, natural cracking of sandstone and inappropriate visitor behaviour (Lambert, 1989; Reeves and Regal, 2017). Limited long term studies have been undertaken on subsidence impacts to overhangs in the NSW Southern Coalfields and as the internal structures of overhangs (e.g. existing bedding planes, joints, cracking and seepage) are not always observable, not all risks to shelters from mining can be identified. This makes it sometimes problematic to clearly differentiate between subsidence impacts and natural impacts.

Section 9 describes the monitoring program and detailed TARP that will be used to assess the Project against the Aboriginal heritage sites performance indicator and Aboriginal heritage sites subsidence impact performance measure. As described in Section 9, a Heritage Management Plan – Subsidence Impact Register (provided in Appendix 1) will be used to progressively monitor the cumulative number and percentage of Aboriginal heritage sites affected by subsidence impacts.

For the purpose of measuring performance against the Aboriginal heritage sites performance indicator and subsidence impact performance measure, sites are considered to be "affected by subsidence impacts" if they exhibit one or more of the following consequences that cannot be attributed to natural weathering or deterioration:

- overhang collapse;
- cracking of sandstone that coincides with Aboriginal art or grinding grooves; and
- rock fall that damages Aboriginal art.

There are 143 Aboriginal heritage sites (142 sites identified in the Project EA and one new site [MET 4] identified during Round 2 monitoring for Longwalls 20-22) within the mining area. The mining area is defined by the Project Approval and is shown on Figure 1 of this HMP (labelled as Project Underground Mining Area Longwalls 20-27 and 301-317).

As described in Section 10, in the event that any subsidence impact is recorded, consideration would be given to implementing appropriate management, remediation and/or mitigation measures in consultation with the BCD and the Aboriginal stakeholders. In the event the Aboriginal heritage sites subsidence impact performance measure is exceeded, Metropolitan Coal will notify the DPIE, BCD and Aboriginal stakeholders as soon as practicable after Metropolitan Coal becomes aware of the exceedance and the Contingency Plan (Section 11) will be implemented.

As indicated in Section 4.2, Metropolitan Coal acknowledges that all Aboriginal heritage sites are culturally significant to the Aboriginal people who have a traditional connection to Country.

7 BASELINE DATA

Baseline recording of Aboriginal heritage sites for Longwalls 20-27, 301-303 and 304-306 has been conducted by Kayandel Archaeological Services or Niche Environment and Heritage. The sites that were subject to detailed baseline recording (where the sites were able to be relocated) are listed in Table 5.

Table 5
Aboriginal Heritage Sites Subject to Previous Baseline Recording

Sites Subject to Baseline Recording for Longwalls 20-22**				
FRC 10	FRC 12	FRC 13	FRC 14	FRC 15
FRC 16.1	FRC 16.2	FRC 17	FRC 19	FRC 20
FRC 21	FRC 22	FRC 23	FRC 24.1	FRC 24.2
FRC 25	FRC 26	FRC 40	FRC 44	FRC 45
FRC 46	FRC 49	FRC 50	FRC 51	FRC 52
FRC 55	FRC 56	FRC 60	FRC 63	FRC 96
FRC 105	FRC 108	FRC 110	FRC 113	FRC 114
FRC 115	FRC 118	FRC 119	FRC 120	FRC 121
FRC 124	FRC 125	FRC 156	FRC 157	FRC 160
FRC 162	FRC 166	FRC 176	FRC 203	FRC 215
FRC 265	FRC 266	FRC 272	FRC 273	FRC 274
FRC 275	FRC 276	FRC 277	FRC 278	FRC 279
FRC 280	FRC 281	FRC 283	FRC 284	FRC 285
FRC 297	FRC 298	FRC 299	FRC 300	FRC 301
FRC 302	FRC 304	FRC 318	FRC 342	FRC 343
MET 1	MET 2	PAD 2	PAD 3	MET 4*
Sites Subject to Baseline Recording for Longwalls 23-27**				
FRC 62	FRC 112	FRC 169	FRC 171	FRC 172
FRC 305	FRC 319	FRC 322	FRC 28	FRC 29
FRC 30	FRC 31	FRC 32	FRC 33	FRC 34
FRC 67	FRC 68	FRC 117	FRC 127	FRC 194
FRC 195	FRC 199	FRC 253	FRC 307	FRC 308
FRC 320	FRC 321	FRC 323	FRC 324	
Sites Subject to Baseline Recording for Longwalls 301-303				
FRC 70	FRC 71	FRC 76	FRC 77	FRC 78
FRC 85	FRC 86	FRC 87	FRC 90	FRC 91
FRC 93	FRC 309	FRC 310	FRC 325	
Sites Subject to Baseline Recording for Longwalls 304-306				
FRC 94	FRC 95	FRC 97	FRC 101	FRC 184
FRC 185	FRC 186	FRC 187	FRC 191	FRC 198
FRC 254	FRC 311	FRC 312	FRC 313	FRC 316
FRC 340	FRC 344	FRC 345	NEW 1	NEW 10
NEW 22				

Sites located within 600 m of Longwalls 305-307 secondary extraction.

* Site MET 4 was recorded during Round 2 monitoring for Longwalls 20-22. This site has been registered on AHIMS and has been subject to monitoring.

** Despite extensive searches, sites FRC 57, FRC 168 and FRC 306 were unable to be relocated for baseline recording for Longwalls 20-22, and sites FRC 72 and FRC 180 were unable to be relocated for baseline recording for Longwalls 23-27.

A number of the Aboriginal heritage sites that have been subject to baseline recording for Longwalls 23-27, 301-303 or 304-306 are located within 600 m of Longwalls 305-307 secondary extraction. These sites are shaded in Table 5. Only one additional site within 600 m of Longwalls 305-307 secondary extraction (site FRC 189) had not been subject to previous baseline recording (Table 6).

The baseline recording of Aboriginal heritage sites for Longwalls 20-27, 301-303 and 304-306 has been previously provided to the DPIE, OEH and Aboriginal stakeholders (and are available on request). Baseline recording of an additional 13 Aboriginal heritage sites overlying or proximal to Longwalls 310-312 has been conducted by Niche Environment and Heritage (2019b) and will be provided in the next Extraction Plan. The baseline records include:

- a photographic record of each Aboriginal heritage site;
- detailed scaled plans of each site including physical characteristics and features; and
- detailed information regarding the dimensions, composition and features of the site.

Table 6
Aboriginal Heritage Sites Subject to Baseline Recording Overlying or Proximal to Longwalls 310-312

FRC 61	FRC 164	FRC 189	FRC 314	FRC 315
FRC 317	NT 11	NT 33	NT 34	NT 35
NT 78	NT 79	NEW 2		

Sites located within 600 m of Longwalls 305-307 secondary extraction.

8 SUPPLEMENTARY FIELDWORK AND PRE-CLEARANCE SURVEYS

8.1 SUPPLEMENTARY FIELDWORK/INVESTIGATION

Supplementary Aboriginal heritage fieldwork may be undertaken over the life of the Project to inform the management and monitoring of Aboriginal heritage sites.

8.2 PRE-CLEARANCE SURVEYS

Pre-clearance surveys may be required to be undertaken in the Project underground mining area to identify the most appropriate location for required Project infrastructure. Pre-clearance surveys will involve the following:

1. Developing an inventory of surface infrastructure required and conducting an initial desktop risk assessment based on the location of known sites.
2. Undertaking a pre-clearance survey (if required[6]) of the proposed site(s) for surface infrastructure by an appropriately qualified and experienced archaeologist.
3. Assessing potential impacts to nearby Aboriginal heritage site(s) based on the results of the pre-clearance surveys and determining the most appropriate location for required surface infrastructure.

[6] A pre-clearance survey would not be required if the area has been previously surveyed or if, in the opinion of an appropriately qualified archaeologist, it contains limited archaeological potential.

4. Where practicable, surface infrastructure will be located so as to avoid or minimise impacts to Aboriginal heritage sites. If impacts cannot be avoided, appropriate management and/or mitigation measures will be undertaken (Section 10).

Where Aboriginal heritage sites are located close to required surface disturbance works, the surface disturbance protocol (described in Section 10.3) will be undertaken.

8.3 RECORDING AND REGISTERING NEW ABORIGINAL HERITAGE SITES

Any previously unrecorded Aboriginal heritage sites identified during fieldwork (e.g. baseline recording, supplementary fieldwork, pre-clearance surveys, monitoring, follow-up inspections to assess the effectiveness of mitigation/management/remediation measures, etc.) would be recorded using the standard BCD site card. This information would be submitted to the BCD for registration on the AHIMS database. Any previously unrecorded sites would also be subject to archaeological and cultural significance assessment, in consultation with Aboriginal stakeholders. Any previously unrecorded sites would be managed in accordance with the requirements of this HMP.

9 MONITORING

A monitoring program will be implemented to monitor subsidence impacts and environmental consequences of Project related subsidence on Aboriginal heritage sites.

Monitoring of the Longwalls 20-27, 301-303 and 304 Aboriginal heritage sites, at which previous monitoring indicates continued change due to mining induced subsidence following the completion of Longwall 304, will be monitored as a component of this HMP.

As indicated in Section 4.2, none of the sites (FRC 28, FRC 29, FRC 34, FRC 60, FRC 76, FRC 117, FRC 176 and MET 1) showed continued change due to mining induced subsidence following the completion of Longwall 303. One Aboriginal heritage site, FRC 76, was determined to have changes due to mining induced subsidence from Longwalls 301-303. Opening of the horizontal bedding plane along the back wall was observed, not coincident with any art.

Sites FRC 76, FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309 will be monitored within three months of the completion of Longwall 304 (Figure 4). Monitoring of these sites will also be undertaken for Longwalls 305-307 as described below.

All[7] Aboriginal heritage sites located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour will be monitored for Longwalls 305-307 (Table 4 and Figure 4).

Round 1 monitoring will be undertaken within three months following the completion of Longwall 305 and will include all sites within the Longwall 305 35° angle of draw and/or predicted 20 mm subsidence contour (Table 7).

Round 2 monitoring will be undertaken within three months following the completion of Longwall 306 and will include all sites within the Longwalls 305 and 306 35° angle of draw and/or predicted 20 mm subsidence contour (Table 7).

[7] Despite extensive searches, site FRC 180 (which is located within the Longwalls 305-307 35°angle of draw and/or predicted 20 mm subsidence contour) was unable to be relocated during baseline recording, and will not be monitored as part of this HMP.

Round 3 monitoring will be undertaken within three months following the completion of Longwall 307 and will include all sites within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Table 7).

Table 7
Longwalls 305-307 Aboriginal Heritage Sites Monitoring Schedule

Aboriginal Heritage Site	Round 1	Round 2	Round 3
FRC 67	•	•	•
FRC 68	•	•	•
FRC 70	•	•	•
FRC 71	•	•	•
FRC 76	•	•	•
FRC 77	•	•	•
FRC 78	•	•	•
FRC 85	•	•	•
FRC 86	•	•	•
FRC 87	•	•	•
FRC 90	•	•	•
FRC 91	•	•	•
FRC 93	•	•	•
FRC 117	•	•	•
FRC 309	•	•	•
FRC 310	•	•	•
FRC 325	•	•	•
FRC 97		•	•
FRC 101		•	•
FRC 180		•	•
FRC 254		•	•
FRC 311		•	•
FRC 316		•	•
FRC 320		•	•
FRC 321		•	•
FRC 94			•
FRC 184			•
FRC 185			•
FRC 186			•
FRC 187			•
FRC 191			•
FRC 198			•
FRC 323			•
FRC 324			•
FRC 344			•
FRC 345			•

Subsequent monitoring would be undertaken as part of future Extraction Plans (i.e. Longwalls 308 on) and would include any sites at which the Round 3 survey indicates continued change due to mining induced subsidence.

The monitoring team will include a suitably qualified archaeologist (with experience in rock art recording and management) and representatives of the Aboriginal stakeholders (where available) (Section 5.1). Specific details that will be recorded during the monitoring program include (but are not limited to):

- the date of monitoring;
- the location of longwall extraction (i.e. the longwall chainage) at the time of monitoring;
- comparison of the physical characteristics of the site at the time of monitoring against the previous monitoring and the baseline record (detail/quantify any changes observed);
- inspections of rock surfaces for cracking and/or exfoliation and/or blockfall since the previous monitoring and against the baseline record;
- inspection of art motifs for damage or deterioration since the previous monitoring and against the baseline record;
- identification of any natural weathering processes that may result in deterioration (e.g. fire, vegetation growth and water seepage);
- detailed description and quantification of any changes noted during the completion of the above tasks;
- a photographic record of any changes noted during monitoring (taken at the same position and distance as baseline record to allow comparison over time);
- whether any follow-up actions are required to be considered (e.g. implementation of management or initiation of the Contingency Plan, etc.); and
- any other relevant information.

An example monitoring *pro forma* detailing the minimum recording requirements during monitoring is provided as Table 8.

A summary of the information collected during monitoring will be recorded in the Heritage Management Plan – Subsidence Impact Register (provided in Appendix 1) and reported in accordance with the Project Approval conditions. At the completion of monitoring, a report will be prepared and distributed to the BCD and each of the Aboriginal stakeholders. The report will include the following:

- a map of the area and the location of Aboriginal heritage sites monitored;
- a table outlining the dates on which each site was monitored and which Aboriginal stakeholders were present;
- a table outlining sites at which change has been noted and the nature and degree of change;
- a summary of comments made by Aboriginal stakeholders present during monitoring regarding:
  - the degree and nature of change to sites; and
  - proposed recommendations;
- general observations made during the monitoring; and
- recommendations for future monitoring.

The monitoring results will be used to assess the Project against the Aboriginal heritage sites performance indicator and subsidence impact performance measure (described in Section 6) in accordance with the detailed TARP provided in Table 9. The Heritage Management Plan – Subsidence Impact Register (provided in Appendix 1) will be used to progressively monitor and document the total number and cumulative percentage of Aboriginal heritage sites against the Aboriginal heritage sites performance indicator and subsidence impact performance measure (Table 9 and Section 6).

As described in Section 10, in the event that any subsidence impact is recorded during monitoring, consideration will be given to implementing appropriate management, remediation and/or mitigation measures in consultation with the BCD and the Aboriginal stakeholders. In addition, the AHIMS site card for any Aboriginal cultural heritage site affected by subsidence impacts will be updated and submitted to the BCD for registration on the AHIMS database. In the event the subsidence impact performance measure is exceeded, the Contingency Plan outlined in Section 11 will be implemented.

Table 8
Monitoring Pro-forma

Site Details						
Site Name			AHIMS Site Number			
Site Type						
GPS Details (GDA94)	Easting		Northing			
Recording Details						
Baseline Recording			Date/time			
Previous Monitoring			Date/time			
Current Monitoring			Date/time			
Archaeological Features						
Previously Identified						
Re-recorded						
Additional Located	(attach recording form)					
Site Condition						
Overall						
Rock surfaces						
Archaeological Feature/s						
Change in vegetation, erosion, soil level or hydrological features						
Observed Change						
Change Type	(e.g. cracking, collapse, exfoliation, segmented detachment, step cracking, platform separation, increased moisture flow)					
Location	(map location of damage within site)					
Dimensions (mm)	Length		Width		Depth/Height	
Comments	(e.g. has the archaeological feature been affected? is the damage new? has damage increased since previous monitoring?)					
Observed Natural Disturbance Processes						
Insects			Weathering			
Animals			Water-wash			
Vegetation			Exfoliation			
Microvegetals			Salts			
Siltation						
Comments						
Recommendations						
Further Monitoring						
Management						
Attach photographs and drawings of changes in site condition, subsidence damage, natural damage and any additional archaeological features. Photos should be taken from the same position and distance as the baseline record to allow comparison over time.						

Table 9
Trigger Action Response Plan – Aboriginal Heritage Sites Monitoring

Performance Measure	Performance Indicator	Monitoring Sites	Parameters	Frequency/ Sample Size	Analysis Methodology	Error Types	Baseline	Significance Levels/ Triggers		Action/Response
Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts	*Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts*[1].	• Monitoring of Aboriginal heritage sites with the potential to be impacted by subsidence related to the extraction of LW305-307.	• Cracking of sandstone at open sites. • Cracking and/or exfoliation of sandstone, blockfall, displacement, breakage and/or collapse of sandstone overhang sites. • Damage or deterioration of art motifs.	Survey of Aboriginal heritage sites within three months of the completion of LW305, LW306 and LW307 (i.e. Round 1, 2 and 3 surveys described in Section 9).	• Visual inspection. • The Heritage Management Plan – Subsidence Impact Register will be used to progressively monitor the cumulative number and percentage of Aboriginal heritage sites affected by subsidence impacts.	• Misidentification of Natural weathering processes that may result in deterioration (e.g. fire, vegetation growth and water seepage) attributed to subsidence.	• Aboriginal heritage sites in variable condition, and in states of constant natural change. Some sites exhibit varying degrees of natural cracking, erosion, seepage, weathering etc. • Two sites, FRC 281 (over LW20-22) and FRC 34 (to the north of LW27) have been affected by subsidence impacts. • Baseline record for sites listed in Section 7 and documented in reports for LW20-22, LW23-27, LW301-303 and/or LW304-306. [2, 3, 4, 5]	Level 1	Monitoring results indicate sites FRC 281 and FRC 34 have been affected by subsidence impacts.	Continue monitoring. Six monthly reporting.
								Level 2	Monitoring results indicate less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.	Consider the implementation of appropriate management, remediation and/or mitigation measures in consultation with the BCD and Aboriginal stakeholders. Six monthly reporting.
								Level 3	Monitoring results indicate greater than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.	Assess against the performance measure. Consider the implementation of appropriate management, remediation and/or mitigation measures in consultation with the BCD and Aboriginal stakeholders.

1 Sites are considered to be "affected by subsidence impacts" if they exhibit one or more of the following consequences that cannot be attributed to natural weathering or deterioration: overhang collapse; cracking of sandstone that coincides with Aboriginal art or grinding grooves; and rock fall that damages Aboriginal art. There are 143 Aboriginal heritage sites (142 sites identified in the Project EA and one new site [MET 4] identified during Round 2 monitoring for Longwalls 20-22) within the mining area. The mining area is defined by the Project Approval and is shown on Figure 1 of this HMP (labelled as Project Underground Mining Area Longwalls 20-27 and 301-317). Metropolitan Coal acknowledges that all Aboriginal heritage sites are considered to be culturally significant to the Aboriginal people who have a traditional connection to Country.

2 Kayandel Archaeological Services (2010) *Longwalls 20-22 – Heritage Management Plan Baseline Record - Aboriginal Heritage Sites.* Report prepared for Metropolitan Coal.

3 Niche Environment & Heritage (2013; 2016) *Longwalls 23-27 Metropolitan Colliery - Baseline Recording.* Report prepared for Metropolitan Coal.

4 Niche Environment & Heritage (2016c) *Longwalls 301-303 Metropolitan Colliery - Baseline Recording.* Report prepared for Metropolitan Coal.

5 Niche Environment & Heritage (2018) *Longwalls 304-306 Metropolitan Colliery - Baseline Recording.* Report prepared for Metropolitan Coal.

10 MANAGEMENT, REMEDIATION AND MITIGATION MEASURES

10.1 MANAGEMENT AND REMEDIATION MEASURES

Following monitoring within three months of the completion of Longwall 304 and within three months of the completion of Longwall 305, Longwall 306 and Longwall 307 (Section 9), Metropolitan Coal will assess the need for implementation of appropriate management and/or remediation measures.

Examples of potential management and remediation measures are provided in Table 10. Development and implementation of these measures will be assessed on a case-by-case basis and will acknowledge that whilst the measures may reduce the risk of impact and consequence, they can also have the potential to cause substantial damage to Aboriginal heritage sites and their settings.

Table 10
Potential Management and Remediation Measures

Consequence[1]	Potential Management and Remediation Measures	
	Measure	**Description**
Increased seepage with the potential to impact art.	Seepage control techniques.	• Installation of an artificial dripline (e.g. silicone dripline) to direct increased moisture/water seepage away from art panels.
Reduction in the stability of a sandstone overhang due to substantial cracking or block fall.	Stabilisation techniques.	• Installation of artificial rock support (e.g. rock bolts, cable bolts, cement sprays [e.g. shotcrete], injection of a binding agent [PUR or similar]). • Installation of standing supports (e.g. timber props, timber cogs, sandbags and metal [hydraulic] props). • Scaling/dislodgement/removal of remaining loose rock.
	Salvage.	• Salvage of artefacts for safekeeping and storage and/or display at a suitable location in consultation with the Aboriginal community.
Impacts on aesthetic values due to cracking.	Restoration of aesthetic values.	• Use of cosmetic treatments (e.g. in the form of coloured grout or similar) to restore aesthetic values.
Cracking of sandstone at open sites, threatening grinding grooves or engraved art.	Strain reduction techniques.	• Installation of a stress relief slot or stress focus notch.

[1] Consequences could also include the loss of site amenity and cultural and archaeological value to the community

The development of management and/or remediation measures will be determined in consultation with the BCD and the Aboriginal stakeholders and with regard to the specific circumstances of the subsidence impact (e.g. the location, nature and extent of the impact) and the assessment of consequences.

If proposed, the implementation of any invasive techniques (e.g. stabilisation, stress relief/focus slots, use of material for aesthetic restoration, etc.) will also be developed in consultation with WaterNSW or other relevant landowners.

Follow-up inspections will be conducted to assess the effectiveness of implemented management and/or remediation measures and the requirement for any additional measures. The specific timing and nature of follow-up inspections/additional monitoring will be dependent on the nature of the management and/or remediation measures implemented. Any management and/or remediation measures implemented will be reported in the Annual Review (Section 13).

10.2 MITIGATION MEASURES

10.2.1 Mitigation Measure Consideration and Implementation Process

As part of the development of Extraction Plans (and on an ongoing basis during mining), Metropolitan Coal will consider the requirement for development and implementation of Aboriginal heritage mitigation measures. The aim of the mitigation measures is to reduce the potential for substantial impacts and consequences to Aboriginal heritage sites of high archaeological significance and/or particular cultural significance.

The development of mitigation measures will be determined with regard to the specific circumstances of individual sites, including accessibility, size and spatial extent, nature of predicted subsidence impacts and consequences, and level of damage or disturbance (to the site or its setting) associated with implementing the measure(s). The consideration of mitigation measures will acknowledge that while they may reduce the risk of consequence to the site, they also have the potential to cause substantial damage to the site and its settings (including impacts to cultural setting). Other potential environmental impacts associated with implementation of mitigation works (e.g. vegetation clearing) will also be considered.

Examples of potential mitigation measures currently available are provided in Table 11.

Table 11
Potential Consequences and Mitigation Measures

Consequence[1]	Potential Mitigation Measures	
	Measure	**Description**
Existing seepage with the potential to increase and threaten art due to subsidence movements.	Seepage control techniques.	• Installation of an artificial dripline (e.g. silicone dripline) to direct increased moisture/water seepage away from art panels if it eventuates.
Reduction in the stability of an overhang due to substantial cracking or block fall.	Stabilisation techniques.	• Installation of artificial rock support (e.g. rock bolts, cable bolts, cement sprays [e.g. shotcrete], injection of a binding agent [PUR or similar]). • Installation of standing supports (e.g. timber props, timber cogs, sandbags and metal [hydraulic] props). • Scaling/dislodgement/removal of remaining loose rock.
Potential cracking of sandstone associated with art or grinding grooves	Strain reduction techniques.	• Installation of a stress relief slot or stress focus notch.

[1] Consequences could also include the loss of site amenity and cultural and archaeological value to the community

Any proposed mitigation measures will be developed and implemented (if considered appropriate) in consultation with BCD, Aboriginal stakeholders and the relevant landowner (e.g. WaterNSW).

If mitigation measures are implemented, follow-up inspections will be conducted to assess the effectiveness of mitigation measures and to determine the requirement for any additional measures. The specific nature of follow-up inspections/additional measures will be dependent on the specific nature of the mitigation measure(s) implemented and their success.

A summary of the development process and success of implemented mitigation measures will be reported in the Annual Review (Section 13).

10.2.2 Consideration of Mitigation Measures for Longwalls 305-307

Five Aboriginal heritage sites of high archaeological significance and/or particular cultural significance are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (Figure 4). Site FRC 185 is of high archaeological significance and particular cultural significance, Sites FRC 68 and FRC 191 are of high archaeological significance, and sites FRC 198 and FRC 316 are of particular cultural significance.

Metropolitan Coal acknowledges that all Aboriginal heritage sites are of cultural significance to the Aboriginal people who have a traditional connection to Country.

Previous monitoring, studies and experience from the Woronora Plateau and greater Southern Coalfield have identified several site characteristics/features as being most relevant when assessing the risk of environmental consequence to an Aboriginal heritage site from subsidence impacts. These characteristics include (Sefton, 2000 and 2004; Biosis Research 2007 and 2009; MSEC, 2007 and 2008):

- overhang volume – > 50 cubic metres increases the risk of negative consequence;
- presence of existing water seepage – damage to art from water is more likely if existing seepage is present;
- location in relation to a drainage line – sites located in valley bottoms can experience valley closure mechanisms and increased risk of cracking;
- location in relation to goaf – location of sites relative to the goaf influences the level of subsidence impacts experienced;
- overhang formation process – block-fall type overhangs are more likely to have roof or rear wall damage due to subsidence impacts;
- depth of cover – increased depth of cover reduces subsidence impacts and consequences; and
- presence of existing joints and bedding planes – subsidence movements may be dissipated through existing joints and bedding planes rather than the creation of new cracks.

Strata Control Limited was engaged by Metropolitan Coal to conduct a geotechnical risk assessment of the Aboriginal heritage sites of high archaeological significance and/or particular cultural significance in order to inform the potential implementation of mitigation measures to reduce the potential for substantial impacts and consequences to the Aboriginal heritage sites. The geotechnical risk assessment report by Strata Control Limited (2019) is provided in Appendix 3 and considers the above characteristics and the potential for damage at each site.

Based on the information provided in the geotechnical risk assessment and in consideration of the potential damage caused by the implementation of available techniques, mitigation measures are not proposed for Aboriginal heritage sites within the Longwalls 305-307 35º angle of draw and/or predicted 20 mm subsidence contour.

Future longwalls have the potential to result in additional subsidence movements at Aboriginal heritage sites associated with Longwalls 305-307 or the previous mining areas (i.e. Longwalls 23-27 and Longwalls 301-304). As part of the development of the future Extraction Plans, Metropolitan Coal will review the potential impacts and environmental consequences to Aboriginal heritage sites and re-consider the development and implementation of mitigation measures if required.

As described above, the development and implementation of any mitigation measures will be undertaken in consultation with BCD, the Aboriginal stakeholders and relevant landowners (e.g. WaterNSW).

10.3 SURFACE DISTURBANCE PROTOCOL

The surface disturbance protocol aims to avoid accidental damage to Aboriginal heritage sites located in close proximity to surface disturbance works. As described in Section 8, pre-clearance surveys will be undertaken (as needed) to identify the most appropriate location for required Project infrastructure.

This protocol will apply to surface disturbance works (e.g. exploration works, installation/operation/ maintenance of surface infrastructure, construction/maintenance of access tracks, monitoring and stream restoration) proposed to be located close to any known Aboriginal heritage site(s).

Surface disturbance works will be undertaken in consideration of the following:

1. Avoidance of impact to Aboriginal heritage sites will be the primary management measure, where practicable.
2. To avoid accidental damage to Aboriginal heritage sites located close to surface disturbance works, appropriate demarcation will be implemented (e.g. fencing, sign-posting or temporary flagging).
3. Where avoidance is not practicable, a comprehensive baseline record will be developed and consideration of salvage will be undertaken in consultation with Aboriginal stakeholders prior to disturbance.

10.4 HUMAN SKELETAL MATERIAL PROTOCOL

Burial sites can have high cultural significance to Aboriginal communities and culturally appropriate management of burial sites is a high priority for the Aboriginal community. "Aboriginal remains" are defined in the *National Parks and Wildlife Act, 1974* as:

> *… the body or the remains of the body of a deceased Aboriginal person, but does not include:*
>
> *(a) a body or the remains of a body buried in a cemetery in which non-Aboriginal persons are also buried, or*
>
> *(b) a body or the remains of a body dealt with or to be dealt with in accordance with a law of the State relating to medical treatment or the examination, for forensic or other purposes, of the bodies of deceased persons.*

No burial or potential burial sites have been identified in the Project underground mining area. Nor are they considered likely to be identified in the future due to the shallow soil profiles present on the Woronora Plateau. Notwithstanding, the following steps will be carried out in the event that suspected Aboriginal human skeletal material is encountered within the Project underground mining area:

- surface works in the immediate vicinity of the skeletal material will cease;
- the DPIE, BCD, NSW Police and Aboriginal stakeholders will be informed as soon as practicable; and
- the identified skeletal remains will not be disturbed until the NSW Police and BCD have inspected the remains and authorised their disturbance.

10.5 CULTURAL AWARENESS PROGRAM

Metropolitan Coal will include a cultural awareness program as part of inductions aimed at minimising the potential for accidental damage to Aboriginal heritage. The cultural awareness program will provide:

- an overview of the cultural heritage management program;
- an overview of the consultation protocol (Section 5);
- an overview of the pre-clearance surveys (Section 8) and surface disturbance protocol (Section 10.3);
- an overview of mitigation, management and remediation measures (Section 10);
- simple criteria and procedures for artefact and human bone recognition;
- actions to follow if human skeletal material is encountered (Section 10.4); and
- personnel to contact for more information or assistance.

11 CONTINGENCY PLAN

In the event the Aboriginal heritage sites subsidence impact performance measure detailed in Section 6 of this HMP is considered to have been exceeded, Metropolitan Coal will implement the following Contingency Plan:

- The exceedance will be reported to the Technical Services Manager and/or the Environment & Community Superintendent within 24 hours.
- The exceedance will be recorded in the Heritage Management Plan – Subsidence Impact Register (provided in Appendix 1) consistent with the monitoring program described in Section 9 of this HMP.
- Metropolitan Coal will report the exceedance to the DPIE, BCD and Aboriginal stakeholders as soon as practicable after Metropolitan Coal becomes aware of the exceedance.
- Metropolitan Coal will conduct an investigation to evaluate the potential contributing factors. The investigation will:
  - compare and critically analyse measured versus predicted subsidence parameters;
  - review measured subsidence parameters against the observed impact; and
  - review the subsidence monitoring program and update the program where appropriate, in consultation with BCD and the Aboriginal stakeholders.
- Metropolitan Coal will identify an appropriate course of action with respect to the identified impact(s), in consultation with specialists, relevant agencies and Aboriginal stakeholders, as necessary. For example:
  - proposed management and/or mitigation measures (Section 10); and
  - a program to review the effectiveness of the management and/or mitigation measures.
- Metropolitan Coal will submit the proposed course of action to the DPIE for approval.
- Metropolitan Coal will implement the approved course of action to the satisfaction of the DPIE.

In accordance with Condition 6, Schedule 6 of the Project Approval, Metropolitan Coal will provide a suitable offset to compensate for the impact to the satisfaction of the Secretary of DPIE if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Secretary of the DPIE determines that it is not reasonable or feasible to remediate the impact.

A Contingency Plan Check List has been developed and is provided in Appendix 2.

12 FUTURE EXTRACTION PLANS

In accordance with Condition 7, Schedule 3 of the Project Approval, Metropolitan Coal will collect baseline data for future Extraction Plans. The collection of baseline data will include:

- photographic records;
- detailed scaled plans including physical characteristics and features; and
- detailed information regarding the dimensions, composition and features.

As described in Section 7, detailed baseline recording has been completed for an additional 13 Aboriginal heritage sites overlying or proximal to Longwalls 310-312 not previously subject to baseline recording, namely sites FRC 61, FRC 164, FRC 189, FRC 314, FRC 315, FRC 317, NT 11, NT 33, NT 34, NT 35, NT 78, NT 79 and NEW 2. The baseline record for these sites will be provided in the next Extraction Plan.

Prior to the commencement of secondary extraction associated with the next Extraction Plan (i.e. Longwalls 308 on), baseline data will be obtained for Aboriginal heritage sites located within the relevant 35^{o} angle of draw and/or predicted 20 mm subsidence contour of the Extraction Plan longwall layout.

In addition to the baseline data collection, consideration of the environmental performance and management measures in accordance with the review(s) conducted as part of this HMP will inform the appropriate type and frequency of monitoring of the Aboriginal heritage sites relevant to the next Extraction Plan.

13 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

In accordance with Condition 3, Schedule 7 of the Project Approval, Metropolitan Coal will conduct an Annual Review of the environmental performance of the Project by the end of March each year.

The Annual Review will specifically address the environmental performance of the HMP and will:

- describe the works that were carried out in the past calendar year, and the works that are proposed to be carried out over the current calendar year;
- include a comprehensive review of the monitoring results and complaints records of the Project over the past year, including a comparison of these results against the:
  - relevant statutory requirements, limits or performance measures/criteria;
  - monitoring results of previous years; and
  - relevant predictions in the Project EA, Preferred Project Report and Extraction Plan;
- identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data over the life of the Project;

- identify any discrepancies between the predicted and actual impacts of the Project, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance of the Project.

As described in Section 2, this HMP will be reviewed within three months of the submission of an Annual Review, and revised where appropriate.

The Annual Review will be made publicly available on the Peabody website in accordance with Condition 10, Schedule 7 of the Project Approval.

14 INCIDENTS

An incident is defined as a set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in the Project Approval.

The reporting of incidents will be conducted in accordance with Condition 6, Schedule 7 of the Project Approval. Metropolitan Coal will notify the Secretary of the DPIE and any other relevant agencies of any incident associated with the Project as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Secretary and any relevant agencies with a detailed report on the incident.

15 COMPLAINTS

A protocol for the managing and reporting of complaints has been developed as a component of Metropolitan Coal's Environmental Management Strategy and is described below.

The Environment & Community Superintendent is responsible for maintaining a system for recording complaints.

Metropolitan Coal will maintain public signage advertising the telephone number on which environmental complaints can be made. The Environment & Community Superintendent is responsible for ensuring that the currency and effectiveness of the service is maintained. Notifications of complaints received are to be provided as quickly as practicable to the Environment & Community Superintendent.

Complaints and enquiries do not have to be received via the telephone line and may be received in any other form. Any complaint or enquiry relating to environmental management or performance is to be relayed to the Environment & Community Superintendent as soon as practicable. All employees are responsible for ensuring the prompt relaying of complaints. All complaints will be recorded in a complaints register.

For each complaint, the following information will be recorded in the complaints register:

- date and time of complaint;
- method by which the complaint was made;
- personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
- nature of the complaint;

- the action(s) taken by Metropolitan Coal in relation to the complaint, including any follow-up contact with the complainant; and
- if no action was taken by Metropolitan Coal, the reason why no action was taken.

The Environment & Community Superintendent is responsible for ensuring that all complaints are appropriately investigated, actioned and that information is fed back to the complainant, unless requested to the contrary.

In accordance with Condition 10, Schedule 7 of the Project Approval, the complaints register will be made publicly available on the Peabody website and updated on a monthly basis. A summary of complaints received and actions taken will be presented to the Community Consultative Committee as part of the operational performance review.

16 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS

A protocol for the managing and reporting of non-compliances with statutory requirements has been developed as a component of Metropolitan Coal's Environmental Management Strategy and is described below.

Compliance with all approvals, plans and procedures will be the responsibility of all personnel (staff and contractors) employed at or in association with the Metropolitan Coal Mine, and will be developed through promotion of Metropolitan Coal ownership under the direction of the General Manager.

The Technical Services Manager and/or Environment & Community Superintendent will undertake regular inspections, internal audits and initiate directions identifying any remediation/rectification work required, and areas of actual or potential non-compliance.

As described in Section 14, Metropolitan Coal will notify the Secretary of the DPIE and any other relevant agencies of any incident associated with Metropolitan Coal as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Secretary of the DPIE and any relevant agencies with a detailed report on the incident.

A review of Metropolitan Coal's compliance with all conditions of the Project Approval, mining leases and all other approvals and licences will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the Peabody website.

Additionally, in accordance with Condition 8, Schedule 7 of the Project Approval, an independent environmental audit was undertaken by the end of December 2011, and is undertaken a minimum of once every three years thereafter. A copy of the audit report will be submitted to the Secretary of the DPIE and made publicly available on the Peabody website. The independent audit will be undertaken by an appropriately qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary of the DPIE.

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APPENDIX 1

HERITAGE MANAGEMENT PLAN
SUBSIDENCE IMPACT REGISTER AND ASSESSMENT FORM

Heritage Management Plan - Subsidence Impact Register

Impact Register Number[1]	Aboriginal Heritage Site	Description of changes due to mine subsidence[2]	Cumulative number of sites with changes due to mine subsidence[3]	Has the site been affected by subsidence impacts? [4]	Cumulative number of sites affected by subsidence impacts [5]	Cumulative percentage of sites affected by subsidence impacts [6, 9]	Management or Contingency Measures Implemented? (Yes/No) [7]	Were Measures Effective? (Yes/No)[8]
1	FRC 281	Multiple cracks ranging from large, medium and small recorded in the shelter wall either running through or next to motifs (Longwalls 20-22 Round 1 Survey)	1	Yes	1	1/142 sites = <1%	No	N/A
2	FRC 284	Fractured corner or a buttress like formation on the rear wall (Longwalls 20-22 Round 1 Survey)	2	No	1	1/142 sites = <1%	No	N/A
3	FRC 284	Exfoliated section associated with the cracking has slumped (Longwalls 20-22 Round 2 Survey)	2	No	1	1/143 sites = <1%	No	N/A
4	FRC 15	Cracking of shelter wall (Longwalls 20-22 Round 2 Survey)	3	No	1	1/143 sites = <1%	No	N/A
5	FRC 15	Increased cracking of shelter wall (Longwalls 20-22 Round 3 Survey)	3	No	1	1/143 sites = <1%	No	N/A
6	MET 1	Cracking in roof of shelter and vertical cracking (Longwalls 20-22 Round 3 Survey)	4	No	1	1/143 sites = <1%	No	N/A
7	FRC 283	Opening of joints and silica forming over art panel (Longwalls 20-22 Round 3 Survey)	5	No	1	1/143 sites = <1%	No	N/A
8	FRC 176	Vertical cracking observed along the northern and southern ends of the shelter (Longwalls 23-27 Round 1 Survey)	6	No	1	1/143 sites = <1%	No	N/A
9	FRC 176	Widening (by 5 mm) of previously identified cracking located along the northern end of the shelter (Longwalls 23-27 Round 3 survey)	6	No	1	1/143 sites = <1%	No	N/A
10	FRC 275	Opening of the horizontal bedding plane and five vertical hair line cracks along the back wall of the shelter (Longwalls 23-27 Round 3 survey)	7	No	1	1/143 sites = <1%	No	N/A
11	FRC 301	A large surface crack was observed running east to west along the rock platform. Crack is approximately 3 m to the north of the grinding groove and is approximately 25m long and continues past the rock platform (Longwalls 23-27 Round 4 survey)	8	No	1	1/143 sites = <1%	No	N/A

Heritage Management Plan - Subsidence Impact Register

Impact Register Number[1]	Aboriginal Heritage Site	Description of changes due to mine subsidence[2]	Cumulative number of sites with changes due to mine subsidence[3]	Has the site been affected by subsidence impacts? [4]	Cumulative number of sites affected by subsidence impacts [5]	Cumulative percentage of sites affected by subsidence impacts [6, 9]	Management or Contingency Measures Implemented? (Yes/No) [7]	Were Measures Effective? (Yes/No)[8]
12	FRC 28	Vertical cracking of the rear shelter wall, opening of horizontal planes/joints and movement of the rock shelf that is part of the shelter floor (Longwalls 23-27 Round 5 survey)	9	No	1	1/143 sites = <1%	No	N/A
13	FRC 29	Horizontal crack along the back wall of the shelter and a joining vertical crack (Longwalls 23-27 Round 5 survey)	10	No	1	1/143 sites = <1%	No	N/A
14	FRC 60	Three vertical cracks along the back wall of the shelter (Longwalls 23-27 Round 5 survey)	11	No	1	1/143 sites = <1%	No	N/A
15	FRC 34	Horizontal cracking along the roof of the shelter and cracking over the most southern hand stencil on the back panel (Longwalls 23-27 Round 5 survey)	12	Yes	2	2/143 sites = <2%	No	N/A
16	FRC 76	Opening of the horizontal bedding plane along the back wall, not coincident with any art (Longwalls 301-303 Survey)	13	No	2	2/143 sites = <2%	No	N/A

Notes:

1: Fill out all details in the Subsidence Impact Register Assessment Form and record the register number here.

2: Description of changes observed due to mine subsidence. (e.g. cracking of shelter wall, opening of joints).

3: Cumulative number of sites with changes due to mine subsidence.

4: Has the site been affected by subsidence impacts? Sites are considered to be 'affected by subsidence impacts' if they exhibit one or more of the following consequences that cannot be attributed to natural weathering or deterioration: overhang collapse; cracking of sandstone that coincides with Aboriginal art or grinding grooves; and rock fall that damages Aboriginal art).

5: Cumulative number of sites affected by subsidence impacts.

6: If the cumulative percentage of sites affected by subsidence impacts equals or exceeds 10%, notify General Manager. If less than 10%, notify the Technical Services Manager or Environment & Community Superintendent of the cumulative percentage.

7: Indicate whether management or contingency measures were implemented (yes or no).

8: Indicate whether the implemented management or contingency measures were considered to be effective (yes or no).

9: The total number of sites within the mining area (as defined by Appendix 3 of the Project Approval) changed from 142 sites to 143 sites due to the identification of a new site within the mining area during Round 2 monitoring (MET 4).

Heritage Management Plan – Subsidence Impact Register
Assessment Form

Date:

Observer (Name and position):

Register Number (i.e. Number 1, 2, etc.):

Longwall Number and Chainage:

Location of Observed Change Due to Mine Subsidence:

Description of Change Due to Mine Subsidence:

Description of Potential Consequences:

Examples:

- cracking through art or grinding groove;
- burial of artefacts and deposit; and
- complete loss of site due to collapse.

Attach photographs

Description of Photographs:

Has the site been affected by subsidence impacts?

What is the cumulative percentage of sites affected by subsidence impacts?

Person Notified:	Manager – Safety & Environment	☐
	Technical Services Manager	☐
	General Manager	☐

Actions Required:	Management/Remediation Measures	☐
	Contingency Plan Initiated	☐
	Incident Notification	☐
	Safety Measures/Public Safety Management Plan Requirements	☐

Management/Remediation Measures Implemented:

Contingency Measures Implemented:

Effectiveness of Contingency or Management Measures:

APPENDIX 2

CONTINGENCY PLAN CHECK LIST

Contingency Plan Check List

Contingency Plan Component	Yes/No	Comment
Observation reported to the Technical Services Manager or the Manager – Safety & Environment (within 24 hours).		
Observation recorded in the Heritage Management Plan - Subsidence Impact Register.		
Reporting of any Aboriginal heritage performance measure exceedance to DPIE and BCD (as soon as practicable after Metropolitan Coal becomes aware of the exceedance).		
Conduct investigation to evaluate the potential contributing factors. Investigation to: • compare and critically analyse measured versus predicted subsidence parameters; • review measured subsidence parameters against the observed impact; and • review the Subsidence Monitoring Program and update the program where appropriate.		
Identification of appropriate course of action with respect to the identified impact(s) in consultation with specialists, relevant agencies and Aboriginal stakeholders, as necessary. For example: • proposed management/mitigation measures; • a program to review the effectiveness of the management/mitigation measures.		
Submission of the proposed course of action to the DPIE for approval.		
Implementation of the approved course of action to the satisfaction of the DPIE.		
Provision of a suitable offset - if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Secretary of the DPIE determines that it is not reasonable or feasible to remediate the impact.		

APPENDIX 3

ABORIGINAL HERITAGE SITES GEOTECHNICAL RISK ASSESSMENT FOR LONGWALLS 305 to 307

STRATA CONTROL
OPTIMISED OUTCOMES

METROPLITAN MINE ABORIGINAL HERITAGE SITES

Geotechnical Risk Assessment for Longwalls 305 to 307

for Peabody Energy

Geotechnical Risk Assessment of Aboriginal Heritage Sites for Longwalls 305 to 307

ATTENTION TO	Jon Degotardi Shane Kornek
CLIENT	Metropolitan Mine (Peabody Energy)
REVISION	Final
DATE	29 August 2019

AUTHOR(S)

Christian Mans
BSc Geology, PGDip Strata Control
Principal Geotechnical Engineer

INTRODUCTION

Strata Control Limited, at the request of the Metropolitan Mine, has undertaken a geotechnical risk assessment of Aboriginal heritage/cultural sites to inform the development of the Longwalls 305-307 Extraction Plan.

As part of Extraction Plan preparation, Metropolitan Coal considers the implementation of mitigation measures to reduce the potential for substantial impacts and consequences to Aboriginal heritage sites of high archaeological significance and/or particular cultural significance.

Strata Control Limited has, specifically, been engaged to:

1. Conduct a desktop review of the Aboriginal heritage sites, that includes consideration of:
    a. the location of the Aboriginal heritage sites in relation to the Longwalls 305 to 307 layout;
    b. the location of the Aboriginal heritage sites in relation to surface features (e.g. drainage lines);
    c. the location of the Aboriginal heritage sites in relation to geological features (e.g. faults); and
    d. subsidence predictions for the Aboriginal heritage sites.
2. Conduct site inspections or desk-top review of site cards/baseline recording information to assess the characteristics and stability of the sites, such as:
    a. overhang volume;
    b. presence of existing water seepage;
    c. overhang formation process;
    d. presence of existing joints and bedding planes; and
    e. any other characteristics that may influence the potential impacts of subsidence.
3. Risk assess the potential for subsidence impacts/consequences on the basis of the information obtained.
4. Consider mitigation measures that could potentially be employed to mitigate subsidence impacts.
5. Prepare a report summarising the results of the Geotechnical Risk Assessment undertaken above.

This report describes the results of the geotechnical risk assessment.

ABORIGINAL HERITAGE SITES OF HIGH ARCHAEOLOGICAL AND/OR PARTICULAR CULTURAL SIGNIFICANCE

Metropolitan Coal has advised that five sites of high archaeological and/or particular cultural significance are located within the Longwalls 305-307 35° angle of draw and/or predicted 20 mm subsidence contour (the Study Area), namely sites FRC 68, FRC 185, FRC 191, FRC 198, and FRC 316 (Figure 1). Metropolitan Coal has advised that site FRC 185 is of high archaeological and particular cultural significance, sites FRC 68 and FRC 191 are of particular cultural significance, and sites FRC 198 and FRC 316 are of high archaeological significance.

While located outside of the Study Area, Metropolitan Coal has also requested consideration be given to the characteristics of sites FRC 195, FRC 340, New 1, New 2 and NT35 which are located above or proximal to Longwalls 308 and 309 to inform future Extraction Plans. Metropolitan Coal has advised that site New 2 is of high archaeological and particular cultural significance, sites NT35, New 1 and FRC 340 are of particular cultural significance, and site FRC 195 is of high archaeological significance.

The area is densely vegetated with steep ridges throughout. A total of 5 sites were inspected in the field, two sites within the Study Area (sites FRC 68 and FRC 185) and three sites outside of the Study Area. The risk assessment is based on the site inspections or site cards/baseline recording of the Aboriginal heritage sites.

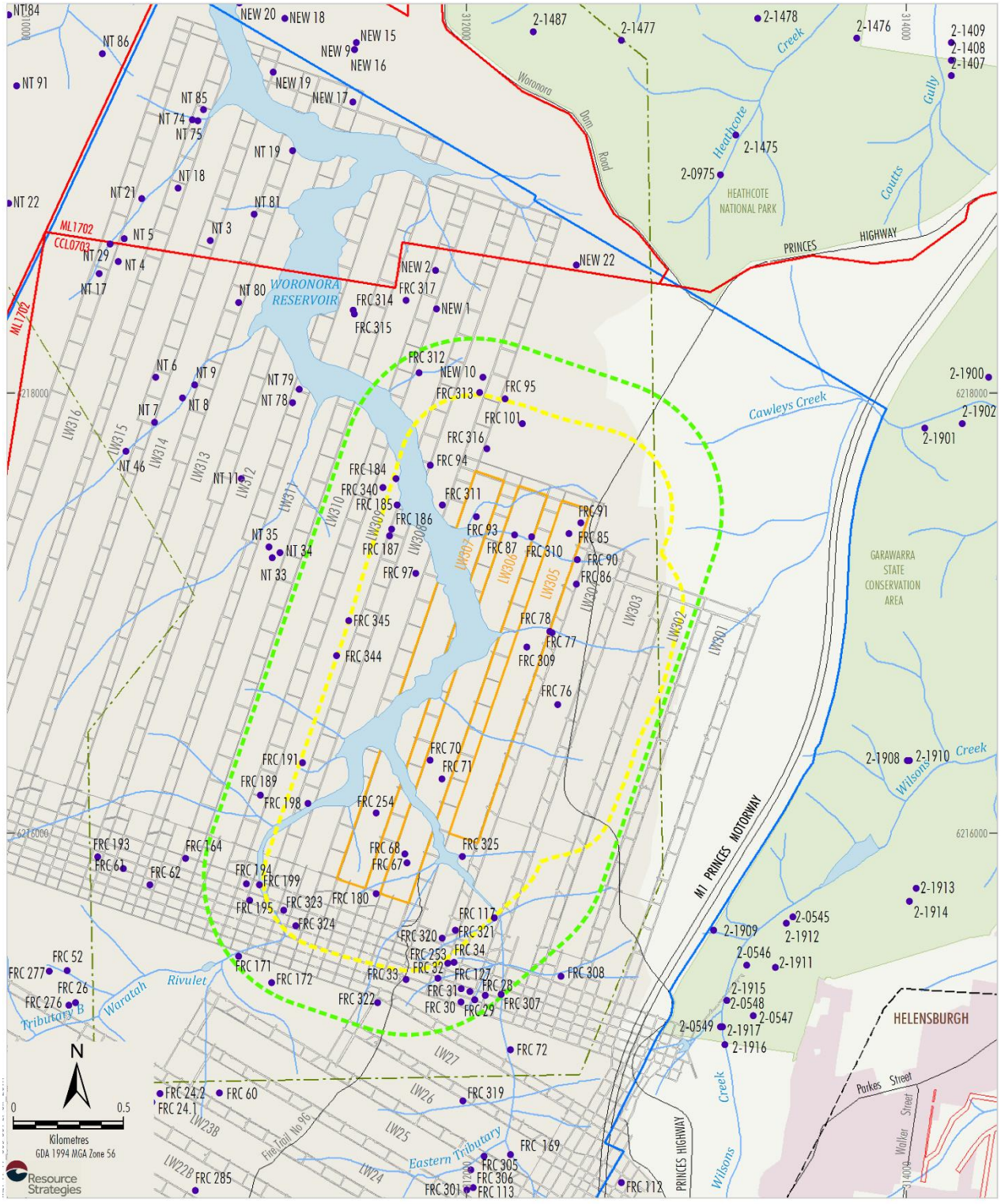

Figure 1 - Longwalls 305-307 Known Aboriginal Heritage Sites (Source: Metropolitan Coal).

SITE LOCATION AND CHARACTERISTICS

The Longwall 304 Heritage Management Plan (Metropolitan Coal, 2019), states:

> *Previous monitoring, studies and experience from the Woronora Plateau and greater Southern Coalfield have identified several site characteristics/features as being most relevant when assessing the risk of environmental consequence to an Aboriginal heritage site from subsidence impacts. These characteristics include (Sefton, 2000 and 2004; Biosis Research 2007 and 2009; MSEC, 2007 and 2008):*
>
> - *overhang volume – >50 cubic metres (m^3) increases the risk of negative consequence;*
> - *presence of existing water seepage – damage to art from water is more likely if existing seepage is present;*
> - *location in relation to a drainage line – sites located in valley bottoms can experience valley closure mechanisms and increased risk of cracking;*
> - *location in relation to goaf – location of sites relative to the goaf influences the level of subsidence impacts experienced;*
> - *overhang formation process – block-fall type overhangs are more likely to have roof or rear wall damage due to subsidence impacts;*
> - *depth of cover – increased depth of cover reduces subsidence impacts and consequences; and*
> - *presence of existing joints and bedding planes – subsidence movements may be dissipated through existing joints and bedding planes rather than the creation of new cracks.*

A photograph and summary description of each site is provided below. The baseline recording of sites (Niche Environment and Heritage, 2014; 2018) or AHIMS site cards are provided in ***Appendix 1***.

Table 1 details the parameters considered in the risk assessment, which include:

- Site description;
- Dimensions of the overhang;
- Facing aspect of the overhang;
- Water seepage;
- Nature of weathering;
- Location relative to topography;
- Presence and alignment of significant jointing;
- Axis trend relative to angle of longwall retreat;
- Position relative to goaf and pillars;
- Presence of nearby faulting;
- Predicted subsidence, tilt and strain.

RISK ASSESSMENT

A five fold classification from A to E has been used as a qualitative measure of impact risk, as follows (similar to that used by Sheppard, 2004):

Probability of Impact

A Most probable

B Possible

C Unlikely

D Highly Unlikely

E Practically impossible

The results of the risk assessment of the probability of impact from Longwalls 305-307 are provided in Table 1.

Further risk assessment of sites of high archaeological significance and/or of particular cultural significance should be conducted for the next Extraction Plan (i.e. for extraction past Longwall 307) and consideration given to the implementation of mitigation measures.

The probability of impacts at Site FRC 68, which is located directly above Longwall 306, is considered possible (category B). For the remaining sites within the Study Area, the probability of impacts are considered unlikely (category C) for sites FRC 185, FRC 198 and FRC 316 and highly unlikely (category D) for site FRC 191 (Table 1).

Outside of the Study Area, the probability of impact is considered highly unlikely (category D) for sites FRC 195 and FRC 340, and practically impossible (category E) for sites New 1, New 2 and NT35 (Table 1).

CONSIDERATION OF MITIGATION MEASURES

In accordance with the Metropolitan Coal Heritage Management Plan, potential mitigation measures have been considered with regard to the specific circumstances of individual sites, including accessibility, size and spatial extent, nature of predicted subsidence impacts and consequences, and level of change or disturbance (to the site or its setting) associated with implementing the measure(s).

Of the 10 sites of high archaeological significance and/or of particular cultural significance, the risk assessment considers the probability of impact to nine sites to be either unlikely, highly unlikely, or practically impossible. The implementation of mitigation measures prior to the commencement of Longwalls 305-307 is not considered to be warranted.

The risk assessment considers the probability of impact to site FRC 68 to be possible. FRC 68 is a small shelter consisting of bedded sandstone and formed by scaling (weathering). The baseline recording of site FRC 68 by Niche Environment and Heritage is provided in Appendix 1.

The Metropolitan Coal Heritage Management Plan identifies seepage control techniques, stabilisation techniques and strain reduction techniques as potential mitigation measures.

No seepage was observed at the time of the site inspection for this risk assessment and implementation of seepage control techniques is not proposed. It is considered to be appropriate to monitor the extent of seepage during the mining of Longwalls 305-307 and consult with Aboriginal stakeholders regarding any proposed mitigation measures.

Consistent with the Metropolitan Coal Heritage Management Plan, it is acknowledged that while mitigation measures may reduce the risk of consequence to the site, they also have the potential to cause substantial damage to the site and its settings (including impacts to cultural setting). Given the access limitations to FRC 68, the likely damage to the site and its settings and the environmental impacts (e.g. vegetation clearing) that would be associated with implementation of mitigation works, no stabilisation techniques or strain reduction techniques are proposed to be implemented. While it is possible the site may be impacted, it is also possible that the site may not be impacted by the extraction of Longwalls 305-307.

Table 1 - Risk Assessment Table

SITE NAME	DESCRIPTION	EASTING	NORTHING	CHARACTERISTICS									LOCATION					SUBSIDENCE PREDICTIONS				PROBABILITY OF DAMAGE FROM LW305-307
				OVERHANG				ASPECT	WATER SEEPAGE	WEATHERING TYPE	LONG AXIS TREND	SIGNIFICANT JOINT TREND	TOPOGRAPHY LOCATION	LW	ANGLE TO LW RETREAT	ABOVE LW/ PILLAR	NEAR FAULT	MAXIMUM PREDICTED SUBSIDENCE AFTER LW307 (MSEC 1057)	MAXIMUM PREDICTED TOTAL TILT AFTER LW307 (MSEC 1057)	MAXIMUM PREDICTED TOTAL TENSILE STRAIN AFTER LW307 (MSEC 1057)	MAXIMUM PREDICTED TOAL COMPRESSIVE STRAIN AFTER LW307 (MSEC 1057)	
				LENGTH	WIDTH	HEIGHT	OVERHANG >50m^3															
SITES WITHIN THE LONGWALLS 305-307 STUDY AREA																						
FRC 68	Sandstone overhang with art, artefacts and deposit	311720	6215905	9	2.4	2	No	E	No	Cavernous	N-S	90	Upper Valley Slope	306	Perpendicular	LW	No	275	1.5	<0.5	0.5	B
FRC 185	Sandstone overhang with art, artefacts and deposit	311685	6217490	16	5	3	Yes	E	No	Cavernous	N-S	-	Lower Valley Slope	309	Perpendicular	PILLAR	Yes	<20	<0.5	<0.5	<0.5	C
FRC 191	Sandstone overhang with art only	311298	6216248	21.5	1.8	2	Yes	NNW	No	Block Fall	NEE-SWW	70	Upper Valley Slope	309	Parralel	LW	No	<20	<0.5	<0.5	<0.5	D
FRC 198	Sandstone overhang with art only	311280	6216135	78	6	1.4	Yes	SE	No	Block Fall	NE-SW	-	Lower Valley Slope	308	Angled	PILLAR	No	40	<0.5	<0.5	<0.5	C
FRC 316	Sandstone overhang with artefacts and deposit	312093	6217745	11	3.9	2.2	Yes	W	No	Cavernous	N-S	-	Upper Valley Slope	307	Perpendicular	PILLAR	Yes	<20	<0.5	<0.5	<0.5	C
SITES OUTSIDE THE LONGWALLS 305-307 STUDY AREA																						
FRC 195	Sandstone overhang with art only	311015	6215695	14	4	2	Yes	NE	Yes	Block Fall	NW-SE	-	Upper Valley Slope	309	Angled	PILLAR (MAINS)	No	NA	NA	NA	NA	D
FRC 340	Sandstone overhang with art only	311619	6217570	15	2.3	2.3	Yes	NNE	Yes	Block Fall	NNW-SSE	-	Lower Valley Slope	309	Angled	LW	Yes	NA	NA	NA	NA	D
NEW 1	Open site with grinding grooves only	311864	6218385	NA	NA	NA	NA	-	No	Surface Erosion	-	-	Upper Valley Basin	309	-	LW	No	NA	NA	NA	NA	E
NEW 2	Sandstone overhang with art, artefacts, deposit and grinding grooves	311860	6218555	40	7.2	5.5	Yes	NE	No	Cavernous	NW-SE	180	Upper Valley Slope	309	Parralel	PILLAR	No	NA	NA	NA	NA	E
NT35	Sandstone overhang with art, artefacts, deposit and grinding grooves	311103	6217300	25	5	1.6	Yes	NW	No	Cavernous	NE-SW	-	Upper Valley Slope	311	Angled	LW	No	NA	NA	NA	NA	E

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SITE	INFORMATION	
FRC 68	 Source: Niche Environment and Heritage (2014) Small shelter consisting of bedded sandstone and formed by scaling (weathering). Sharp backwall and front edge undulates. A prominent joint was observed perpendicular to the trend and parallel to the longwall approach.	
FRC 185	 Source: Niche Environment and Heritage (2018) Small shelter consisting of bedded sandstone with cavernous weathering. Undulating backwall and front edge. Block fall (in antiquity) of overhang, edges well weathered.	

FRC 191	 Source: Niche Environment and Heritage (2018) Small shelter consisting of bedded sandstone with cavernous weathering. Undulating backwall and front edge appear joint controlled. Repeated block fall (in antiquity) of overhang, edges moderately to well weathered.	
FRC 195	 Source: Niche Environment and Heritage (2014) Large wet shelter consisting of bedded sandstone with cavernous weathering. Undulating backwall and front edge. Scaled material on floor.	

FRC 198	 Source: Niche Environment and Heritage (2018) Large shelter consisting of bedded sandstone with cavernous weathering. Undulating backwall and front edge. Scaled material on floor.	
FRC 316	 Source: Niche Environment and Heritage (2018) Small shelter consisting of bedded sandstone with cavernous weathering. Undulating backwall and front edge. Block fall (in antiquity) of overhang, edges well weathered.	

FRC 340	 Source: Niche Environment and Heritage (2018) Moderately sized wet shelter consisting of bedded sandstone with cavernous weathering. Sharp backwall and undulating front edge. Block fall (in antiquity) present. Some evidence of scaling along backwall.	
NEW 1	 Source: Niche Environment and Heritage (2018) Open site on sandstone pavement, material is continuous with no evident jointing.	

NEW 2	 Photograph taken by Strata Control on 04/07/2019 Large shelter consisting of bedded sandstone with cavernous weathering. Sharp backwall and weathered front edge and minor joint bound. Some block fall in antiquity.	
NT35	 Source: Niche Environment and Heritage (2019) Moderately sized shelter consisting of bedded sandstone with cavernous weathering. Limited information available.	

BASELINE RECORDING OR ARCHAEOLOGY SITE CARDS

2.10 Flat Rock Creek 68 (FRC 68, AHIMS# 52-2-0186 and #52-2-0326)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and block fall in antiquity. The original AHIMS site card describes one bipolar quartz core (18 x 13 x 10 mm), one quartz bipolar flake (12 x 9 x 5 mm), one quartz manuport (48 x 43 51mm), one bipolar silcrete flake (12 x 84 mm) and one grey chert bipolar core (12 x 18 x 3 mm), located within the dripline of the shelter, however these artefacts could not be relocated during this baseline recording. There was also a single anadara shell identified in the original site card, however this was also not relocated during this baseline recording.

The art observed during the baseline recording is in the same condition as previously described in the AHIMS site card (i.e. generally poor condition). The white stencils however are difficult to see in some light angles and not all of the documented motifs are still visible.

2.10.20 Baseline recording data

Table 20: Baseline recording data for FRC 68.

Overview					
Site type	Shelter with Artefacts and Deposit	**Corrected MGAE**	311720	**Corrected MGAN**	6215905
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	**Date**	17 June 2016		
Site Details					
Width	9m	**Depth**	2.4m	**Height**	3.6m
Orientation	Northeast	**Floor area**	21.6m^2	**Floor condition**	Some vegetation growth deposit in good condition.
Location in Landscape	Four ridgelines up from the Eastern Tributary. Easily accessible from Fire Road 9G. Enter from fire road 9G at 311782E, 6215786N.				
Shelter exterior/formation	Block fall in antiquity and cavernous weathering.				
Shelter interior	Some vegetation growth along the back wall. Fluorescent green lichen at eastern end of shelter. Black mould along the shelter.				
Distance to water	150m west of Eastern Tributary	**Landform**	Ridgeline		
Setting	Continuous overhang.				
Archaeological Deposit					
Deposit	Yes	**Describe**	Deposit comprises of brown loamy sand approximately 25 cm deep. Artefacts listed on the site card could not be relocated. *Leptosperma* sp. growing in floor deposit.		
Visible artefacts?	No[1]	**Where?**	n/a	**How many?**	n/a
Art					
Art surfaces	Three art panels: Panel (1): Charcoal infill bird Panel (2): Charcoal infill kangaroo Panel (3): Multiple hand and foot stencils are present along the back wall. Axe stencil is also present.				
Art Condition	The observed art is in the same condition as originally recorded, based on the description on the site card. Some of the art surfaces have case hardened and not all of the originally recorded motifs were visible at the time of baseline recording.				

Art Overview	The original AHIMS recording included 12 white clay hand stencils (2 of which are children's), one axe stencil, one adult foot stencil, one charcoal human figure and one charcoal animal head. As per Sefton's secondary recording only 7 of the white hand stencils remain with the other motifs.				
Damage/threats					
Waterwash	No	**Graffiti**	Yes – Panel 3 Letters TT scratched over the art	**Macrovegetals**	Yes – ferns and fungus
Animals	No	**Salt/granular loss**	Yes – over all panels	**Fissuring**	No
Insects	Yes – spider webs	**Spalling/exfoliation**	Yes – along roof	**Other**	No
Fire	Yes – Near panels 1 and 2.	**Block fall**	No		

1. The original AHIMS site card indentified three quartz artefacts, one silcrete artefact and one chert artefact.

Table 21: Baseline recording data for art surfaces present within FRC 68.

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Charcoal infill	Kangaroo	Charcoal	Black/grey	25cm x 12cm
Panel 2					
1	Charcoal outline	Bird	Charcoal	Black	26cm
Panel 3					
1	Charcoal infill	Anthropomorphic?	Charcoal	Black	25cm x 15cm
2	Stencil	Child's hand	White ochre	White	10cm x 8cm
3	Stencil	Adolescent's hand	White ochre	White	12cm x 12cm
4	Lines	Lines	Charcoal	n/a	20cm x 10cm
5	Lines	Lines	Charcoal	n/a	15cm x 8cm
6	Stencil	Adult left hand	White ochre	White	15cm x 15cm
7	Stencil	Adolescent's hand	White ochre	White	20cm x 30cm
8	Charcoal infill	Kangaroo head facing north	Charcoal	Black	15cm x 10cm
9	Stencil	Axe head and handle	White ochre	White	Not clear[1]
10[1]	Stencil	Foot	White ochre	White	No longer visible
11[1]	Stencil	Foot	White ochre	White	No longer visible

1. Motifs 10 and 11 (Panel 3) were not photographed as they were not easily visible due to fading and lighting.

2.10.21 Baseline recording images – site overview

Plate 76: External context of site FRC 68. View north.

Plate 77: External context of site FRC 68. View south.

2.10.22 Baseline recording plans – site overview

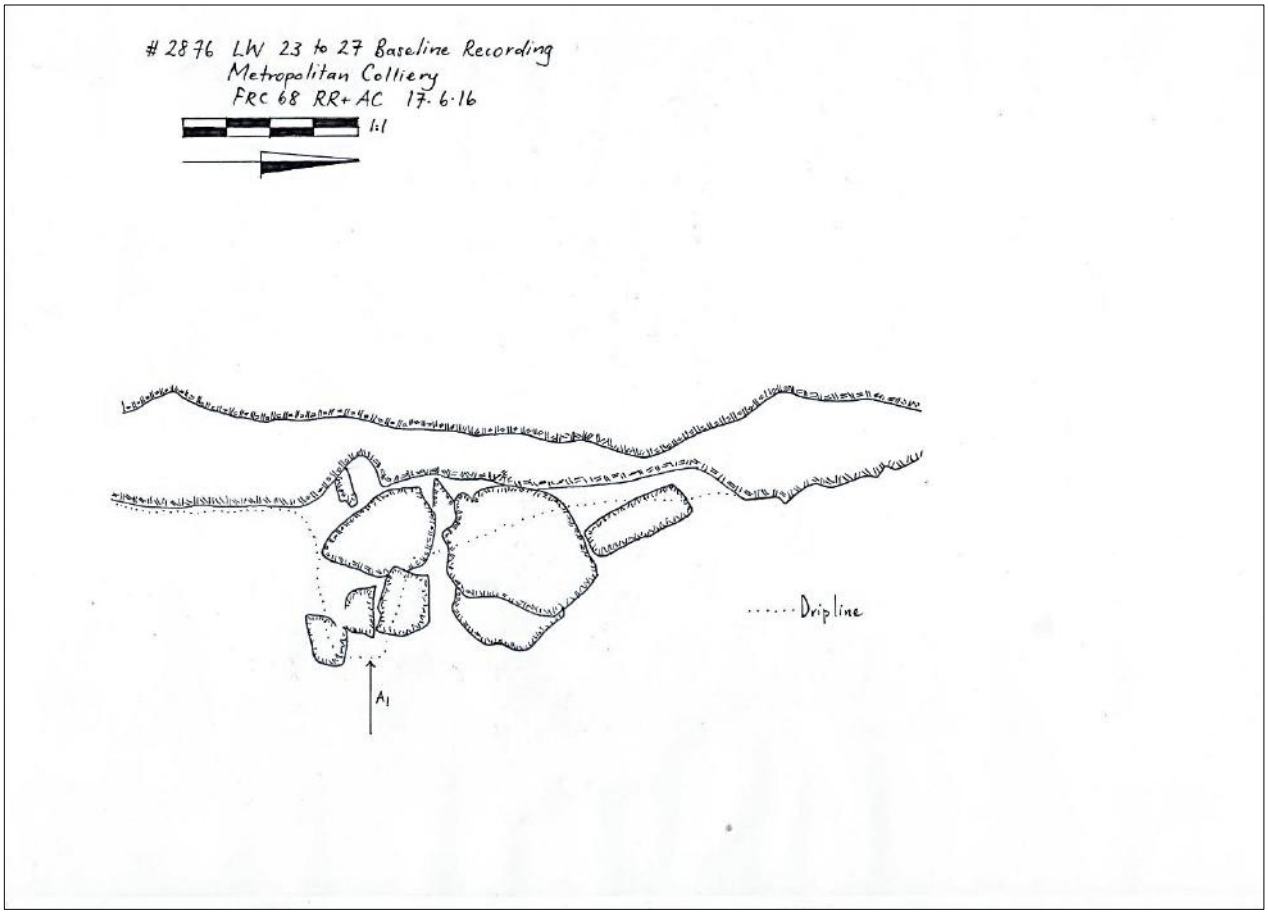


Figure 16: Plan of FRC 68.

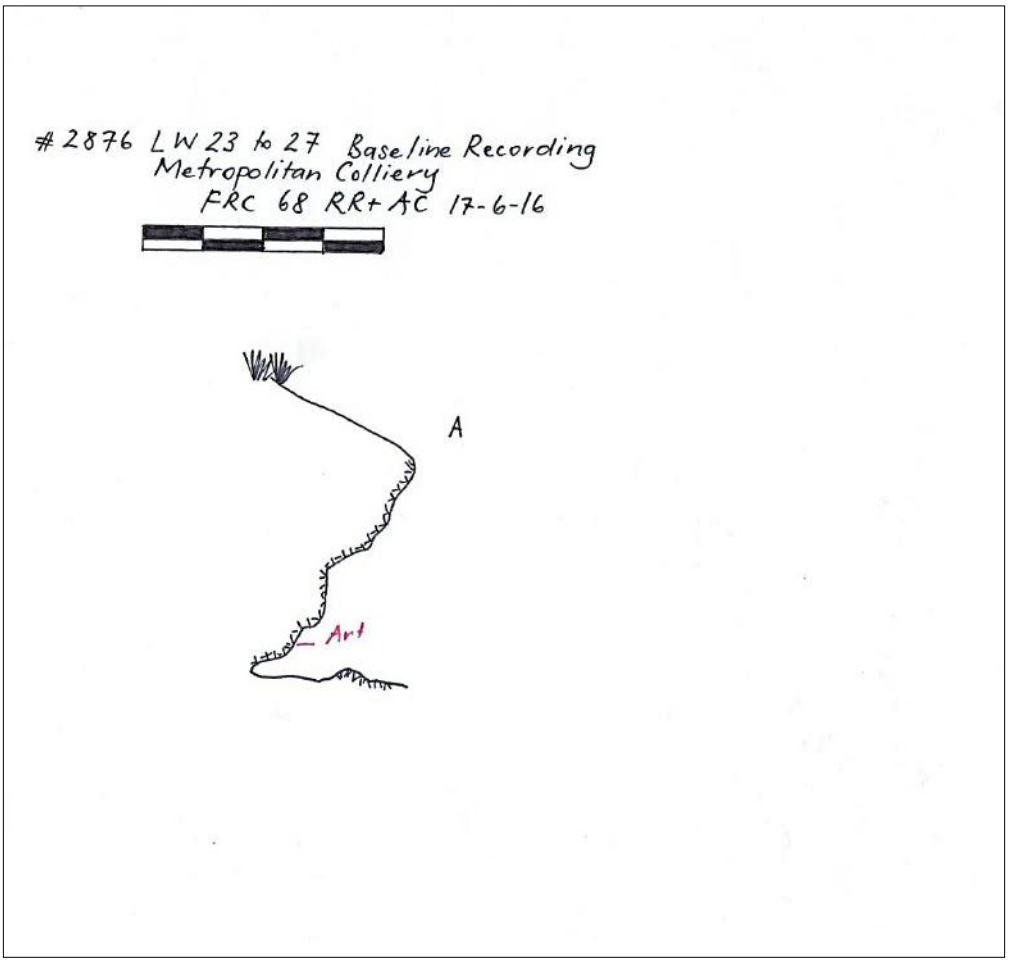


Figure 17: A1 section drawing of FRC 68.

2.10.23 Baseline recording images – detailed panel recording

Panel 1

Plate 78: Context of Panel 1. View south.

Plate 79: Panel 1, motif 1: charcoal bird. View south.

Plate 80: Scale interpretive drawing of Panel 1, motif 1: charcoal bird. View south.

Panel 2

Plate 81: Context of Panel 2. View south.

Plate 82: Detail image of Panel 2. View south.

Panel 3

Plate 83: Context image of Panel 3. View north.

Plate 84: Interpretive drawing of Panel 3, motif 2: white ochre hand stencil of a young child. View west.

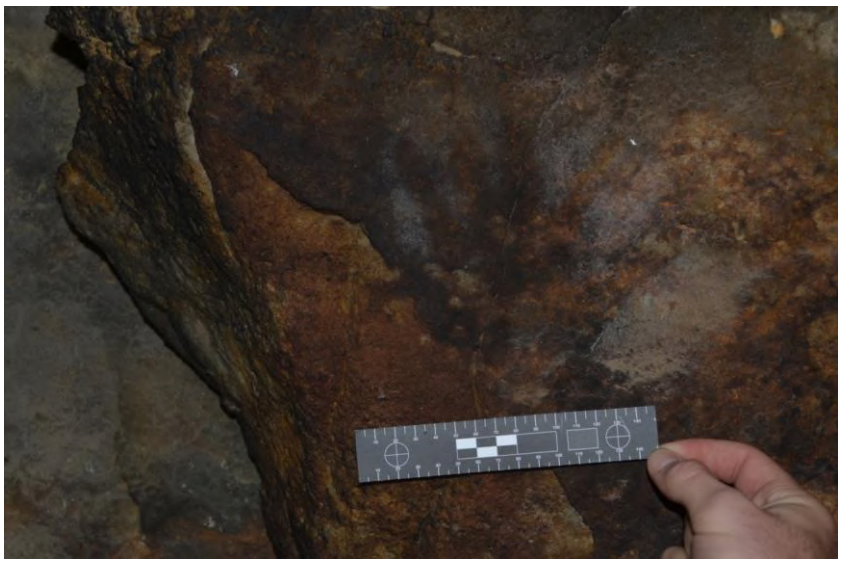


Plate 85: Panel 3, motif 3: white ochre hand stencil of an adolescent. View west.

Plate 86: Scale interpretive drawing of Panel 3, motif 3: white ochre hand stencil of an adolescent. View west.

Plate 87: Panel 3, motif 8: Charcoal infill. View west.

Plate 88: Panel 3, motif 9: Axe stencil. View west.

2.7 Flat Rock Creek 185 (FRC 185, AHIMS# 52-2-0223/ 52-2-0307)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and blockfall in antiquity. The art located at this shelter is in poor condition and has been affected by heavy exfoliation and water wash since it was recorded by Sefton (during the initial site recording). The artefacts recorded on the AHIMS site card were not relocated during this assessment. They were listed as:

- 1 flake broken into two (33x18x10mm)
- 1 complete flake (54x39x18mm)
- 1 broken pebble (104x84x32mm).

2.7.1 FRC 185 baseline recording data

Table 13: Baseline recording data for FRC 185.

Overview					
Site type	Shelter with Art and Deposit	Corrected MGAE	0311685	Corrected MGAN	6217490
Previous Recording	Site Card- Caryll Sefton Illawarra Prehistory Group	Date	Not specified		
Site Details					
Width	21m	Depth	5m	Height	3m
Orientation	NE	Floor area	24m²	Floor condition	Good
Location in Landscape	First ridgeline above stored water in Waratah Rivulet section of Woronora Dam, opposite Garrawarra under a large cliffline.				
Shelter exterior/formation	Cavernous weathering and block fall				
Shelter interion	Water wash, chemical weathering, exfoliation.				
Distance to water	<100m	Landform	Lower ridgeline		
Setting	Continuous overhang				
Archaeological Deposit					
Deposit	Yes	**Describe**	Yellow loamy sand of 10cm depth		
Visible artefacts?	No- Artefacts on site card, not relocated during assessment	Where?	N/A	How many?	
Art					
Art Surfaces	Poor, heavy exfoliation, water wash				
Art Condition	Poor				
Art Overview	Two panels: 5 human figures, 12 macropods, 1 kangaroo track motif, 21 indeterminate, 1 eel, 2 fish, 1 possum.				
Damage/threats					
Water wash	Yes	**Graffiti**	No	**Macro vegetals**	Yes
Animals	Yes - wallaby	**Salt/granular loss**	Yes	**Fissuring**	No
Insects	Yes - spider	**Spalling/exfoliation**	Yes	**Other**	
Fire	No	**Block fall**	Yes		

Table 14: Baseline recording data for art surfaces present within FRC 185.

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Macropod	Partial/line	Charcoal	Black	123 x 150cm
2	Indeterminate	Line	Charcoal	Black	7 x 0.5cm
3	Indeterminate	2x lines	Charcoal	Black	8 x 1cm/L9x 1cm
4	Indeterminate	Infill	Charcoal	Black	35 x 14cm
5	2x Indeterminate	Infill x2	Charcoal	Black	54 x 2cm/20 x 2cm
6	Indeterminate	Infill line	Charcoal	Black	9 x 26cm
7	Indeterminate	Line	Charcoal	Black	30 x 1cm
8	Kangaroo Tracks	Infill	Charcoal	Black	25 x 20cm
9	Indeterminate	Infill	Charcoal	Black	20 x 7cm
10	Fish	Outline/infill	Charcoal	Black	20 x 10cm
11	Indeterminate/Claw	Line/infill	Charcoal	Black	13 x 4cm
12	Indeterminate	Line	Charcoal	Black	20 x 10cm
13	Eel	Line/infill	Charcoal	Black	40 x 13cm
14	Human top half upside down	Line/infill	Charcoal	Black	30x 38cm
15	Macropod front legs	Line/infill	Charcoal	Black	44x 19cm
16	Half fish	Line/infill	Charcoal	Black	19 x 7cm
17	Indeterminate	Line	Charcoal	Black	60 x 33cm
18	Macropod	Infill	Ochre	Orange	105 x 196cm
19	Macropod/partial top	Line	Ochre	Orange	20 x 33cm
20	Bottom half macropod	Line/infill	Charcoal	Black	120 x 25cm
21	Bottom half macropod	Line/infill	Charcoal	Black	79 x 26cm
22	Frontal male hands raised	Line/hatching	Charcoal	Black	80 x 21cm
23	Kangaroo print	Line/infill	Charcoal	Black	10 x 5cm
24	Eel	Red ochre outline, charcoal infill	Ochre/charcoal	Orange/Black	150 x 30cm
25	Indeterminate	Infill	Charcoal	Black	35 x 12cm
26	Indeterminate	Infill	Charcoal	Black	10 x 10cm
27	Indeterminate	Line	Charcoal	Black	30 x 15cm
28	Frontal female	Line	Charcoal	Black	42 x 16cm
29	Indeterminate	Lines	Charcoal	Black	22 x 13cm
30	Possum	Line/infill	Charcoal	Black	63 x 38cm
31	Macropod?	Line/infill	Charcoal	Black	10 x 60cm
32	Macropod?	Line/infill	Charcoal	Black	55 x 25cm
33	Macropod?	Line/infill	Charcoal	Black	59 x 23cm
34	Indeterminate	Line/infill	Charcoal	Black/red	29 x 67cm

Motif No.	Type	Form	Media	Colour	Measurement
35	Macropod	Line/infill	Charcoal	Black	49 x 72cm
36	Bottom half macropod	Line/infill	Charcoal	Black	26 x 43cm
37	Bottom half macropod	Line/infill	Charcoal	Black	35 x 54cm
Panel 2					
1	Indeterminate	Lines	Charcoal	Black	17 x 24cm
2	Indeterminate	Lines	Charcoal	Black	10 x 5cm
3	Frontal male, head remaining	Lines	Charcoal	Black	20 x 15cm
4	Frontal male, head remaining	Lines	Charcoal	Black	15 x 10cm
5	Indeterminate humans?	Lines	Charcoal	Black	24 x 17cm
6	Indeterminate humans?	Lines	Charcoal	Black	15 x 17cm
7	Indeterminate	Lines	Charcoal	Black	6 x 4cm

2.7.2 Baseline recording images – site overview

Plate 24: Overview of shelter at FRC 185. View looking North.

2.7.3 Baseline recording plans – site overview

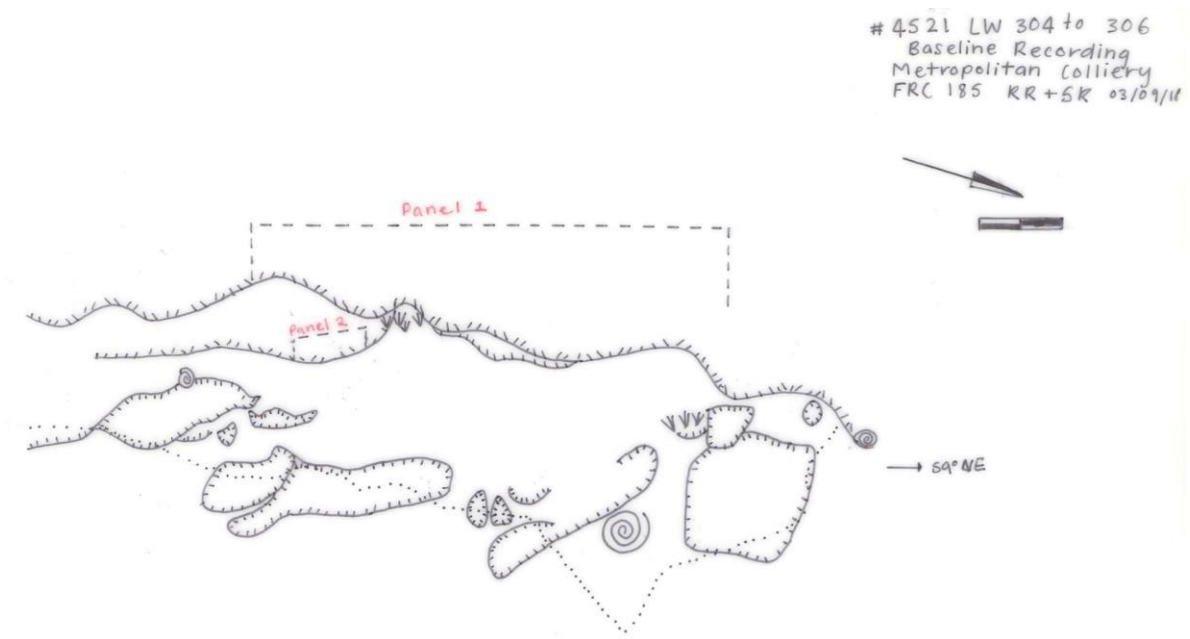


Figure 11: Plan of FRC 185.

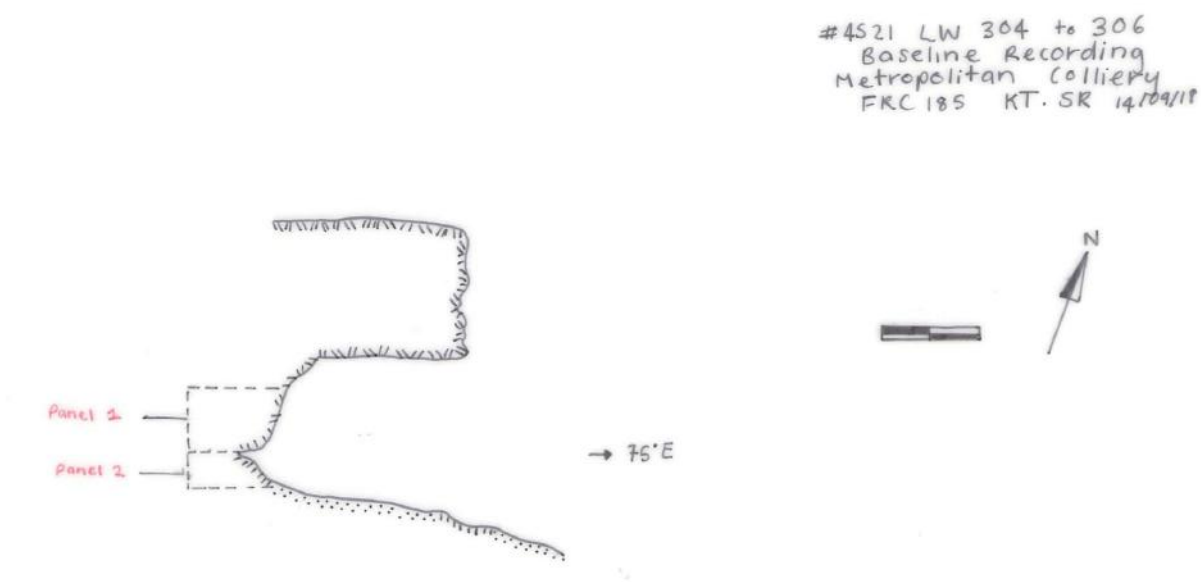


Figure 12: A1 Section of FRC 185.

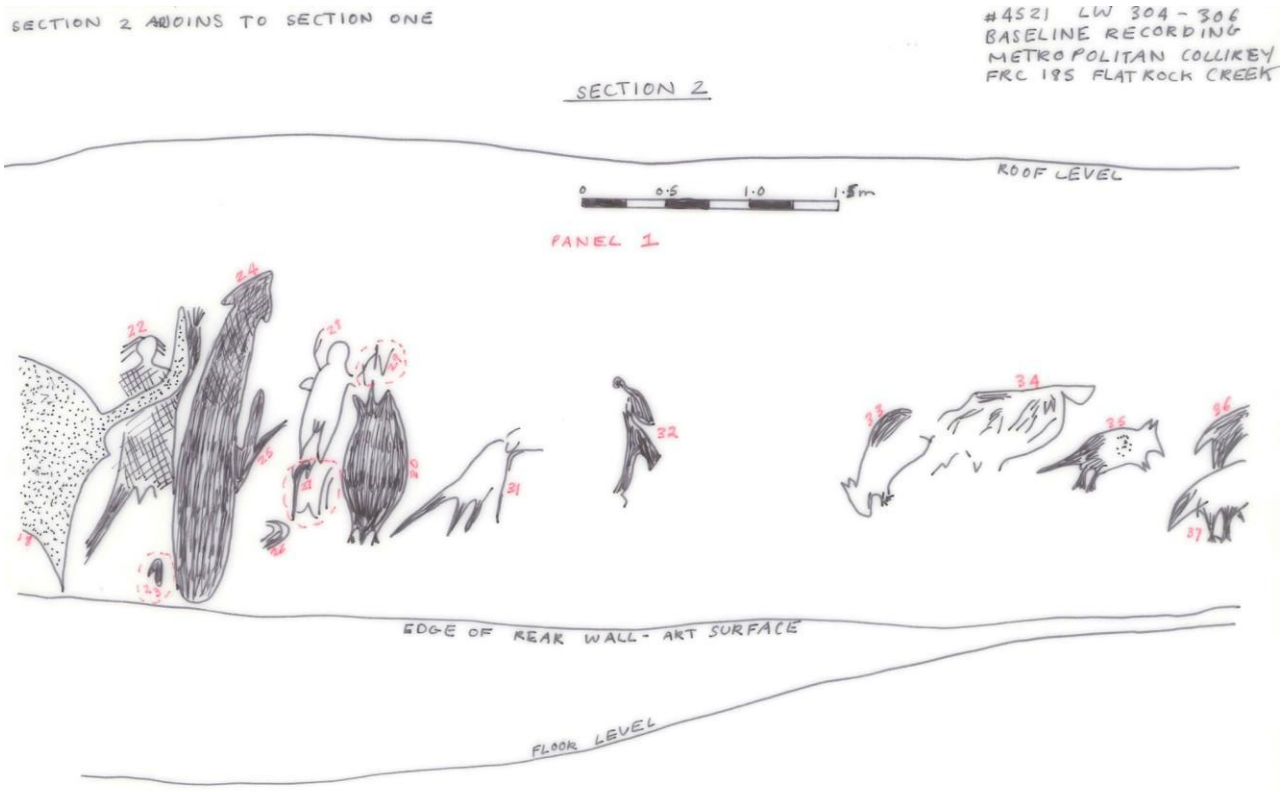


Figure 13: Artform drawing of FRC 185, Panel 1. Reproduced from the AHIMS site card.

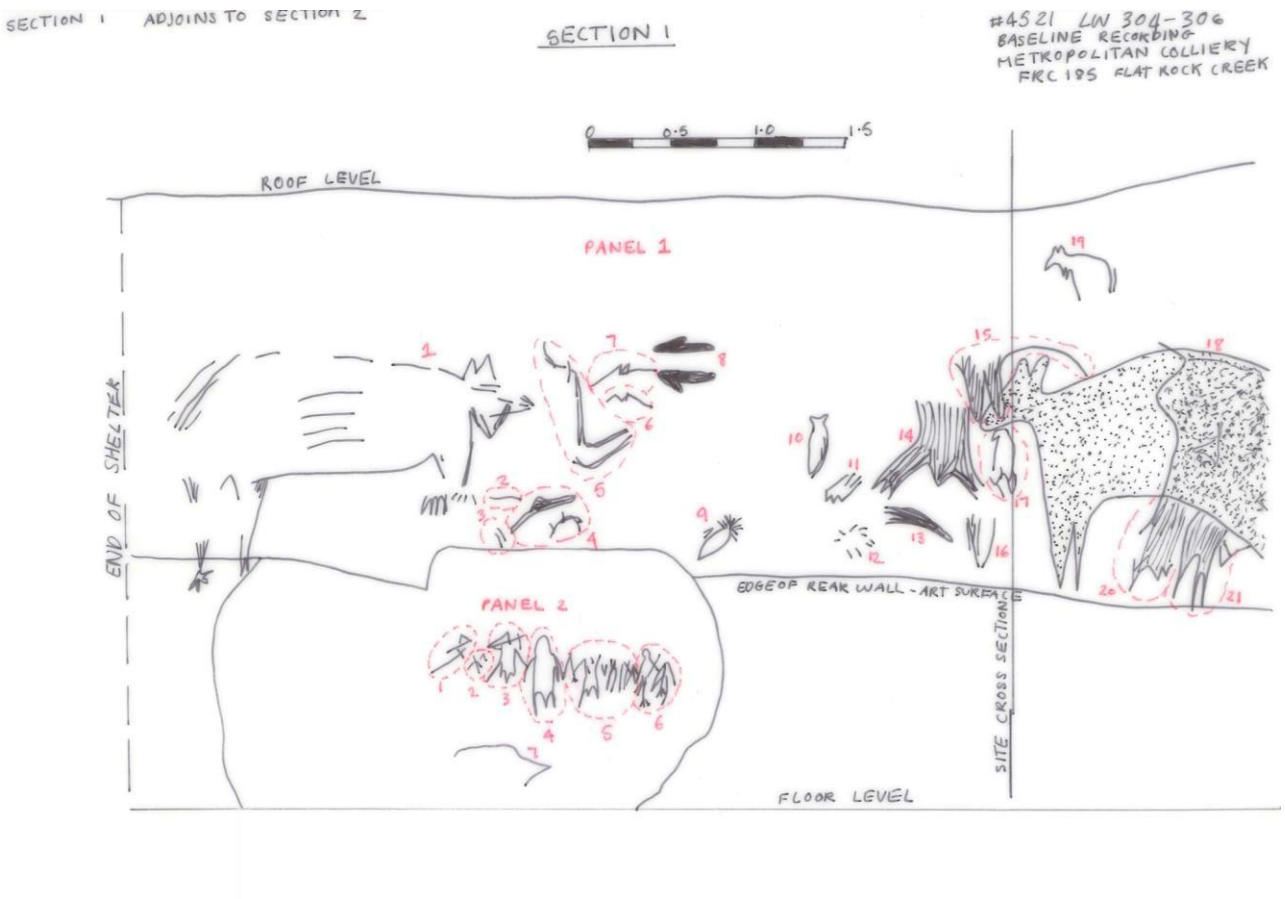


Figure 14: Artform drawing of FRC 185, Panel 1, 2. Reproduced from the AHIMS site card

2.7.4 Baseline recording images – detailed recording

Panel 1

Plate 25: Overview of Panel 1 at FRC 185. Panel 1, Motif 1.

Plate 26: Overview of Panel 1 at FRC 185. Panel 1; Motifs 2, 3, 4.

Plate 27: Overview of Panel 1 at FRC 185. Panel; Motifs 5, 6, 7, 8.

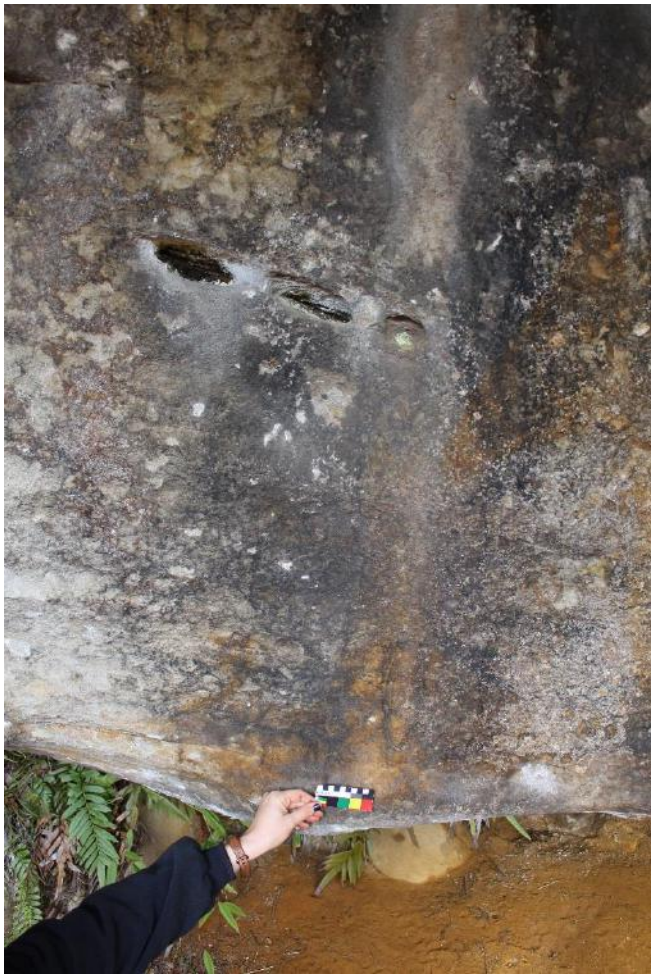


Plate 28: Overview of Panel 1 at FRC 185. Panel 1; Motifs 10, 11, 12, 13, 14, 16.

Plate 29: Overview of Panel 1 at FRC 185. Panel 1; Motifs 18, 15, 20, 21.

Plate 30: Overview of Panel 1 at FRC 185. Panel 1; Motifs 10, 24, 23, 27, 25, 26.

Plate 31: Overview of Panel 1 at FRC 185. Panel 1; Motifs 33, 34, 35, 36, 37.

Panel 2

Plate 32: Overview of Panel 2 at FRC 185. Panel 2; Motif 1 to 4.

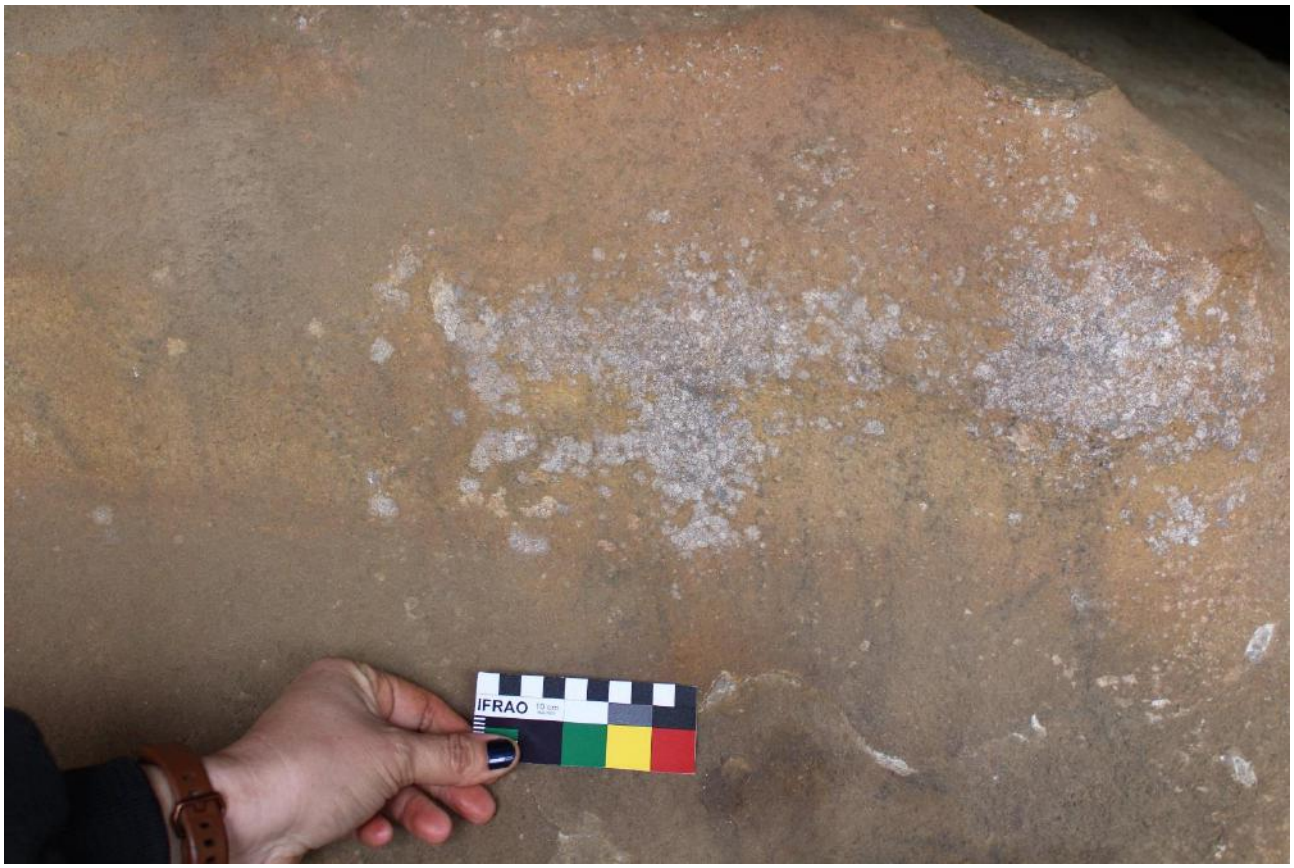


Plate 33: Overview of Panel 2 at FRC 185. Panel 5 to 6.

2.10 Flat Rock Creek 191 (FRC 191, AHIMS# 52-2-0183)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and heavy blockfall in antiquity. The art recorded by Sefton were relocated during this baseline recording, however the condition was very poor. The art has been impacted by granular loss, and exfoliation of the rock surface, and there is evidence of block fall from the roof and outside the shelter. Algae growth is also present.

2.10.1 FRC 191 baseline recording data

Table 17: Baseline recording data for FRC 191.

Overview					
Site type	Shelter with Art and Deposit	Corrected MGAE	0311298	Corrected MGAN	6216248
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	Date	Not specified		
Site Details					
Width	21.5m	Depth	1.8m	Height	2m
Orientation	NNW	Floor area	21.5m x 2m	Floor condition	Good
Location in Landscape	On the southern side of a small unnamed tributary running E-W on the western side of the stored water of Woronora Dam, on the first ridgeline up from the creek.				
Shelter exterior/formation	The shelter has been formed by cavernous weathering and heavy blockfall.				
Shelter interior	Chemical weathering on roof of shelter, exfoliation and algae growth on back panel. Block fall out of dripline. Salt/granular loss on back wall. Wombat scat noticed on floor of shelter.				
Distance to water	30m North	Landform	First ridgeline up from creek line on the side of a small gully.		
Setting	Continuous overhang				
Archaeological Deposit					
Deposit	Yes	**Describe**	Grey sand approximately 50cm deep		
Visible artefacts?	None visible	Where?	N/A	How many?	N/A
Art					
Art surfaces	Panel 1: Motif 1: has completely faded. Motif 2: the total of the macropod is barely visible and very patchy. Motif 3: Partial lines only visible, Motif 4: one complete macropod has faded and partial outline and the legs of the other macropod are visible. Motif 5: the head of the macropod is barely visible and the rest has faded and not visible. Motif 6: Partial line visible. Motif 7: partial lines visible. Motif 8: is completely gone. Panel 2: Motif 9: barely visible, nearly faded away. Motif 10: heavy fading since last recording barely visible. Motif 11: heavy fading since last recording barely visible. Motif 12 comprises of a human figure, Motif 13 through to 16 are heavily faded since their original recording.				
Art Condition	Very poor				
Art Overview	1 human figure frontal, 2 kangaroo, 1 snake, 3 indeterminate and 1 fish.				
Damage/threats					
Water wash	No	**Graffiti**	N/A	**Macro vegetals**	Yes – Algae growth
Animals	Yes	**Salt/granular loss**	Yes – Back panel	**Fissuring**	N/A
Insects	No	**Spalling/exfoliation**	Yes – Back panel	**Other**	N/A
Fire	No	**Block fall**	Yes – from roof and outside of dripline.		

Table 18: Baseline recording data for art surfaces present within FRC 191.

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Completely faded	N/A	N/A	N/A	N/A
2	Partial macropod (only tail showing – rest is faded)	Infill – partial	Charcoal	Black	30 x 7 cm
3	Indeterminate	Outline – partial	Charcoal	Black	12 x 1 cm
4	Legs of macropod	Outline – partial	Charcoal	Black	80 x 1cm
5	Head of macropod (poor condition)	Outline – partial	Charcoal	Black	10 x 25cm
6	Macropod	Outline – partial	Charcoal	Black	25 x 25cm
7	Macropod	Infill of back – partial	Charcoal	Black	25 x 15cm
Panel 2					
9	Indeterminate	Partial	Charcoal	Black	15 x 25cm
10	Indeterminate	Partial	Charcoal	Black	10 x 20cm
11	Indeterminate	Infill – partial	Charcoal	Black	9 x 12cm
12	Human figure	Outline – complete	Charcoal	Black	32 x 23cm
13	Snake	Outline/infill - complete	Charcoal	Black	2.15 x 9cm
14	Indeterminate	Outline/infill – partial	Charcoal	Black	46 x 22cm
15	Macropod	Outline - partial	Charcoal	Black	22 x 13cm
16	Indeterminate	outline/infill - complete	Charcoal	Black	20 x 11cm

2.10.2 Baseline recording images – site overview

Plate 40: Overview of site FRC 191. View looking East.

Plate 41: Overview of site FRC 191. View looking Southwest.

2.10.3 Baseline recording plans – site overview

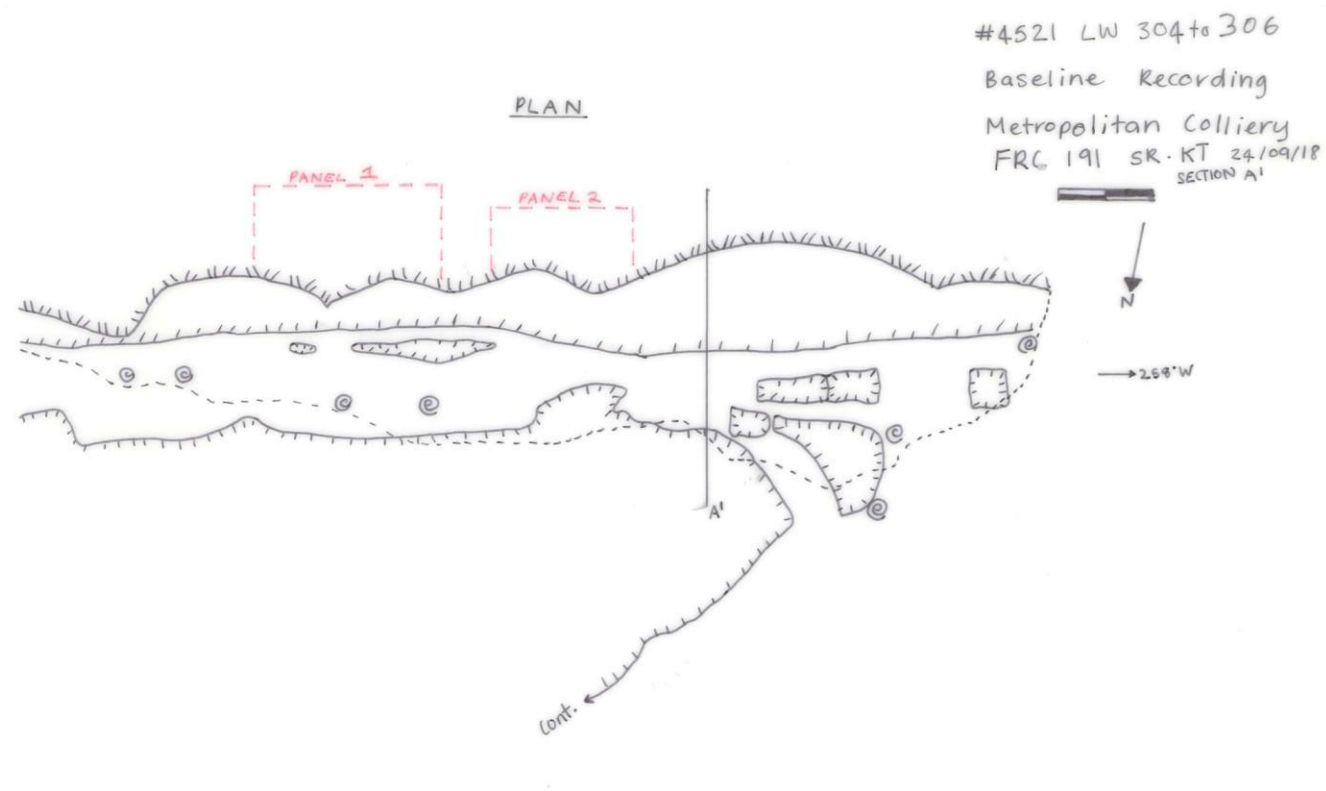


Figure 20: Plan of FRC 191.

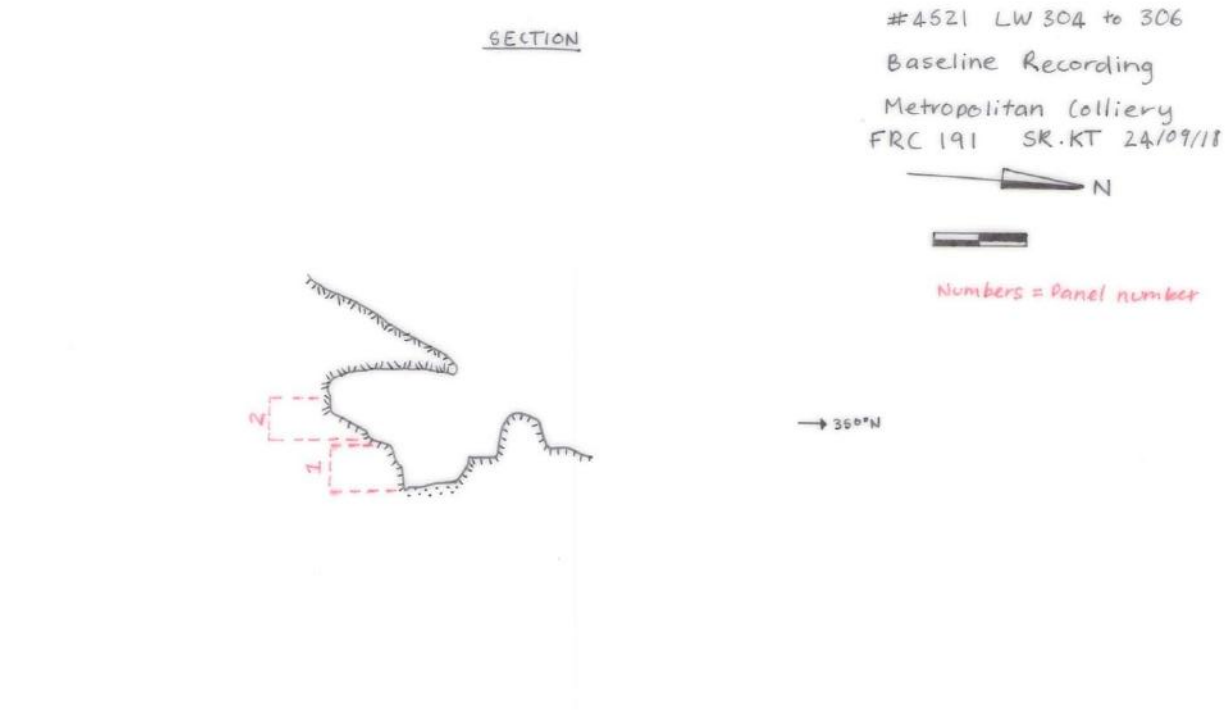


Figure 21: A1 Section of FRC 191.

2.10.4 Baseline recording images – detailed panel recording

Panel 1

Plate 42: Detail of Panel 1 at FRC 191. Panel 1, Motif 2.

Plate 43: Detail of Panel 1 at FRC 191. Panel 1, Motif 3.

Plate 44: Detail of Panel 1 at FRC 191. Panel 1, Motif 4.

Plate 45: Detail of Panel 1 at FRC 191. Panel 1, Motif 5.

Plate 46: Detail of Panel 1 at FRC 191. Panel 1, Motif 6.

Plate 47: Detail of Panel 1 at FRC 191. Panel 1, Motif 7.

Panel 2

Plate 48: Detail of Panel 2 at FRC 191. Panel 2; Motif 9, 10.

Plate 49: Detail of Panel 2 at FRC 191. Panel 2; Motif 11.

Plate 50: Overview of Panel 2 at FRC 191. Panel 2; Motif 10, 12, 13, 14, 15.

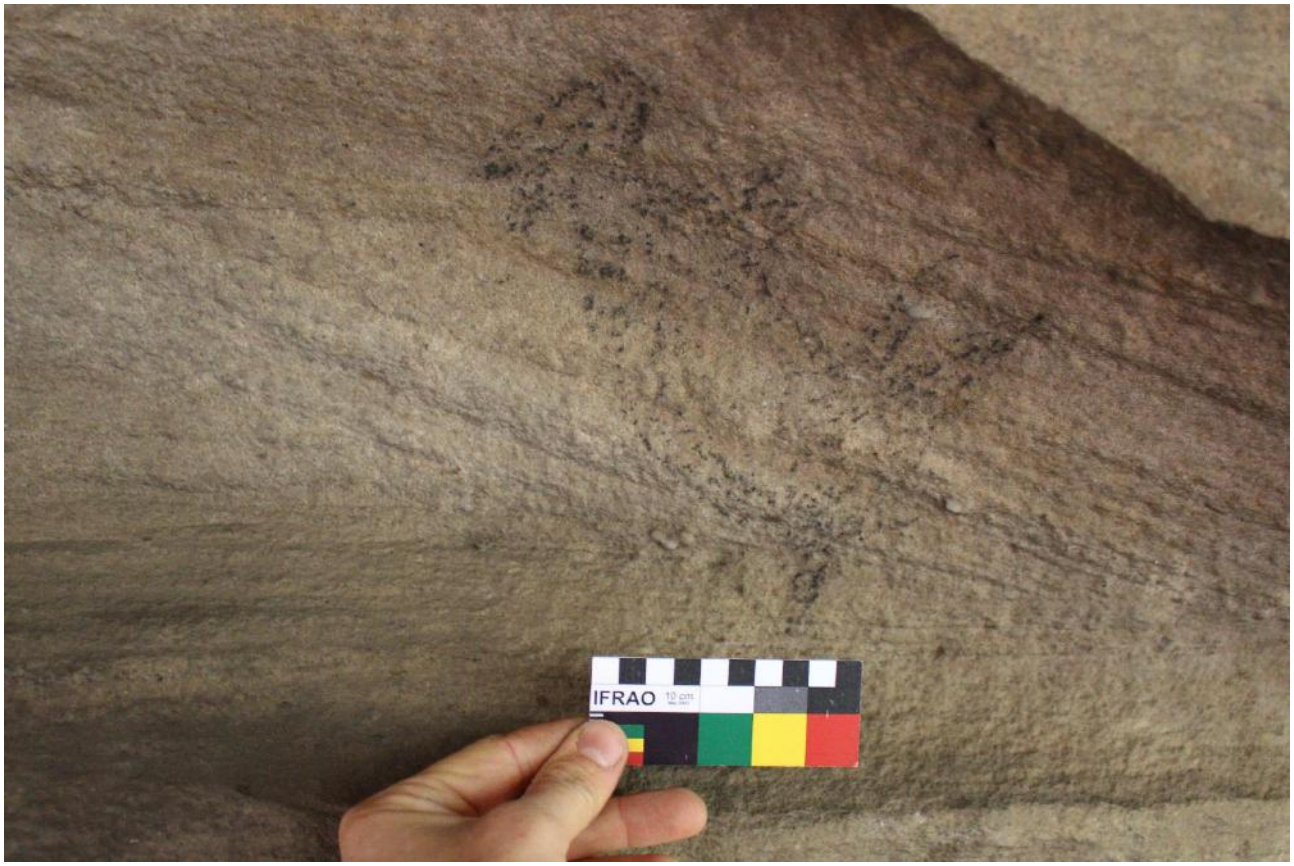


Plate 51: Detail of Panel 2 at FRC 191. Panel 2; Motif 16.

2.18 Flat Rock Creek 195 (FRC 195, AHIMS# 52-2-0264)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and block fall in antiquity. The AHIMS site card describes 93 charcoal motifs at the site these comprised of:

- 64 Human figures frontal.
- 16 Indeterminates.
- 5 Eels.
- 3 Kangaroos.
- 2 Boomerangs.
- 1 Bird.
- 1 Lizard.
- 1 Human figure profile.

There has been heavy damage over Panel 1 due to water wash and exfoliation which has caused many of these motifs to fade and wear away. Only 70 motifs remain visible at the time of this baseline recording. Figure 26 and Figure 27 are a reproduction of the original Sefton site card drawings demonstrating the loss of motifs at the site due to natural processes.

2.18.51 Baseline recording data

Table 36: Baseline recording data for FRC 195.

Overview					
Site type	Shelter with Art	**Corrected MGAE**	311015	**Corrected MGAN**	6215695
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	**Date**	Unspecified		
Site Details					
Width	14m	**Depth**	4m	**Height**	2m
Orientation	50°	**Floor area**	56m^2	**Floor condition**	Mostly rock, limited deposit.
Location in Landscape	80m from Waratah Rivulet, close to Woronora Dam.				
Shelter exterior/formation	Block fall in antiquity and cavernous weathering.				
Shelter interior	Very damp, with water seeping along the rear wall and along the roof. Microvegetals are present on every surface.				
Distance to water	80m	**Landform**	Continuous ridgeline.		
Setting	Continuous ridgeline.				
Archaeological Deposit					
Deposit	Yes	**Describe**	Deposit, where present, comprises of a creamy loaming sand approximately 6 cm deep.		
Visible artefacts?	n/a	**Where?**	n/a	**How many?**	n/a
Art					
Art surfaces	Art is exfoliating.				
Art Condition	Condition is poor, being heavily deteriorated due to water seepage and vegetal growth.				
Art Overview	Four panels of art are present. See the site card motif table for details. The majority of the motifs are full frontal males with eels, with only one macropod represented.				
Damage/threats					
Waterwash	Yes- water seepage at the northern end along the back wall and roof	**Graffiti**	No	**Macrovegetals**	Yes- along back wall at northern end
Animals	No	**Salt/granular loss**	Yes-entire shelter	**Fissuring**	No
Insects	Yes-spiders	**Spalling/exfoliation**	Yes-along art surfaces	**Other**	n/a
Fire	No	**Block fall**	Yes-In antiquity		

Table 37: Baseline recording data for art surfaces present within FRC 195.

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Male-full frontal	Complete	Charcoal outline	Black	25 x 66cm
2	Male-partial side view	Partial	Charcoal outline	Black	30 x 33cm
3	Male-partial fill frontal	Partial	Charcoal outline	Black	56 x 27cm
4	Male-full frontal	Left hand side remaining	Charcoal outline	Black	34 x 7cm
5	Male- Full frontal	Complete	Charcoal infill	Black	49 x 15cm
6	Indeterminate line	Partial	Charcoal	Black	22 cm long
7	Male- Bottom half	Partial	Charcoal	Black	38 cm x 15cm
8	Male- Full frontal	Complete	Charcoal	Black	47 x 21cm
9	Indeterminate lines	Partial	Charcoal	Black	40 x 15cm
10	Male- Full frontal	Complete	Charcoal outline	Black	47 x 15cm
11	Male- Full frontal	Complete	Charcoal outline	Black	41 x 13cm
12	Male- Full frontal	Complete	Charcoal outline	Black	38 x 18cm
13	Male- Full frontal	Complete	Charcoal outline	Black	36 x 17cm
14	Male-Full frontal	Complete	Charcoal outline	Black	25 x 9cm
15	Male- Full frontal	Complete	Charcoal outline	Black	20 x 14cm
16	Male- Full frontal	Complete	Charcoal outline	Black	26 x 10cm
17	Indeterminate	Partial	Charcoal outline	Black	28 x 29cm
18	Male- side view	Complete	Charcoal outline	Black	22 x 17cm
19	Human	Complete	Charcoal outline	Black	26 x 14cm
20	Human	Partial- top half	Charcoal outline	Black	10 x 20cm
21	Human	Partial-top half	Charcoal outline	Black	19 x 12cm
22	Male- full frontal	Complete	Charcoal outline	Black	30 x 12cm
23	Male- full frontal	Complete	Charcoal infill	Black	34 x 18 cm
24	Male- full frontal	Complete	Charcoal outline	Black	20 x 10cm
25	Male- full frontal	Complete	Charcoal outline	Black	17 x 14cm

Motif No.	Type	Form	Media	Colour	Measurement
26	Human- full frontal	Complete	Charcoal outline	Black	29 x 10cm
27	Female- full frontal	Complete	Charcoal infill	Black	30 x 29cm
28	Frontal human	Complete	Charcoal infill	Black	24 x 18cm
29	Indeterminate line	Partial	Charcoal	Black	10 x 6cm
30	Human?	Partial	Charcoal hatched	Black	36 x 19cm
31	Cleverman (man with 'rays' drawn out of his head)	Complete	Charcoal- Herringbone	Black	36 x 20cm
32	Cleverman- full frontal (man with 'rays' drawn out of his head)	Complete	Charcoal	Black	26 x 18cm
33	Male- full frontal	Complete	Charcoal infill	Black	35 x 15cm
34	Male- full frontal	Complete	Charcoal infill	Black	25 x 12cm
35	Male- full frontal	Complete	Charcoal infill	Black	27 x 9cm
36	Male- full frontal in a circle?	Complete	Charcoal outline	Black	29 x 15cm
37	Male- full frontal	Complete	Charcoal outline	Black	30 x 14cm
38	Male full frontal	Partial- bottom half	Charcoal outline	Black	8 x 10cm
39	Indeterminate	Partial	Charcoal outline	Black	17 x 6cm
40	Cleverman- full frontal	Complete	Charcoal outline	Black	30 x 15cm
41	Male- full frontal	Partial- bottom half	Charcoal infill	Black	18 x 6cm
42	Male- full frontal	Partial- feet and penis only	Charcoal infill	Black	19 x 7cm
43	Indeterminate	Lines- exfoliating	Charcoal	Black	148 x 40cm
Panel 2					
1	Male- full frontal	Complete	Charcoal outline	Black	23 x 12 cm
2	Male- full frontal	Complete	Charcoal outline	Black	23 x 8 cm
3	Human legs	Partial	Charcoal infill	Black	9 x 8cm
4	Macropod	Complete	Charcoal infill	Black	72 x 70cm
5	Human	Partial- no legs	Charcoal outline	Black	10 x 5 cm
6	Male- full frontal	Complete	Charcoal infill	Black	34 x 13cm
7	Eel tail	Partial	Charcoal infill	Black	50 x 12cm
8	Full eel	Complete	Charcoal infill	Black	105 x 23cm
9	Male- Full frontal	Complete	Charcoal outline	Black	26 x 10cm

Motif No.	Type	Form	Media	Colour	Measurement
10	Eel	Partial- head and body	Charcoal outline	Black	50 x 7cm
11	Eel	Complete	Charcoal infill	Black	110 x 26cm
12	Eel	Partial- part missing	Charcoal infill	Black	59 x 26cm
13	Male- full frontal	Complete	Charcoal infill	Black	48 x 14cm
14	Cleverman- full frontal (man with 'rays' drawn out of his head)	Complete	Charcoal outline	Black	30 x 15cm
15	Male- full frontal	Complete	Charcoal outline	Black	27 x 13cm
16	Male- full frontal	Complete	Charcoal outline	Black	28 x 16cm
17	Male in a goanna	Complete	Charcoal outline	Black	30 x 14cm
18	Goanna	Complete	Charcoal outline	Black	120 x 38cm
19	Cleverman- full frontal (man with 'rays' drawn out of his head)	Complete	Charcoal outline	Black	40 x 24cm
20	Indeterminate	Partial- lines	Charcoal lines	Black	13 x 5 cm
Panel 3					
1	Indeterminate	Partial	Charcoal infill	Black	28 x 20 cm
2	Bird?	Partial	Charcoal infill	Black	80 x 30 cm
3	Indeterminate	Partial line	Charcoal line	Black	77cm
4	Bird?	Partial	Charcoal outline	Black	44 x 33 cm
5	Indeterminate	Partial	Charcoal line	Black	24 x 18cm
Panel 4					
1	Boomerang	Complete	Charcoal outline	Black	28 x 7 cm
2	Boomerang	Complete	Charcoal outline	Black	39 x 10cm[1]

1. A sample of photographs has been included below. All of the photographs taken during the baseline recording have been provided to the colliery for future monitoring programs.

2.18.52 Baseline recording images – site overview

Plate 115: External context of FRC 195. View east.

Plate 116: External context of FRC 195. View north.

Plate 117: External context of FRC 195. View north.

2.18.53 Baseline recording plans – site overview

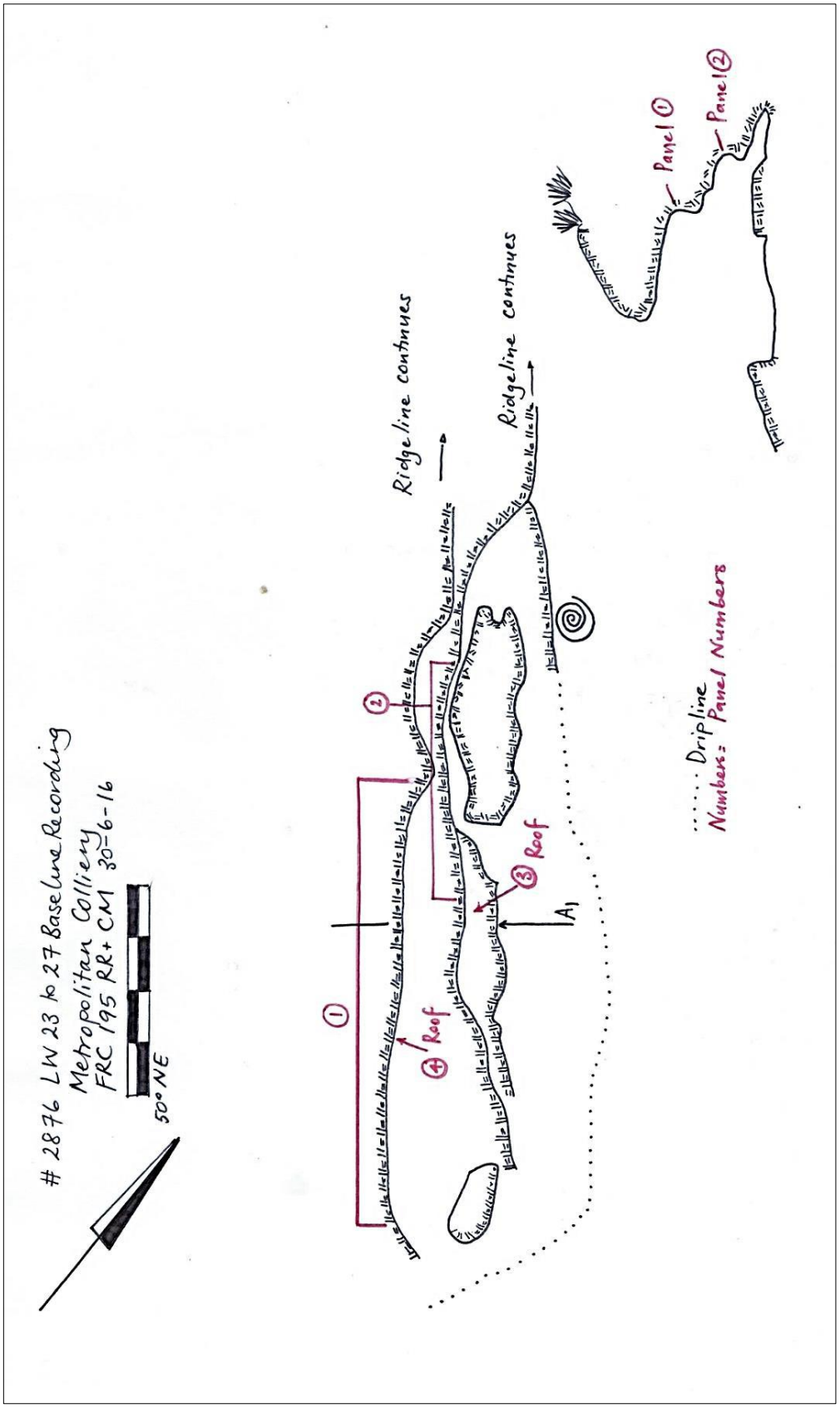


Figure 26: Plan of FRC 195.

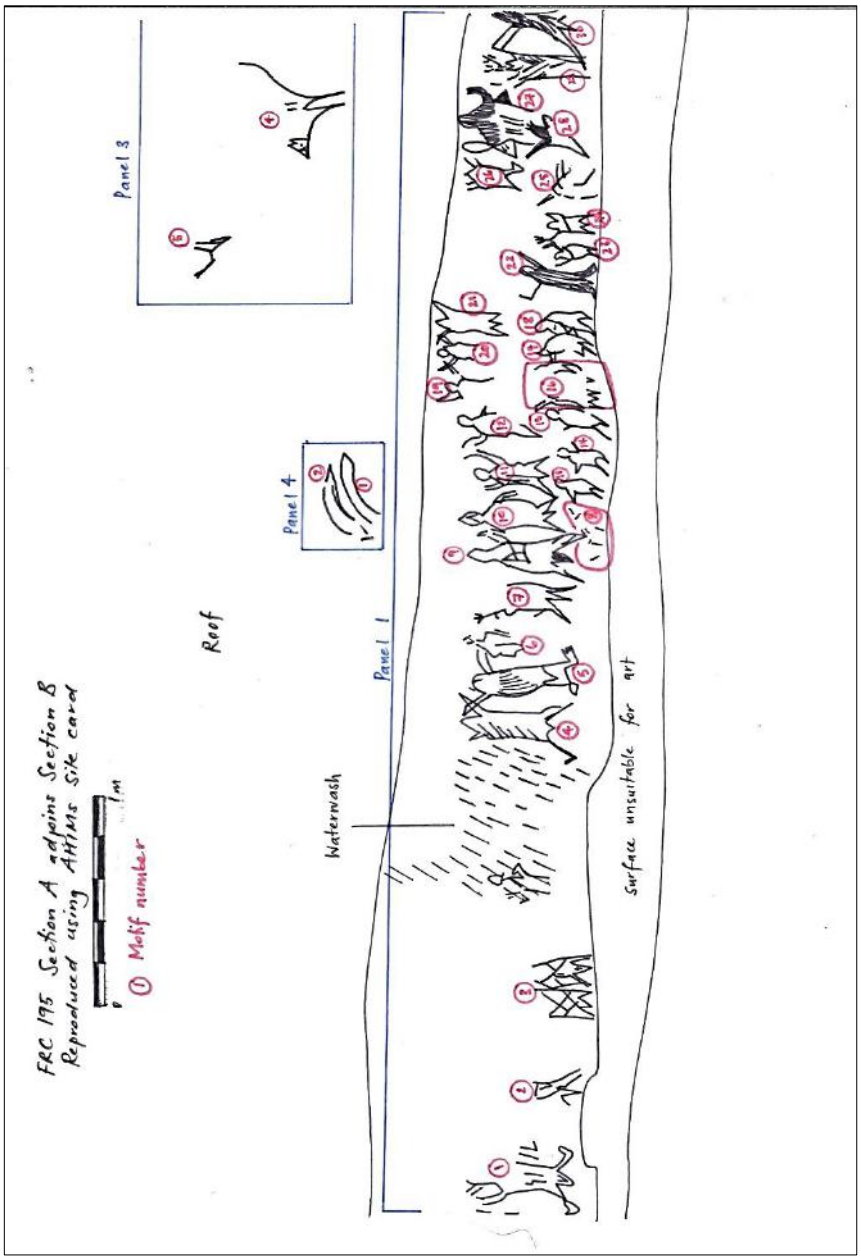


Figure 27: Section A adjoins Section B Plan of art remaining at FRC 195, see original AHIMS card for original art recording.

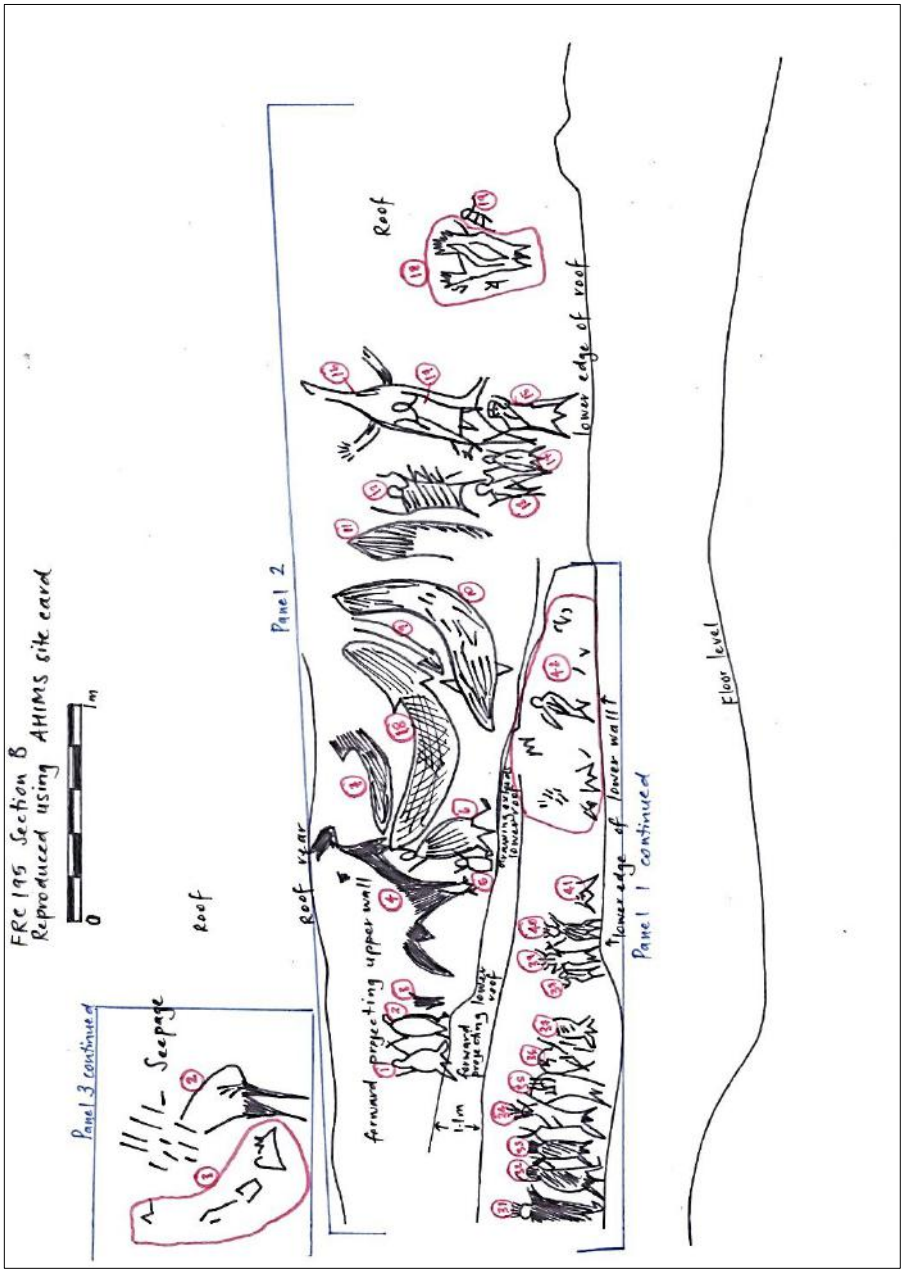


Figure 28: Section B adjoins Section A Plan of art remaining at FRC 195, see original AHIMS card for original art recording.

2.18.54 Baseline recording images – detailed panel recording

Panel 1

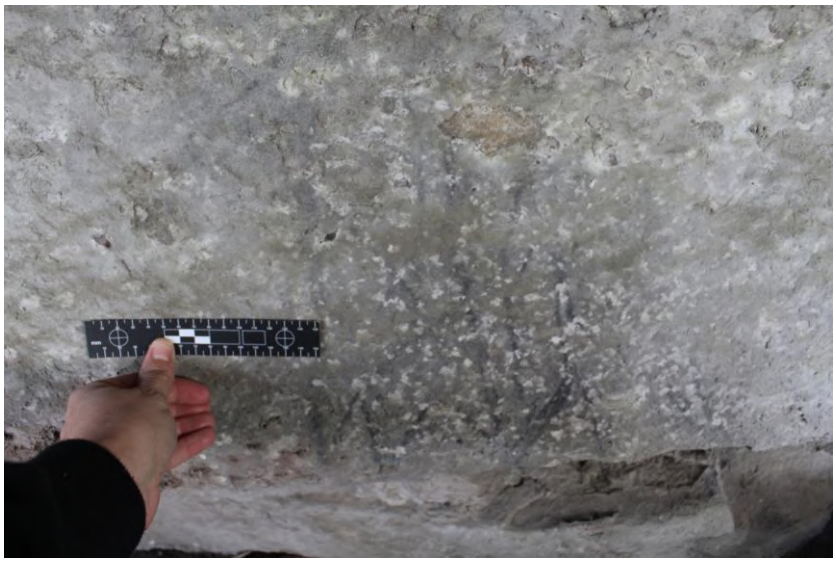


Plate 118: Image of Panel 1, view west.

Panel 2

Plate 119: Image of Panel 2, Motif 7 to Motif 11. View west.

Plate 120: Image of Panel 2, Motif 19. View west.

Plate 121: Image of Panel 2, Motif 17 (full frontal man in goanna) to Motif 18 (goanna). View west.

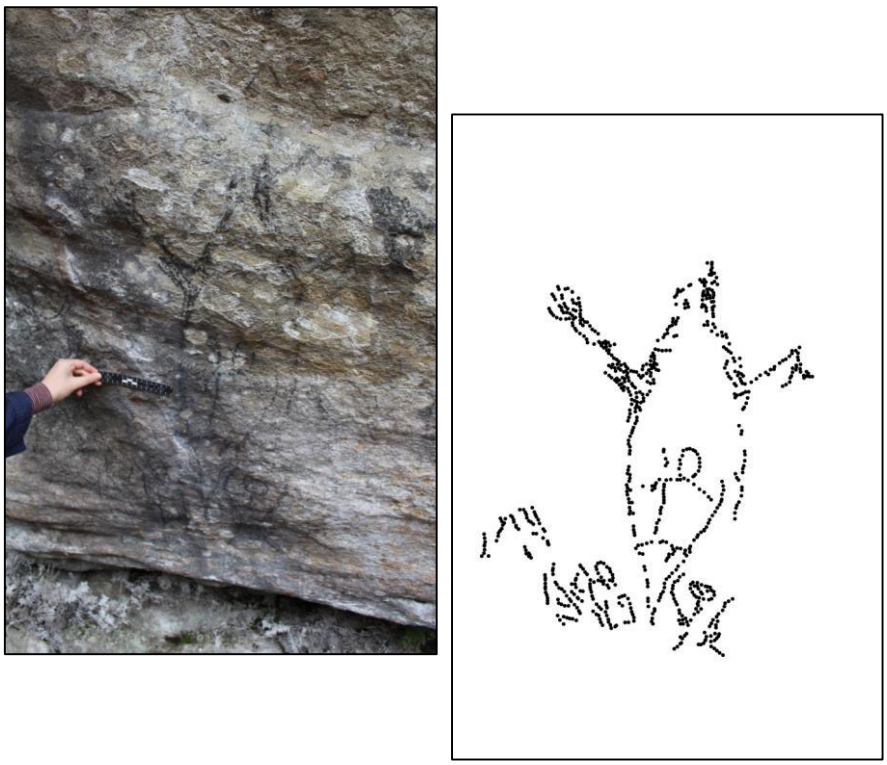


Plate 122: Scaled interpretive drawing of Panel 2, Motif 17 (full frontal man in goanna) to Motif 18 (goanna). View west.

Panel 4

Plate 123: Image of Panel 4, Motif 1 and Motif 2 (boomerangs). View west.

2.11 Flat Rock Creek 198 (FRC 198, AHIMS # 52-2-0268/ 52-2-0404)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and blockfall in antiquity. The art is in poor condition and has been impacted by water wash, fading, white algae, silica accretion since it was first described by Sefton on the AHIMS site card. There was evidence of a person occupying the shelter, with fire damage and rubbish present. Fissuring was also present on the roof of the shelter.

2.11.1 FRC 198 baseline recording data

Table 19: Baseline recording data for FRC 198.

Overview					
Site type	Shelter with Art and Deposit	Corrected MGAE	0311280	Corrected MGAN	6216135
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	Date	Not specified		
Site Details					
Width	78m	Depth	6m	Height	1.4m
Orientation	S-SE	Floor area	4m x 78m	Floor condition	Good
Location in Landscape	Shelter is on Waratah Rivulet at the high water level of Woronora Dam. It is on the northern side of the rivulet facing SE and 500m from the start of the stored water				
Shelter exterior/formation	Block fall and cavernous weathering. Chemical weathering on roof. Algae growth on roof and back panel. Block fall from roof and outside of dripline.				
Shelter interior	Fissure line on roof. Disturbance from person living in shelter: fire damage, rubbish. Water wash on back panel around art surfaces. Exfoliation on roof through shelter. Wombat scat throughout shelter.				
Distance to water	20m	Landform	Lower slope: base of ridgeline, first overhang from the stored water.		
Setting	Continuous overhang.				
Archaeological Deposit					
Deposit	Yes	**Describe**	Brown loamy sand approximately 15cm deep		
Visible artefacts?	No – Noted on site card (though not described) but not found during site assessment.	Where?	N/A	How many?	N/A
Art					
Art surfaces	Art sample in very poor condition and very faded. Panel 1: water wash, white algae and silica over motif 1 and 2. Panel 2: water wash, white algae and silica over motif – extremely faded. Panel 3 – extremely faded, algae growth. Panel 4: faded, white algae.				
Art Condition	Poor condition.				
Art Overview	2 charcoal indeterminate drawings, 1 kangaroo charcoal drawing and 1 fish charcoal drawing. Panel 1: Motif 1 and 2 are drawn upside-down on site card. Panel 2 – multiple sections of motif 3 are faded and missing/two additional indeterminate lines noticed on return – (panel in wrong location on site drawing). Multiple indeterminate lines missing from motif 4. Indeterminate lines partially faded on motif 5. Fish partially faded on motif 6. Part of motif 7 is missing and one indeterminate line has completely faded.				
Damage/threats					
Water wash	Yes	**Graffiti**	N/A	**Macro vegetals**	Yes
Animals	Yes	**Salt/granular loss**	No	**Fissuring**	Yes
Insects	No	**Spalling/exfoliation**	Yes	**Other**	N/A
Fire	Yes	**Block fall**	Yes		

Table 20: Baseline recording data for art surfaces present within FRC 198.

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Indeterminate (14 parallel lines)	Partial	Charcoal	Black	25 x 15cm
2	Indeterminate	Partial - infill	Charcoal	Black	15 x 25cm
Panel 2					
3	Indeterminate (7 parallel lines)	Partial	Charcoal	Black	1.5m x 60cm
4	Indeterminate	Partial – outline/infill	Charcoal	Black	20 x 15cm
5	Indeterminate (5 parallel lines)	Partial	Charcoal	Black	15 x 10cm
6	Fish	Partial – outline/infill	Charcoal	Black	35 x 20cm
7	Indeterminate (4 lines)	Partial	Charcoal	Black	20 x 10cm

2.11.2 Baseline recording images – site overview

Plate 52: Overview of site FRC 198. View looking east.

Plate 53: Overview of site FRC 198. View looking west.

2.11.3 Baseline recording plans – site overview

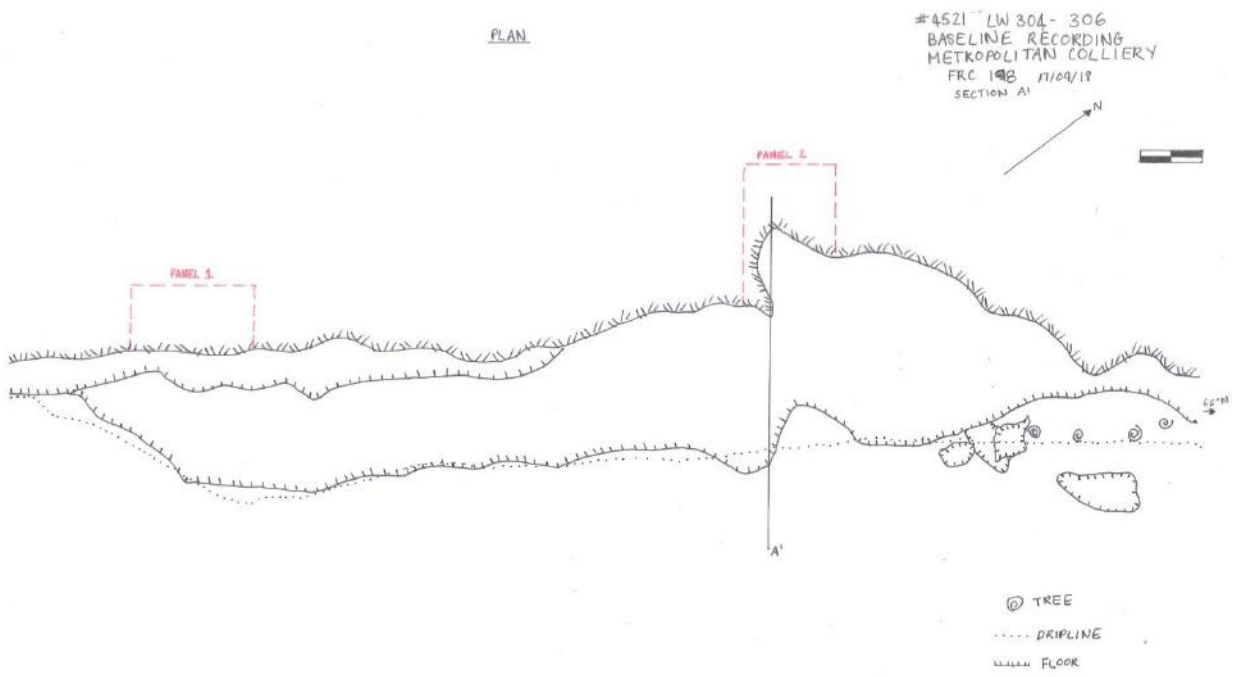


Figure 22: Plan of FRC 198.

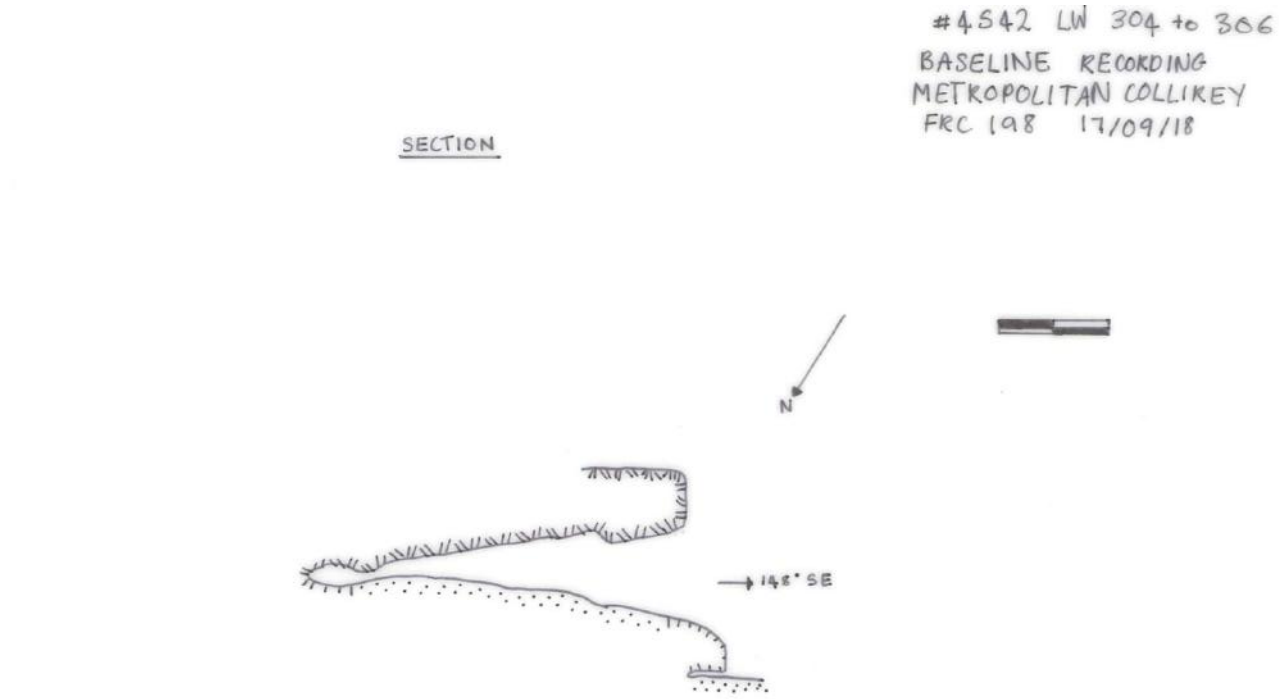


Figure 23: A1 Section of FRC 198.

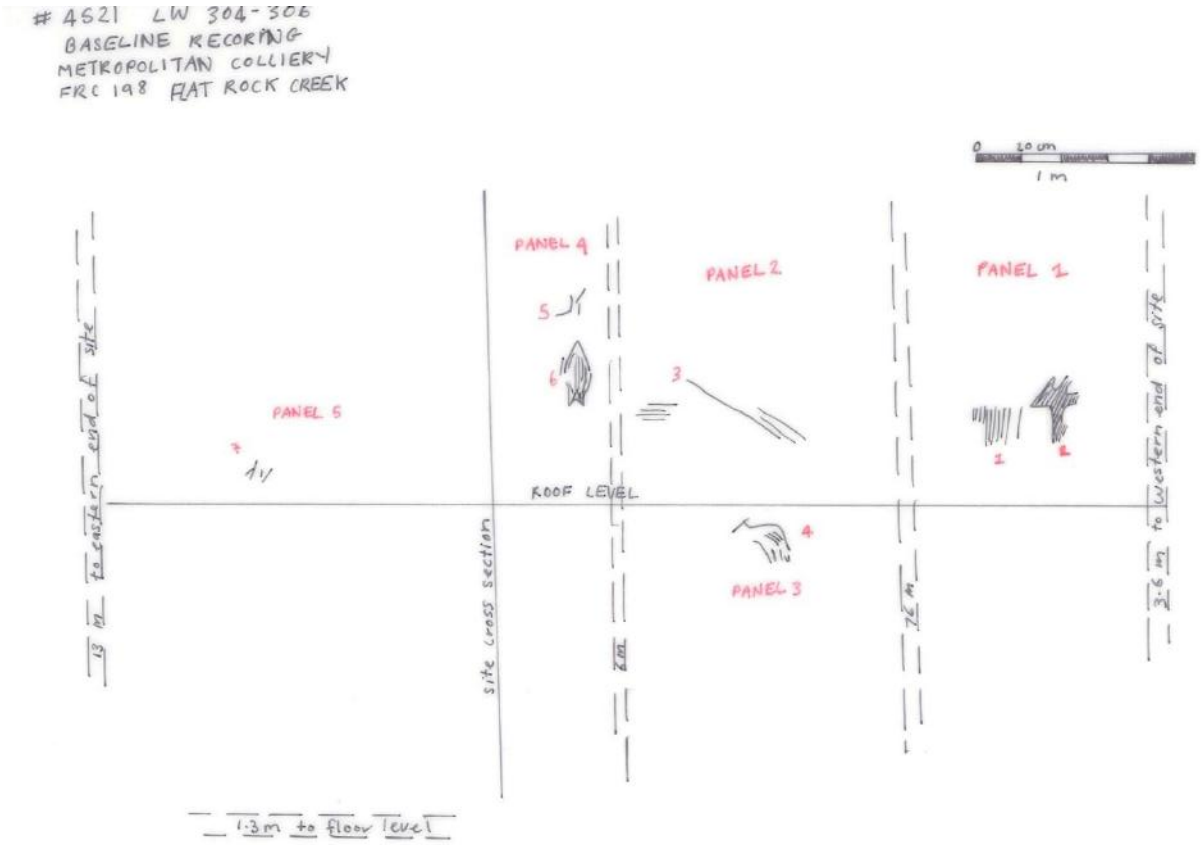


Figure 24: Artform drawing of FRC 198. Reproduced from the AHIMS site card.

2.11.4 Baseline recording images – detailed panel recording

Panel 1

Plate 54: Detail of Panel 1 at FRC 198. Panel 1, Motif 1, 2.

Panel 2

Plate 55: Detail of Panel 2 at FRC 198. Panel 2, Motif 3.

Panel 3

Plate 56: Detail of Panel 3 at FRC 198. Panel 3, Motif 4.

Panel 4

Plate 57: Detail of Panel 4 at FRC 198. Panel 4, Motif 5, 6.

Panel 5

Plate 58: Detail of Panel 5 at FRC 198. Panel 5, Motif 7.

2.16 Flat Rock Creek 316 (FRC 316, AHIMS # 52-2-3447)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and blockfall in antiquity. The shelter shows evidence of exfoliation and chemical weathering. The artefacts recorded by Sefton (in the AHIMS site card) on the shelter's dripline were not relocated during this baseline recording. The following artefacts were listed on the site card:

- 1 orange/cream chert flake (20x12x2mm)
- 1 light brown chert flake (17x14x2mm)
- 1 black chert flake (35x17x3mm)
- 1 red chert core (20x15x10mm with 40% pebble cortex)
- 1 grey chert flaked piece (17x8x5mm).

2.16.1 FRC 316 baseline recording data

Table 25 Baseline recording data for FRC 316.

Overview					
Site type	Shelter with Deposit.	**Corrected MGAE**	0312093	**Corrected MGAN**	6217745
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	**Date**	Not specified		
Site Details					
Width	11m	**Depth**	3.9m	**Height**	2.2m
Orientation	W facing	**Floor area**	$4m^2$	**Floor condition**	
Location in Landscape	Top of ridgeline, first ridgeline before proceeding down slope.				
Shelter Exterior/formation	Cavernous weathering and block fall				
Shelter Interior	Exfoliation, chemical weathering.				
Distance to water	>500m	**Landform**	Top of ridgeline.		
Setting	Isolated overhang.				
Archaeological Deposit					
Deposit	Yes	**Describe**	Cream Sand of approx. 15cm deep		
Visible artefacts?	No – recorded on site card, not relocated in inspection	**Where?**	No	**How many?**	N/A
Grinding Groove					
Surfaces	N/A				
Condition	N/A				
Damage/threats					
Water wash	Yes	**Graffiti**	N/A	**Macrovegetals**	Yes
Animals	No	**Salt/granular loss**	Yes	**Fissuring**	Yes
Insects	No	**Spalling/exfoliation**	Yes	**Other**	N/A
Fire	No	**Block fall**	Yes		

2.16.2 Baseline recording images – Site Overview

Plate 67: Overview of site FRC 316. View looking South-Southeast.

Plate 68: Overview of site FRC 316. View looking North.

2.16.3 Baseline recording plans – Site overview

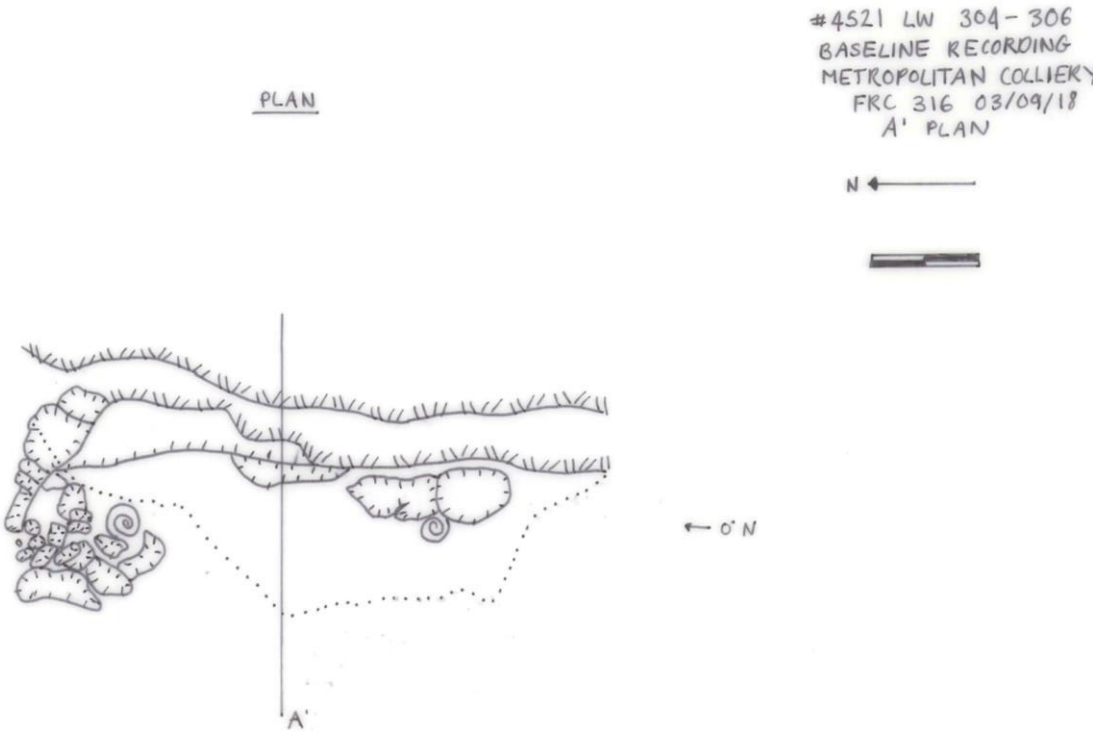


Figure 33: Plan of FRC 316.

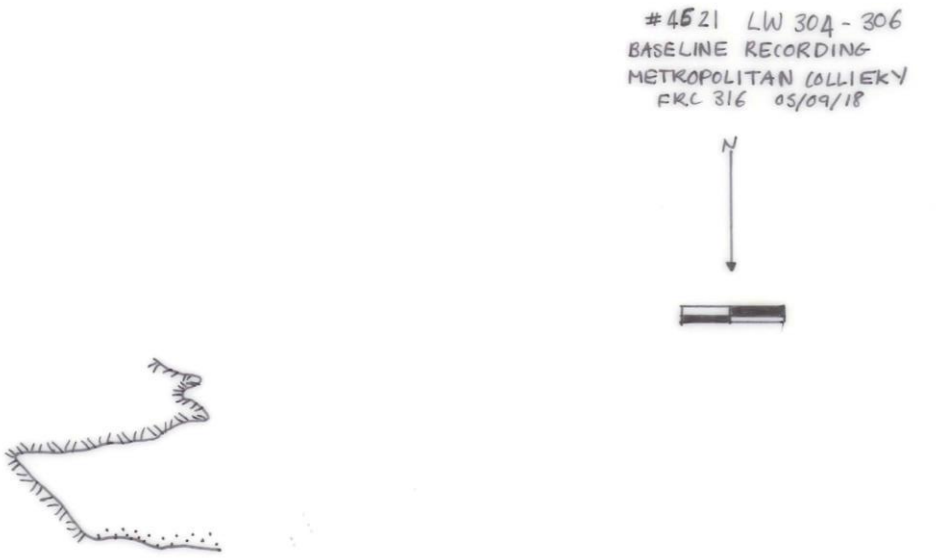


Figure 34: Plan of FRC 316.

2.17 Flat Rock Creek 340 (FRC 340, AHIMS # 52-2-3471)

This shelter is formed out of Hawkesbury sandstone by cavernous weathering and blockfall in antiquity. The art is in poor condition and has been impacted by water wash, and chemical weathering since it was first described by Sefton on the AHIMS site card. There was evident seepage from the bedding planes, exfoliation on the roof, and block fall near the dripline and the southern end of the shelter.

2.17.1 FRC 340 baseline recording data

Table 26 Baseline recording data for FRC 340.

Overview					
Site type	Shelter with Art and Deposit	Corrected MGAE	0311619	Corrected MGAN	6217570
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	Date	Not specified		
Site Details					
Width	15m	Depth	2.3m	Height	2.3m
Orientation	N-NE	Floor area	15 x 2.3m	Floor condition	Good
Location in Landscape	The shelter is 70m west from the stored water, 210m NE of the Fire Trail 9E – under second cliffline up from stored water.				
Shelter exterior/formation	Cavernous weathering and block fall.				
Shelter interior	Chemical weathering on roof, minimal macro vegetation between bedding plane. Seepage from bedding planes on back panel, exfoliation visible on roof. Block fall near dripline and at southern end of shelter. Water wash on back panel around art surfaces.				
Distance to water	70m	Landform	Mid to Lower Valley Slope, mid ridgeline.		
Setting	Continuous overhang.				
Archaeological Deposit					
Deposit	Yes	**Describe**	Cream Sand approx. 45cm deep		
Visible artefacts?	N/A	Where?	N/A	How many?	N/A
Art					
Art Surfaces	Poor, seepage points and chemical weathering on back panel between art panels. Some art has been removed by water wash.				
Art Condition	Poor				
Art Overview	Panel 1 comprises of motif 1 stingray, motif 2 and 3 charcoal indeterminates and motif 4 macropod outline with indeterminate lines and infill. Panel 2 comprises of one charcoal indeterminate. Panel 3 comprises of charcoal macropod paw prints.				
Damage/threats					
Water wash	Yes	**Graffiti**	N/A	**Macro vegetals**	Yes
Animals	No	**Salt/granular loss**	No	**Fissuring**	No
Insects	Yes – spiders	**Spalling/exfoliation**	Yes	**Other**	N/A
Fire	No	**Block fall**	Yes		

Table 27 Baseline recording data for art surfaces present within FRC 340

Motif No.	Type	Form	Media	Colour	Measurement
Panel 1					
1	Stingray	Complete	Charcoal	Black	38 x 26cm
2	Indeterminate infill/outline	Partial?	Charcoal	Black/water wash over	18 x 40cm
3	Indeterminate outline	Partial?	Charcoal	Black/water wash	50 x 20cm
4	Macropod outline/infill with indeterminate lines and indeterminate infill	Partial	Charcoal	Black/water wash	70 x 40cm
5	Indeterminate line/infill	Partial	Charcoal	Black/water wash	32 x 28cm
Panel 2					
6	Indeterminate line/infill	Partial	Charcoal	Black/case hardening	32 x 12cm
Panel 3					
7	Macropod paw prints infill	Complete	Charcoal	Black/case hardening	10 x 8cm

2.17.2 Baseline recording images – Site Overview

Plate 69: Overview of FRC 340. View looking West.

Plate 70: Overview of FRC 340. View looking East

2.17.3 Baseline recording plans – Site overview

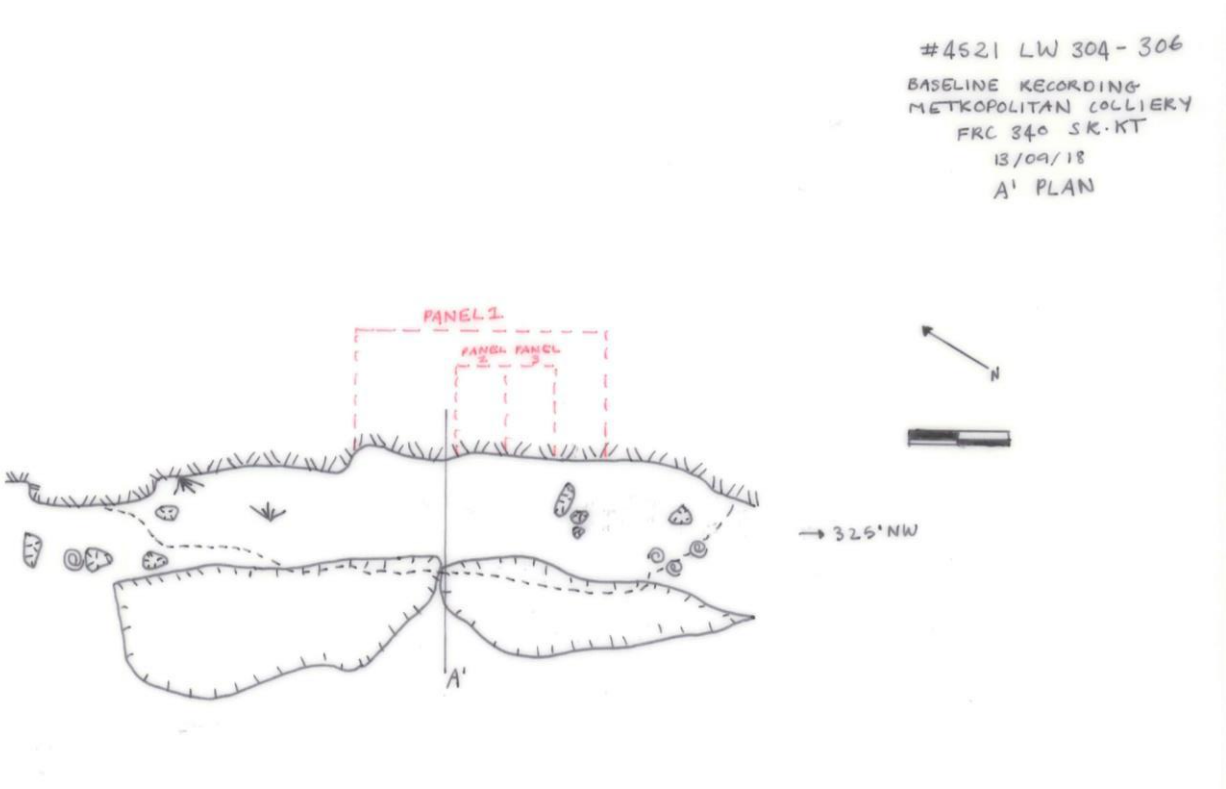


Figure 35: Plan of FRC 340.

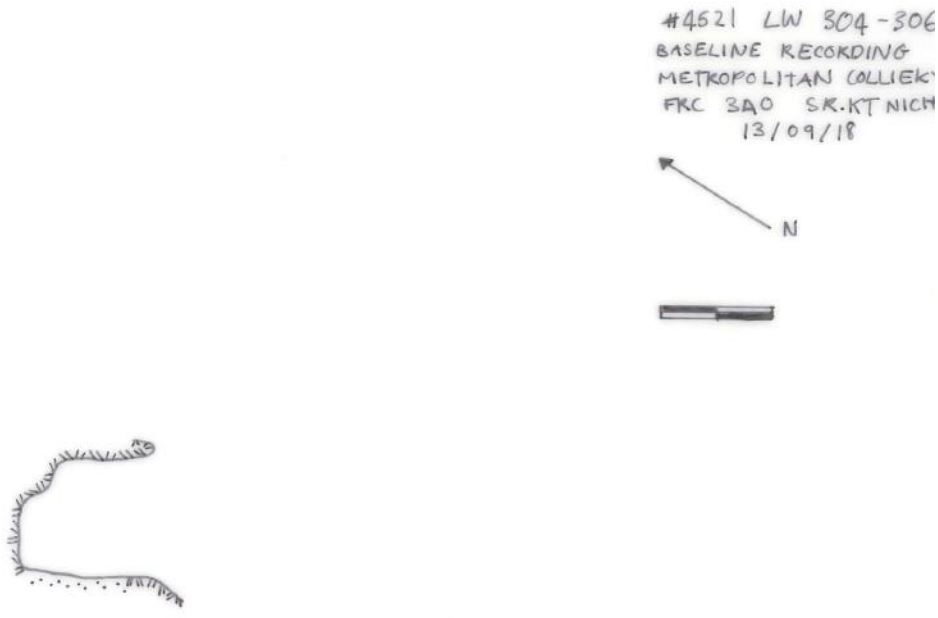


Figure 36: A1 Section of FRC 340.

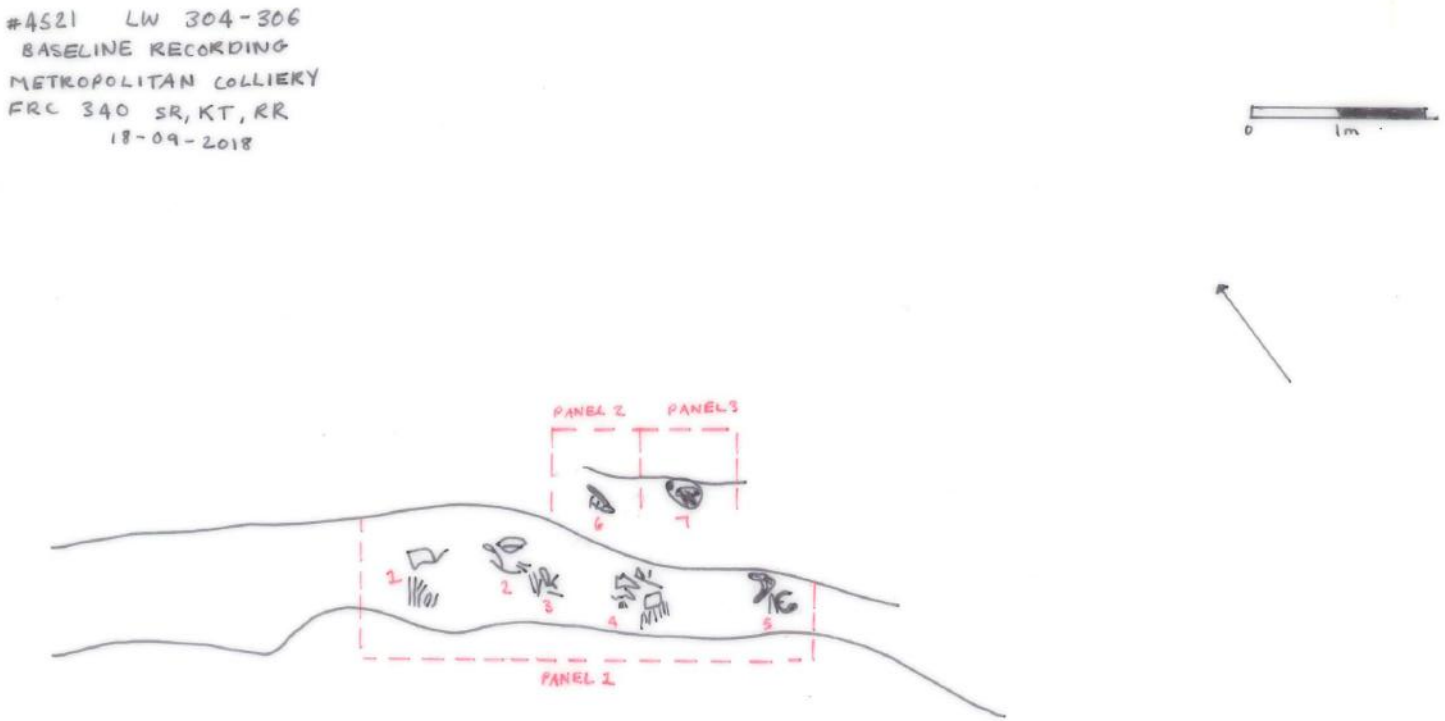


Figure 37: Art at FRC 340. Reproduced from the AHIMS site card.

2.17.4 Baseline recording images – Detailed panel recording

Plate 71: Detail of Panel 1 at FRC 340. Panel 1, Motif 1.

Plate 72: Detail of Panel 1 at FRC 340. Panel 1, Motif 2.

Plate 73: Detail of Panel 1 at FRC 340. Panel 1, Motif 3.

Plate 74: Detail of Panel 1 at FRC 340. Panel 1, Motif 4.

Plate 75: Detail of Panel 1 at FRC 340. Panel 1, Motif 5.

Plate 76: Detail of Panel 2 at FRC 340. Panel 2 Motif 6.

Plate 77: Detail of Panel 3 at FRC 340. Panel 3, Motif 7.

2.20 North East Woronora 1 (NEW 1, AHIMS # 52-2-0219)

This grinding groove site is located on a large open area of sandstone with many shallow plans. There is one visible groove in the SE end of the outcrop. The condition was noted as per the AHIMS site card (first recorded by Sefton).

2.20.1 NEW 1 baseline recording data

Table 30 Baseline recording data for NEW 1

Overview					
Site type	Axe Grinding Groove	**Corrected MGAE**	0311864	**Corrected MGAN**	6218385
Previous Recording	Site card – Caryll Sefton Illawarra Prehistory Group	**Date**	Not specified		
Site Details					
Width	35m	**Length**	20m	**Height**	N/A
Orientation	N/A	**Floor area**	N/A	**Floor condition**	N/A
Location in Landscape	Grinding site is approx. 200m SSE of the large art site at NEW2 and approx. 300m WNW of the intersection on Fire Road 9I				
Site context	On the ridge top				
Distance to water	200m	**Landform**	Upper Basin		
Setting	Gradual Slope				
Archaeological Deposit					
Deposit	N/A	**Describe**	N/A		
Visible artefacts?	N/A	**Where?**	N/A	**How many?**	N/A
Grinding Groove					
Surfaces	1 grinding groove at the side of a large flat pan at the SE end of the sandstone outcrop				
Condition	Distinct. Grinding groove size, 25x8x1cm				
Damage/threats					
Water wash	N/A	**Graffiti**	N/A	**Macrovegetals**	N/A
Animals	N/A	**Salt/granular loss**	N/A	**Fissuring**	N/A
Insects	N/A	**Spalling/exfoliation**	N/A	**Other**	N/A
Fire	N/A	**Block fall**	N/A		

Table 31 Baseline recording data for grinding grooves at NEW 1.

Site Context	
Site Dimensions	25 x 8 x 1cm
Context	Located on the ridge top on a large open area of sandstone with many shallow pans
Site Condition	Poor- eroding
Groove Description	
Number of groups grooves	1
Total number of grooves	1
Type, Profile	U shape
Function	Axe Grinding
Condition	Poor- eroding
Orientation	S-SE

2.20.2 Baseline recording images – Site Overview

Plate 82: Overview of NEW 1. View looking North.

Plate 83: Overview of NEW 1. View looking South.

2.20.3 Baseline recording plans – Site overview

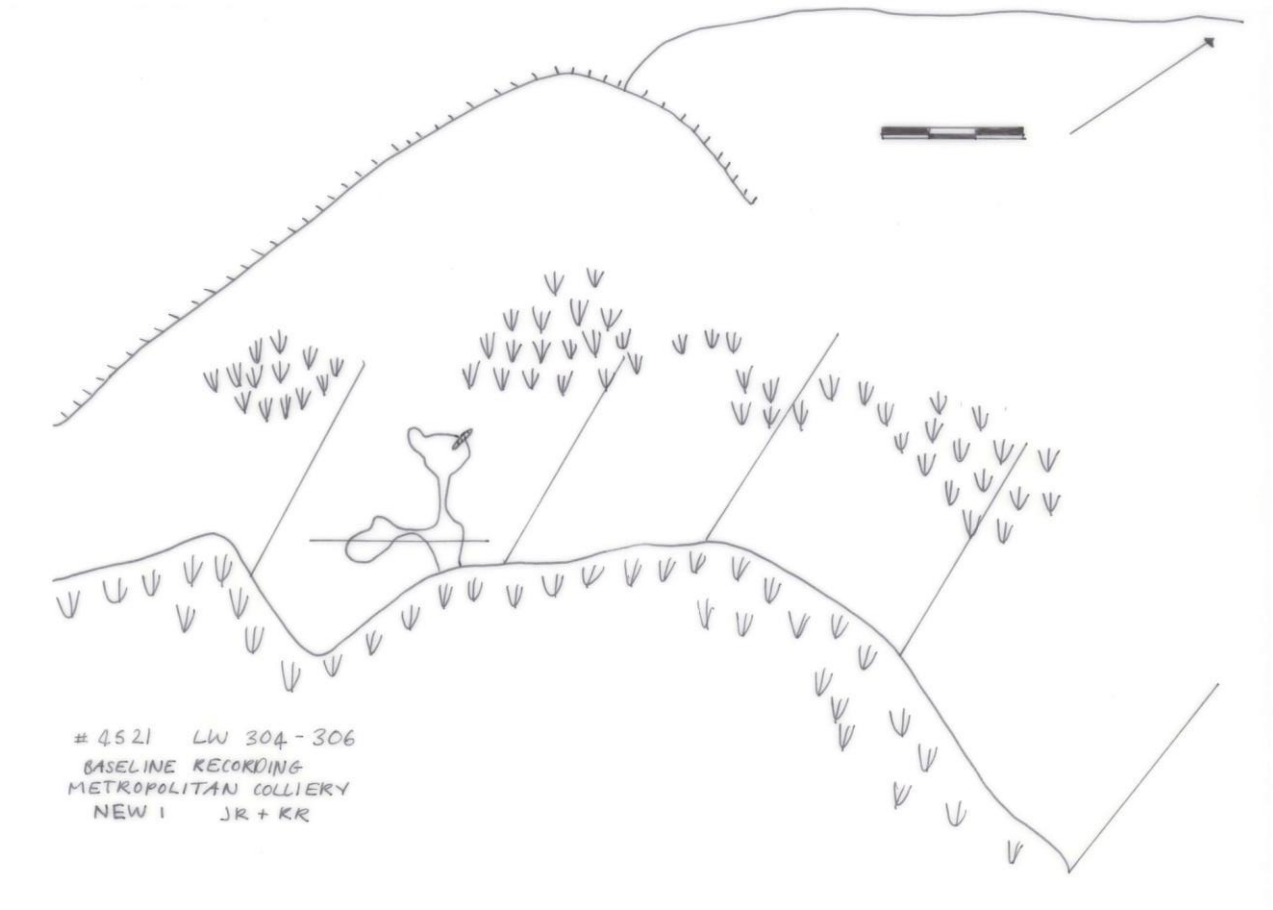


Figure 42: Plan of NEW 1.

2.20.4 Baseline recording images – Detail recording

Plate 84: Detail of NEW 1. Axe Grinding Groove.

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☐ Additional information ☐

SITE IDENTIFICATION

Site name	NORTH EAST WORONORA No 2	NPWS Site Number	
Owner/manager	Sydney Catchment Authority		
Owner Address	PO Box 323 Penrith Business Centre NSW 2751		

LOCATION

Location	Woronora Catchment Area				
How to get to the site	Site location : A shelter is under a large cliff line on the eastern side of the NW running ridge that starts at the 'T' intersection on Fire Road 9l. It is 1.5km NW of the Garrawarra Aged Care centre. Site position : under the first cliff line down from the top.				
1:250,000 map name	Wollongong			NPWS map code	52
AMG Zone XXX MGA	56	AMG Easting XXX MGA	311860	AMG Northing XXX MGA	6218555
Method for grid reference	Hand-held GPS (GDA94 datum)	Map scale (If method = map)		Map name	APPIN
NPWS District Name (see map)	Southern Metropolitan			NPWS Zone (see map)	Sydney Zone
Portion no.				Parish	Heathcote

SITE DESCRIPTION

Site type(s)	Archaeological Deposit Shelter/Grind.Grooves	Site type code (NPWS use only)	

Description of site and contents
CHECKLIST eg. length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.
ART area of decorated surface, motifs, colours, wet,/dry pigment, engraving technique, no. of figures, sizes, patination.
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried

Closed Site Size : L (m): 40 W (m): 7.2 H (m): 5.5 Site Faces: NE
Living Area (sq m): 72 Site Formed By : Cavernous Weathering : Y Blockfall : Y
Deposit : Depth (cm): 50 Deposit Colour: Brown Texture: Loamy Sand
Open Site Size(m) Grinding Grooves: 9 Groove Size (cm):44x8x2 Condition:
Artefacts Present: 3 FGS: Silcrete: Quartz: 2 Quartzite: Chalcedony:
Chert: 1 Jasper: Fossilised Wood: Igneous: Artefact Location : Dripline
Art Condition : Good/poor Art Surface: Case hardened

ART/DEPOSIT COMMENTS

There is a large quantity of art in this shelter in good to poor condition, as follows:
1. Rear wall : 1 charcoal outline and infill frontal human figure, 2 charcoal indeterminate drawings.
2. 3 charcoal indeterminate drawings, 1 charcoal outline kangaroo, 5 charcoal outline and infill fish
3. 8 charcoal indeterminate drawings, 2 charcoal outline and infill kangaroos
4. 1 large charcoal outline and infill kangaroo with joey, superimposed with 1 charcoal outline and infill kangaroo, 1 indeterminate red ochre drawing, 1 charcoal outline and infill kangaroo. [Contin. on attached sheet] ..

Further comments ? As attachment to NPWS Site Recording form

ART SUMMARY

Art Method	Art Motif	Art Nos
Charcoal Drawings	Kangaroo	14
Charcoal Drawings	Symbol	94
Charcoal Drawings	Fish	6
Charcoal Drawings	Human Figure Frontal	3
Charcoal Drawings	Wombat	1
Charcoal Drawings	Indeterminate	32
Red Ochre Drawings	Indeterminate	5
	Total Art :	155

REPRESENTATIVE ARTEFACTS

Type	Material	LxWxTmm
Bipolar Flake	Quartz	13x5x2
Bipolar Flake	Quartz	18x10x6
Flaked piece	Chert	10x10x6

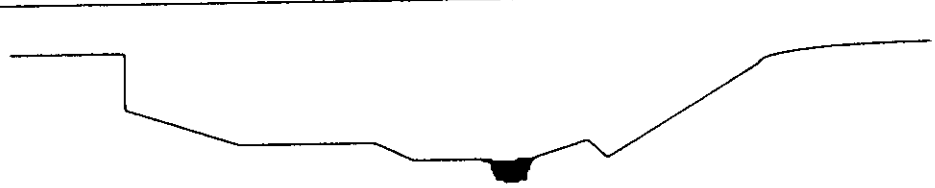
Attach photographs and sketches, eg. plan & section of shelter.
Do NOT dig, disturb or damage site or contents.

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Upper Valley Slope	Aspect	NE	Slope	Moderate
Mark position of the site					
Local rock type	Hawkesbury sandstone	Land use/effect		Undeveloped catchment area	
Distance from drinking water	150 (m)	Source		Side creek	
Resource zone (eg. estuarine, river, forest)	Woodland	Vegetation	Angophora costata Banksia serrata	Eucalyptus piperita Acacia longifolia	
Edible plants		Faunal resources (include shellfish)		Shell : No	
Other exploitable resources (eg. ochre)	Ochre Source: No		Ochre Colour:		
Are there other sites in the locality	Yes	Are they in the Sites Register	Yes	Other site types include	Shelters with art/deposits,grinding grooves, rock engravings

SITE MANAGEMENT

Site condition	Weathering/eroding	Site Disturbance: No	Type : Wombat: Rubbish: Feral: Fireplace Graffiti: Other:
Management recommendations			
Have artefacts been removed from site	No	When	
By whom		Deposited at	
Consent applied for	☐	Consent issued	☐
Date of Issue		Consent number	

SITE INSPECTION AND RECORDING

Reason for investigation	Routine survey by Illawarra Prehistory Group		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☐ Contacted and present ☒ Contacted but not present	Names and addresses	Jim Davis,Senior Sites Officer, Illawarra Local Aboriginal Land Council 484 Northcliffe Dr., Berkeley NSW 2506
Is the site important to local Aborigines	Yes		
Verbal/written reference sources	Illawarra Prehistory Group diary	ASR report number(s) (or title)	C- C-
Photographs taken	Yes	No. of Photos attached	
Site recorded by	Caryll Sefton	Date of recording	
Address/institution	Illawarra Prehistory Group 12 Chenhall St WOONONA, NSW 2517 Tel 02 4284 2004		

Version: June 1998 Data entered by: Date entered:

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☐ Additional information ☐

SITE IDENTIFICATION

Site name	NORTH EAST WORONORA No 2	NPWS Site Number	
Owner/manager			
Owner Address			

LOCATION

Location					
How to get to the site					
1:250,000 map name				NPWS map code	
AMG Zone		AMG Easting		AMG Northing	
Method for grid reference		Map scale (If method = map)		Map name	
NPWS District Name (see map)				NPWS Zone (see map)	
Portion no.				Parish	

SITE DESCRIPTION

Site type(s)	Art Shelter/Archaeol.Deposit/Grind.Grooves	Site type code (NPWS use only)	

Description of site and contents
CHECKLIST eg length, width, depth, height of site, shelter deposit, structure, element eg tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.
ART area of decorated surface, motifs, colours, wet./dry pigment, engraving technique, no. of figures, sizes, patination
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried

FURTHER COMMENTS (continued from ART/DEPOSIT COMMENTS on attached Site Card

. .. [Contin. from Site Card]
5. 1 red ochre indeterminate drawing, 6 charcoal indeterminate drawings.
6. 2 charcoal outline and infill kangaroos, 1 large charcoal outline and infill kangaroo, 1 charcoal outline fish. Superimposed over these is 1 red ochre indeterminate drawing, 1 charcoal indeterminate drawing.
7. 1 charcoal outline with 'V' shaped infill frontal human figure, 1 charcoal outline wombat, 3 charcoal outline kangaroos, 1 charcoal outline and infill kangaroo, 3 charcoal indeterminate drawings.
8. 12m further along the shelter in a second area : 1 charcoal outline profile human male figure.
9. 6 charcoal indeterminate drawings, 5 charcoal outline symbols, 1 charcoal outline and infill kangaroo.
10. Upper wall : 89 charcoal symbols.
11. In a concavity at the W end of the shelter : 2 red ochre indeterminate drawings, 3 charcoal indeterminate drawings.

Artefacts found on the drip line inside the shelter were : 1 grey chert flaked piece (10 x 10 x 6mm) with 20% pebble cortex, 1 white quartz bipolar flake (13 x 5 x 2mm), 1 white quartz bipolar flake (18 x 10 x 6mm).

Grinding grooves are on three boulders in the front of the shelter. They are in several drip lines over 8m inside the shelter, 3 on a large boulder in the centre and 4 + 2 on an outcrop of rock on the floor at the western end.

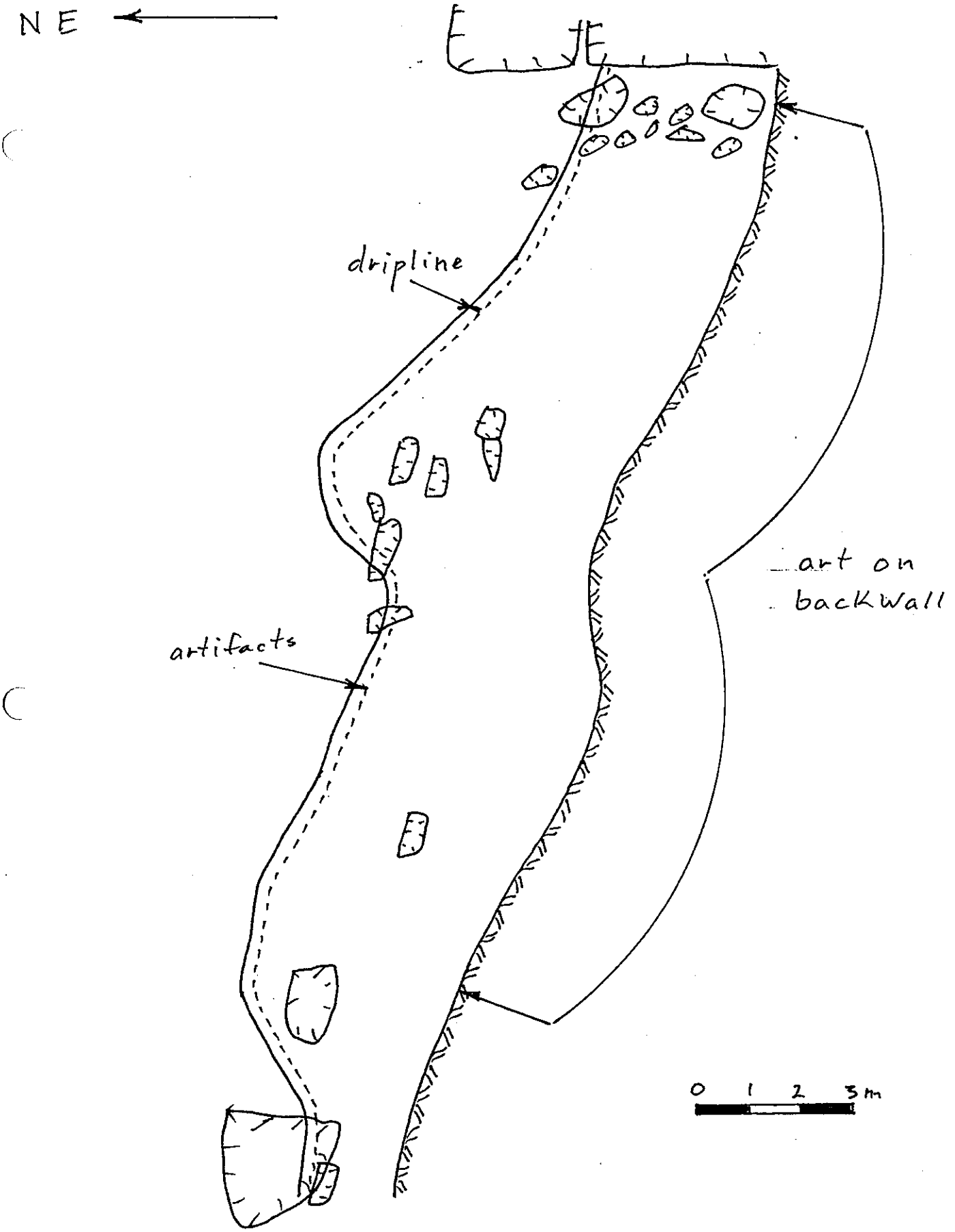
Total grooves = 9

Groove Size = 44 x 8 x 2cm.

Attach photographs and sketches, eg. plan & section of shelter.
Do NOT dig, disturb or damage site or contents.

Caryll Sefton
12 Chenhall St WOONONA NSW 2517 Tel 02 4284 2004

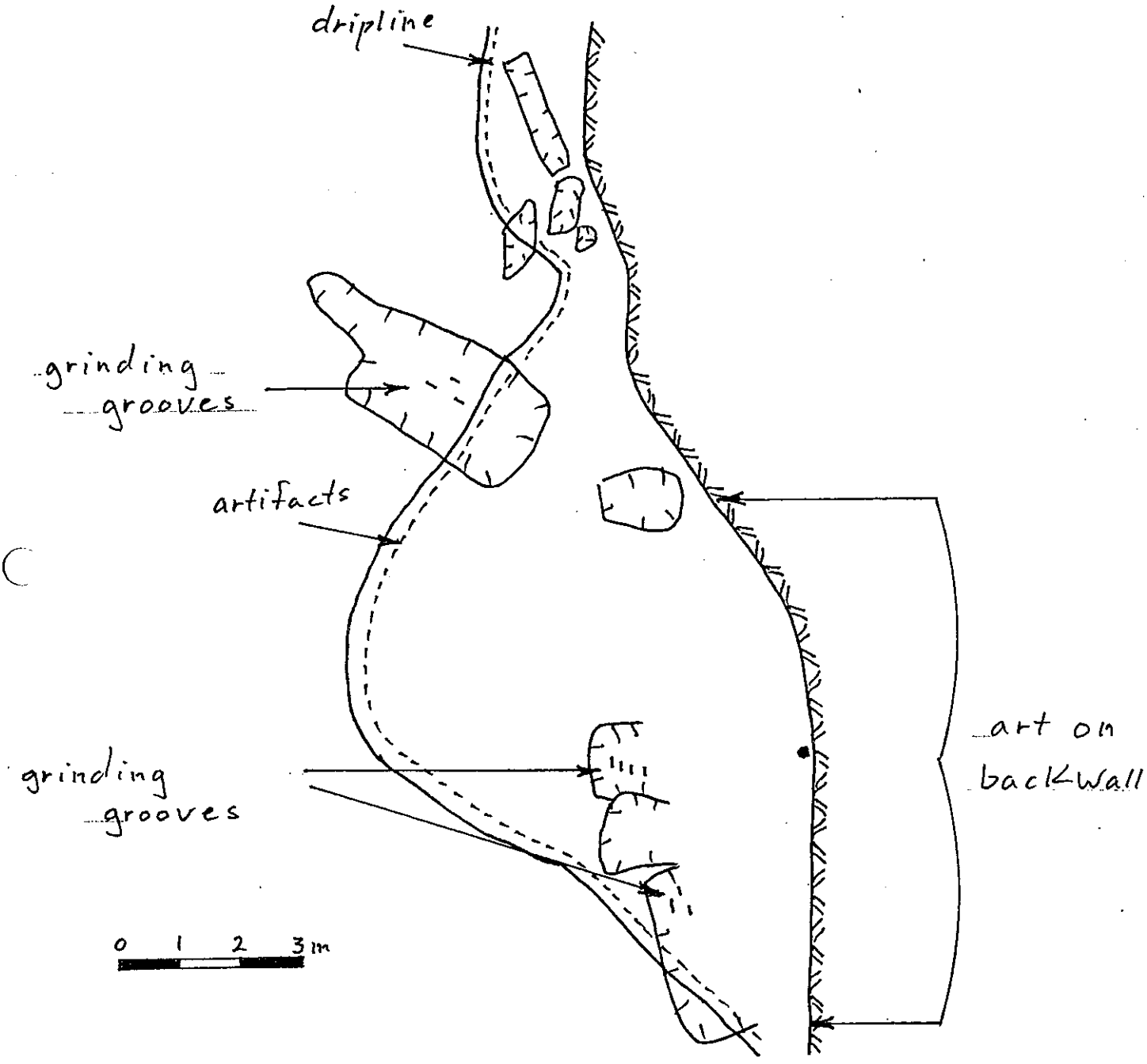
N.E.W. No 2



Plan of Shelter (continued on sheet 2)

N.E.W. No 2

NE ←



Plan of shelter (continued from sheet

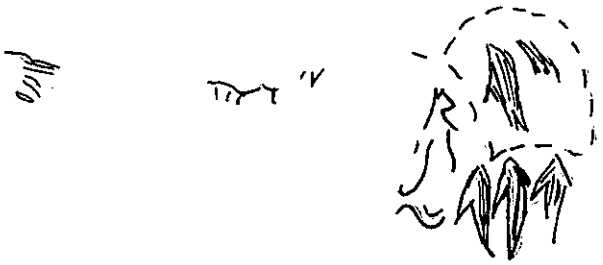
Roof level
1.5m

North East Woronora 2
Section 1

①

Roof Level

②



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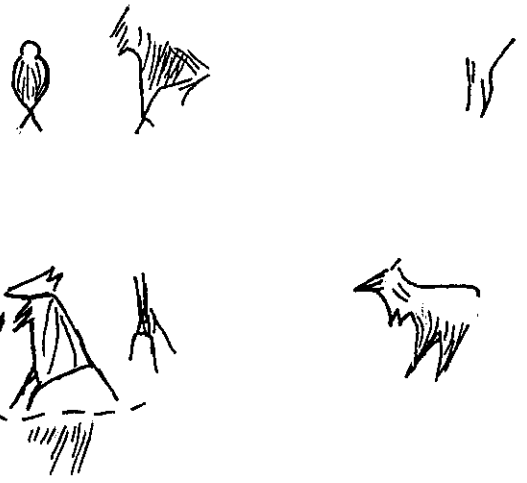


Legend

charcoal drawing

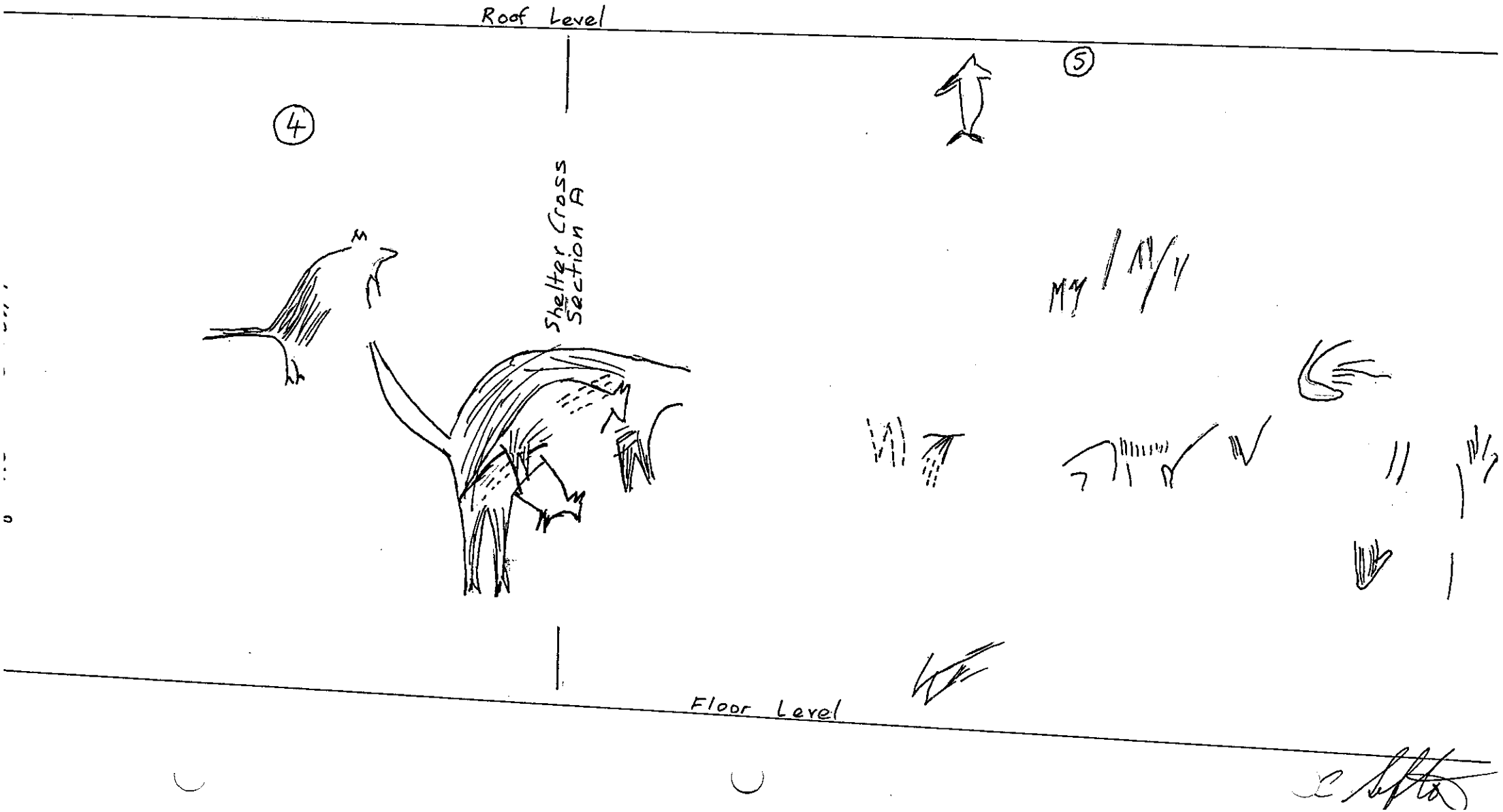
red ochre drawing

structure line: edge of concavity, art surface etc.

0 0.2 0.4 0.6m

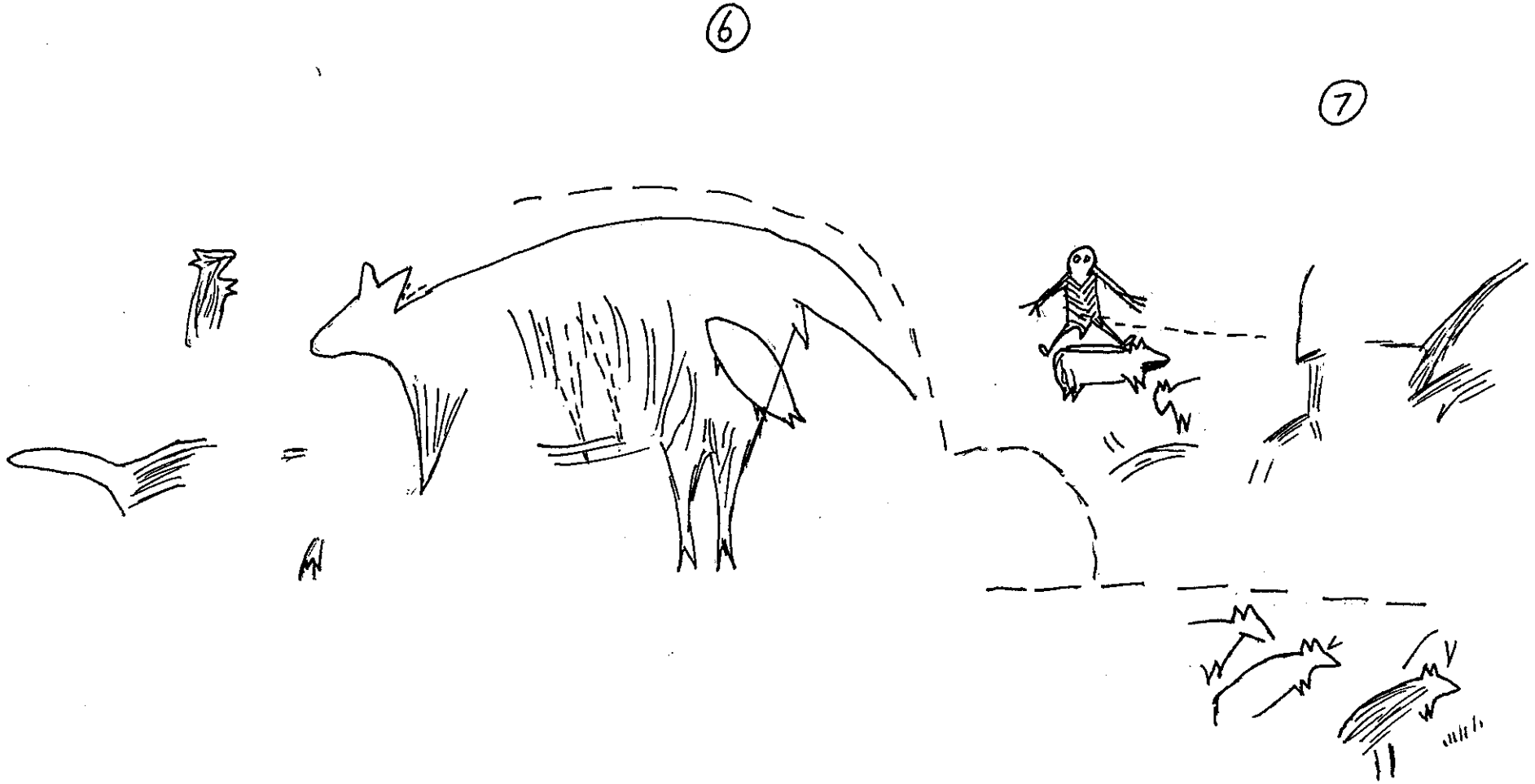
Floor level

North East Woronora 2 – Section 2



North East Woronora 2 Section 3

Roof level



Floor Level

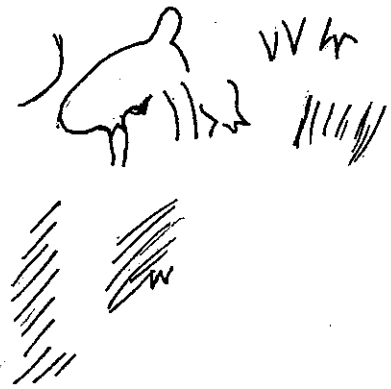
North East Woronora 2 Section 4

Roof Level
2·3 m

⑧

⑨

10·5 m to section 3

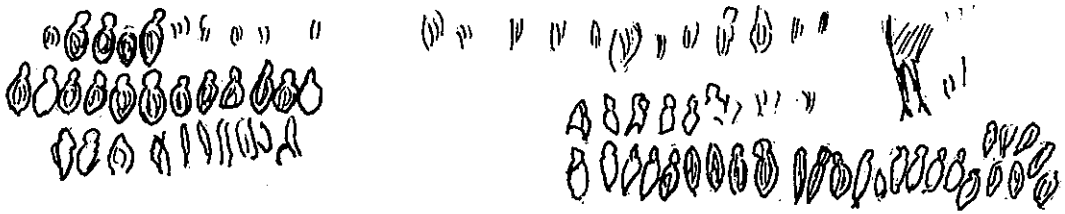


Floor Level 0·5 m

North East Woronora 2

Section 5

Roof Level 0.8m



(10)

(9)

(11)

Shelter Cross section B

end of shelter

Floor Level

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☐ Additional information ☒

SITE IDENTIFICATION

Site name	NORTHERN TRAIL No 35	NPWS Site Number	
Owner/manager	Sydney Catchment Authority		
Owner Address	PO Box 323 Penrith Business Centre NSW 2751		

LOCATION

Location	Woronora Catchment Area				
How to get to the site	Site location : A shelter 350m SW of the end of Fire Road 9E, and 50m SE of the NE-flowing creek parallel to and N of that road. Site position : under the third cliffline down from the road, and 80m E of FRC34.				
1:250,000 map name	Wollongong			NPWS map code	52
AMG Zone XXX MGA	56	AMG Easting XXX MGA	311103	AMG Northing MGA	6217300
Method for grid reference	Hand-held GPS (GDA94 datum)	Map scale (if method = map)		Map name	APPIN
NPWS District Name (see map)	Southern Metropolitan			NPWS Zone (see map)	Sydney Zone
Portion no.				Parish	Heathcote

SITE DESCRIPTION

Site type(s)	Art Shelter/Archaeol.Deposit/Grind.Grooves	Site type code (NPWS use only)	

Description of site and contents
CHECKLIST eg. length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.
ART area of decorated surface, motifs, colours, wet./dry pigment, engraving technique, no. of figures, sizes, patination
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried

Closed Site Size : L (m): 12 W (m): 3.6 H (m): 1.7 Site Faces: NW
Living Area (sq m): 10 Site Formed By : Cavernous Weathering : Y Blockfall : Y
Deposit : Depth (cm): 30 Deposit Colour: Cream Texture: Sandy Loam
Open Site Size(m) Grinding Grooves: 1 Groove Size (cm):40x9x2 Condition: Indistinct
Artefacts Present: 1 FGS: Silcrete: Quartz: Quartzite: Chalcedony:
Chert: 1 Jasper: Fossilised Wood: Igneous: Artefact Location : Dripline
Art Condition : Fair/poor Art Surface: Fungal grwth, water damage

ART/DEPOSIT COMMENTS

Art is present in fair to poor condition, as follows;
1.:On an upper slanting back wall : 1 outline and infill charcoal kangaroo with joey, 1 outline only charcoal drawing of a pointy nosed marsupial (bandicoot?).
2.:On the lower back wall : 1 charcoal outline drawing of a fish.
1 grinding groove is on a rock surface in front of the western end of the shelter.
An artefact was found on the drip line : 1 grey chert flake (13 x 9 x 3mm

Further comments ? No

ART SUMMARY

Art Method	Art Motif	Art Nos
Charcoal Drawings	Kangaroo	1
Charcoal Drawings	Bandicoot	1
Charcoal Drawings	Fish	1
	Total Art :	3

REPRESENTATIVE ARTEFACTS

Type	Material	LxWxT (mm)
Flake	Chert	13x9x3

Attach photographs and sketches, eg. plan & section of shelter.
Do NOT dig, disturb or damage site or contents.

Data entered by: Date entered:

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Lower Valley Slope	Aspect	NW	Slope	Gradual
Mark position of the site					
Local rock type	Hawkesbury sandstone	Land use/effect		Undeveloped catchment area	
Distance from drinking water	75 (m)	Source		Tributary creek	
Resource zone (eg. estuarine, river, forest)	Woodland	Vegetation	Angophora costata Ceratopelalum gummiferu	Eucalyptus piperita Doryanthes excelsa	
Edible plants		Faunal resources (include shellfish)		Shell : No	
Other exploitable resources (eg. ochre)	Ochre Source: No			Ochre Colour:	
Are there other sites in the locality	Yes	Are they in the Sites Register	Yes	Other site types include	Shelters with art/deposits,grinding grooves, rock engravings

SITE MANAGEMENT

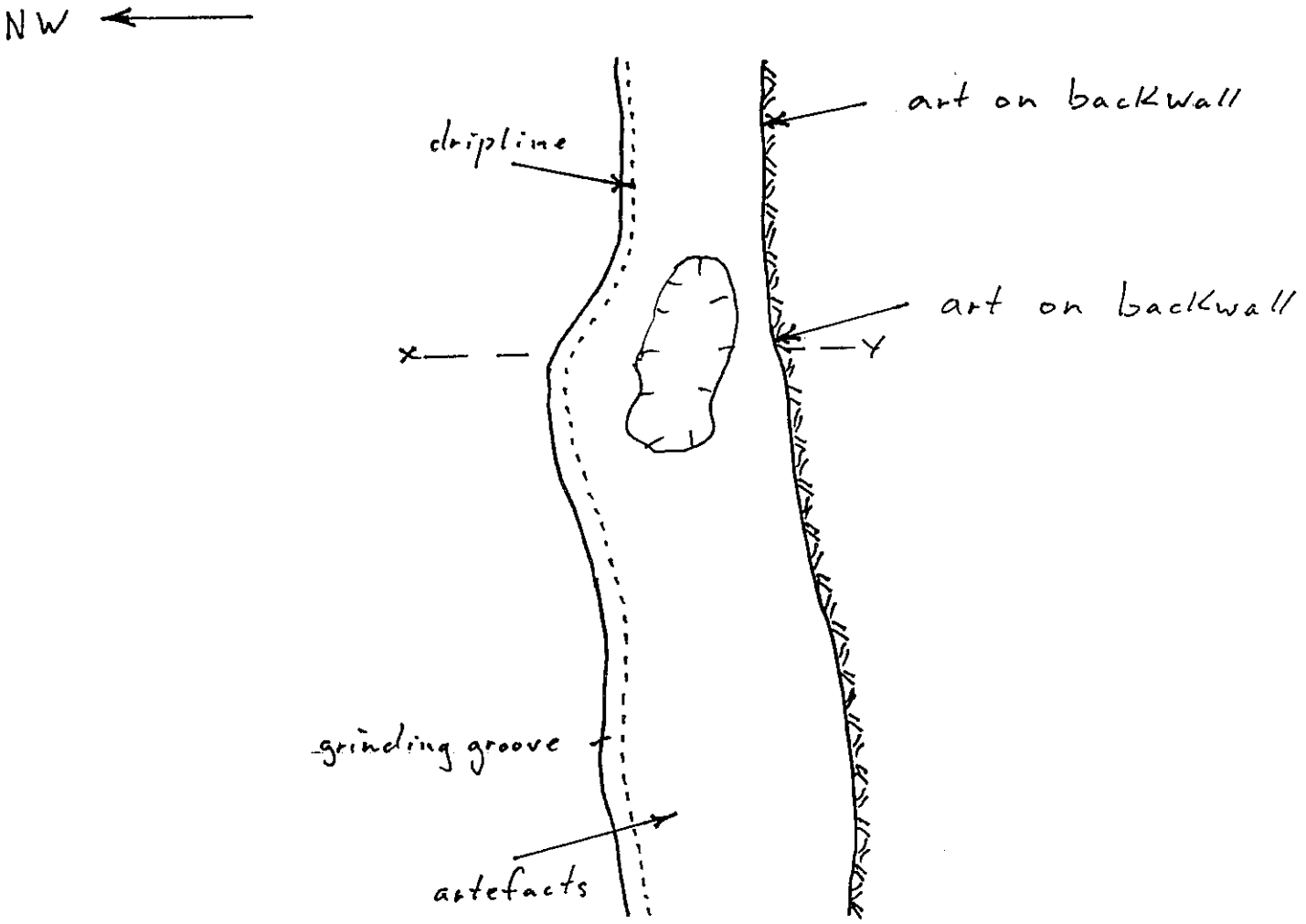
Site condition	Disturbed	Site Disturbance: Yes Type :	Wombat: Y Rubbish: Feral: Fireplace Graffiti: Other:
Management recommendations			
Have artefacts been removed from site	No	When	
By whom		Deposited at	
Consent applied for	☐	Consent issued	☐
Date of Issue		Consent number	

SITE INSPECTION AND RECORDING

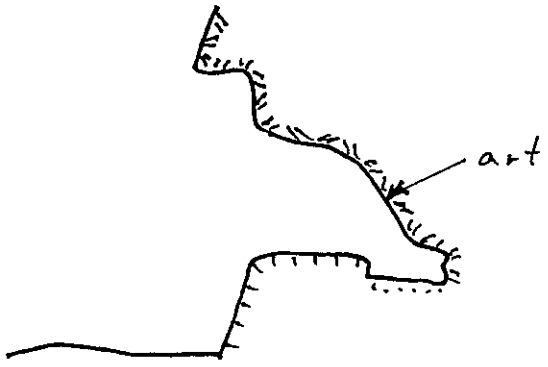
Reason for Investigation	Routine survey by Illawarra Prehistory Group		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☐ Contacted and present ☒ Contacted but not present	Names and addresses	Jim Davis,Senior Sites Officer, Illawarra Local Aboriginal Land Council 484 Northcliffe Dr., Berkeley NSW 2506
Is the site important to local Aborigines	Yes		
Verbal/written reference sources	Illawarra Prehistory Group diary	ASR report number(s) (or title)	C- C-
Photographs taken	Yes	No. of Photos attached	
Site recorded by	Caryll Sefton	Date of recording	
Address/Institution	Illawarra Prehistory Group 12 Chenhall St WOONONA NSW 2517 Tel 02 4284 2004		

Version: June 1998 Data entered by: Date entered:

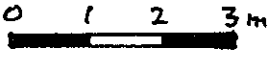
Northern Trail NO 35



Plan of shelter

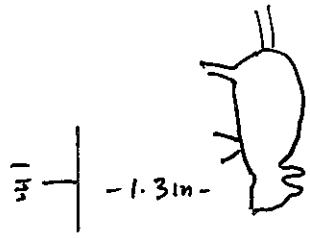


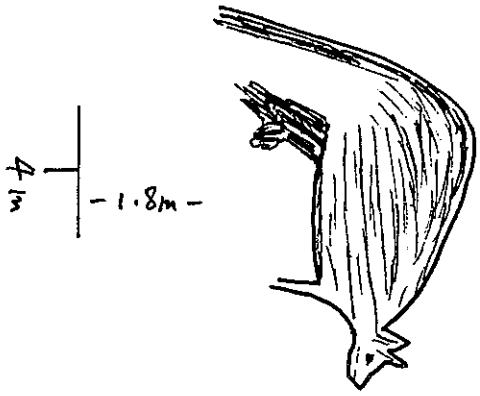
cross-section

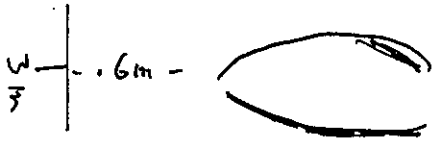


Northern Trail No 35

NW ←







0 .1 .2 .3m

Details of Art

charcoal outline and infill drawings

drawn by K. Kort