14. Archaeology

This Chapter focuses on the Aboriginal and European Heritage items located within the mining area, as well as the areas of direct impact required for the establishment of the surface facilities and infrastructure.

14.1 Introduction

Initial archaeological and cultural heritage assessments commenced in 2000 by Environmental Resource Management Pty Ltd (ERM 2001a). The work was expanded in 2006 by OzArk Environment and Heritage Management Pty Ltd. The study area included the direct impact areas covered by the surface facilities, the potential offset areas and the proposed underground extraction area. Following the development of a predictive model for the occurrence of Indigenous sites, field investigations were undertaken in consultation with Indigenous community involvement. The results of this assessment are provided in Appendices S and T.

In summary, no Indigenous sites were recorded in the Tooheys Road study area, however, two zones of archaeological sensitivity were delineated. The first comprising a 150 m wide corridor centred on Wallarah Creek and extending for approximately 1.4 kms (the length of Wallarah Creek within this study area) and the second being a 100 m wide zone centred on Spring Creek and extending for 200 m. Test excavation of the Wallarah Creek zone was recommended by OzAark and this work will be completed prior to determination of the project.

No sites were recorded in either the Buttonderry study area or the Western Shaft study area however three sites were recorded in the potential offset areas. This area is not subject to any development impact but will be available as an offset for areas of direct disturbance from the project. The three sites included one possible modified (scarred) tree; one open camp site and one isolated find. All were located close to Wallarah Creek.

The survey of the mine subsidence area included sampling the agricultural floodplain and Jilliby Jilliby Creek formation as well as the forested hills of Wyong State Forest and Jilliby State Conservation Area. No sites were detected in the agricultural flooplain however a total of 5 axe grinding grooves were located within the mine subsidence footprint. The surveys also located other sites outside the study area which will be recorded in the State data base (AHIMS).

The results of the archaeological investigations is summarised in the following sections. Both Indigenous and Non-Indigenous heritage is discussed for both the surface facility areas and the proposed mining area.

14.2 Indigenous Heritage - Surface Facility Areas

This section is specific to works associated with surface infrastructure development for the proposed underground mine and land identified as proposed conservation off-sets. A separate assessment was undertaken on the potential impacts to archaeological sites above the proposed mining area, and is summarised in Section 14.4.

The survey was undertaken to identify items of Indigenous and non-Indigenous heritage significance and is in compliance with the DECC *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* and the NSW Heritage Office *Heritage Manual*.

The report is summarized in the following sections and contained in full in Appendix R.

14.2.1 Community Involvement

Consultation for this project was undertaken according to the DECCW "Interim Community Consultation Guidelines" which became effective on the 1st January 2005. An advertisement was placed seeking expressions of interest from Indigenous groups and organisations in the Wyong area to participate in the heritage assessment. Letters were sent to local government and government agencies seeking knowledge of any Indigenous stakeholder groups to contact for inclusion in the consultation process.

Letters seeking an expression of interest to participate in the heritage assessment for the proposed Wallarah 2 Coal Project were sent to Darkinjung Local Aboriginal Land Council (DLALC), Guringai Tribal Link Aboriginal Corporation (GTLAC) and Mur- Roo-Ma Inc. Responses were received from the DLALC and GTLAC. These two groups were then sent details of the planned field assessment and methodology and were engaged to undertake the fieldwork. Draft reports were provided to the groups for review.

14.2.2 Aboriginal Historical Background

Although the exact position of pre-European tribal boundaries is not clear, most of the Central Coast in the Gosford and Wyong area was the country of the Darkinjung tribe; an area today covered by the two local government areas. The Darkinjung lived by fishing, gathering bush foods and hunting. The region was part of an extensive trade network and large ceremonies were held at times of the year when fish were plentiful. Ourimbah, in the middle of the Central Coast region, was a ceremonial ground in which boys were initiated (Vinnicombe 1980).

14.2.3 Archaeological Potential

A search of the DEC AHIMS register revealed 66 previously recorded Aboriginal sites in a 25 km (E-W) x 15 km (N-S) area centred on the current study area. Of these 66 sites, none were recorded in the current study area.

On the basis of the geology, topography and soils, the study area has moderate archaeological potential. In terms of rock shelters, there appears to be low potential of finding such sites in the area covered by the current study as substantial sandstone outcropping is rare. The only potential location is outside the Western shaft study area to the north.

Open sandstone art sites and grinding grooves may also be evident in any landscape where rock outcropping is present. As the current study area contains little sandstone outcropping, the potential for recording such site types would also be low. Open artefact scatters and/or Isolated Finds are likely to exist on ridge tops and associated high slopes (approximately 10 m down slope from the ridge top/ slope break), as well as on low gentle slopes and terraces surrounding creek lines. On the basis of topography, the potential of recording artefact scatters would be moderate across the study area. However, as much of the study area is prone to

erosion and soil movement, there is also the possibility that scatters have been locally redistributed or buried and may be therefore not as evident in the landscape. Furthermore, freshwater middens, which commonly occur along creek lines may be equally affected by both flooding, erosion and soil movement.

There also remains the possibility of subsurface archaeological deposits (including burials) in the study area. Soils in the district are described as moderately deep to deep, particularly along the valley floors of Quaternary alluvium. While erosion should be considered, there remains some potential for sub-surface archaeological deposits in valley floors and on low slopes on Quaternary alluvium. The deep alluvial soils and siliceous sands present along the valley floors are also the most likely environment to yield burials.

The possibility of recording scarred trees within the study area is low as most mature timber has been logged at some time in the past. It should also be noticed that there are very few Scarred Trees recorded in the general vicinity of the study area, probably for the same reason.

Other site types such as quarries, ceremonial places and middens can exist in any landscape although it is assessed that the probability of locating such site types in the area of the surface facilities would be low. This assessment was reached as there is a lack of suitable stone outcrops for quarrying activities and although middens have been located in the region, they are predominantly coastal or associated with larger drainage lines than that afforded by Wallarah Creek. The high degree of disturbance across the study area suggests that ceremonial places would have a low probability of survival.

14.2.4 Indigenous Archaeological Findings

Tooheys Road

The current survey did not record any Indigenous sites or heritage items within the Tooheys Road study area. Although no sites were recorded, it was assessed that two areas within the Tooheys Road study area had archaeologically sensitive landforms. Figure 14.1 shows the two areas.

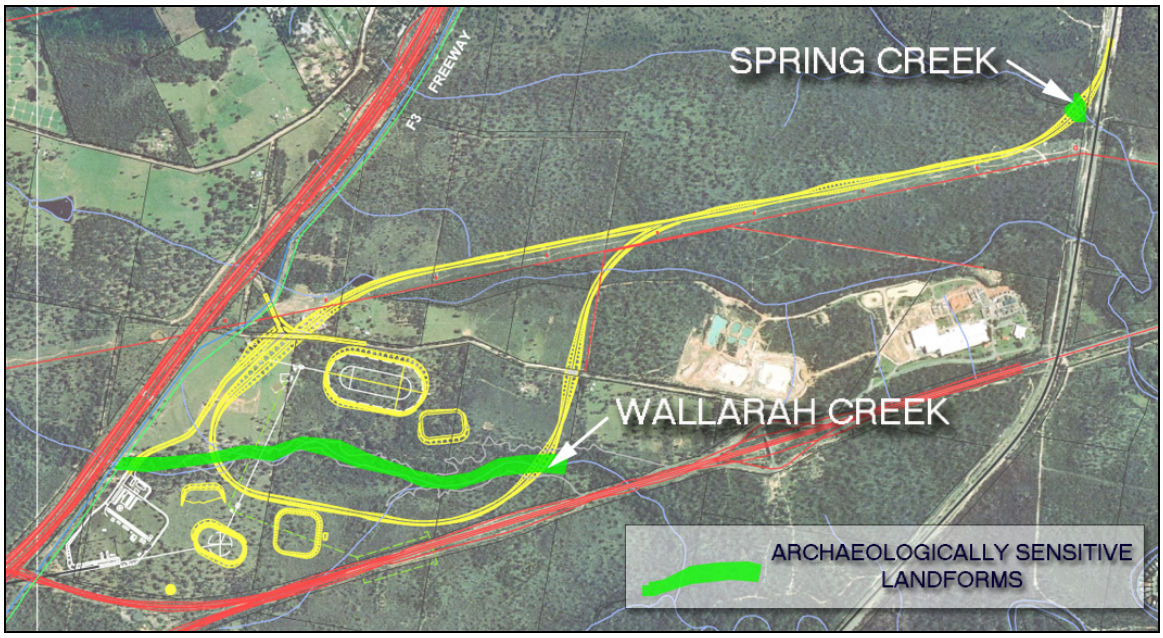

Figure 14.1 Archaeologically Sensitive Landforms at Tooheys Road

The largest area is 75 m north and south from the centre line of Wallarah Creek. This archaeologically sensitive area stretches along the whole length of Wallarah Creek within the Tooheys Road study area. This area of archaeological sensitivity is approximately 1.4 km long (east–west), which gives it a total area of around 210,000 m^2.

The second area of archaeological sensitivity is for 50 m on both banks of Spring Creek. This area of archaeological sensitivity is approximately 200 m long (northwest–southeast), which gives it a total area of around 20,000 m^2.

These two locations were assessed as archaeologically sensitive due to their proximity to permanent water and the nature of their landforms. Although erosion and other disturbances have lessened, in places, the potential for these areas to yield intact subsurface deposits, there remains large areas of land that are suitable for the retention of intact subsurface deposits.

These areas of archaeological sensitivity are recommended for the following reasons:

- A previous archaeological survey (ERM 2001b) assessed that the area along the north and south bank of Wallarah Creek was archaeologically sensitive;
- A site complex was recorded by the present survey on the bank of Wallarah Creek a few kilometres west of the Tooheys Road study area;
- The landform in the Tooheys Road study area is similar to the landform where the present survey recorded a site complex;
- The landform and soil depth in the Tooheys Road study area suggest that intact subsurface deposits could be present; and
- There was low ground surface visibility at the time of survey that hindered the detection of sites.

These areas are being termed areas of archaeological sensitivity rather than Potential Archaeological Deposits (PADs) as there is nothing distinctive in the landscape that would aid the determination of a particular PAD to a discreet area. The areas are rather seen as worthy of further investigation that will assess the nature and extent of any subsurface deposits that may be present.

Within this zone of archaeological sensitivity are several locations where there will be direct impact from the proposed works:

- Rail loop;
- Conveyor; and
- Access road to Pit Top Facility.

The test excavations as described in this EA will be undertaken during the project assessment phase so that the results will be available prior to project determination.

Buttonderry study area
No Indigenous sites were located within the area of direct impact at the Buttonderry study area. It is possible that factors of visibility influenced this outcome, however the general sloping nature of the majority of the landform and the agricultural disturbance to the flatter lands closer to Buttonderry Creek combine to make the detection of *in situ* Indigenous sites unlikely.

It was deemed that no specific zones of archaeological sensitivity could be delineated within this area.

Western shaft study area
No Indigenous sites were recorded within the area of the direct impact at the Western Shaft study area. The study area here is small, fairly extensively disturbed and provided limited visibility, hence making site presence and detection unlikely.

Immediately outside the proposed impact area to the north is a steep, sandstone escarpment that was also assessed during the fieldwork component. Although no rock shelter sites were recorded in the local vicinity of the proposed Western shaft study area, potential was noted for the presence of caves within the escarpment.

Buttonderry off-set study area
No Indigenous sites were located within the Buttonderry off-set study area. A scar on a mature spotted gum (*E. maculata)* was documented in this area, however, the scar was assessed as being of natural, not anthropomorphic origin. No zones of archaeological sensitivity were delineated in this area.

Hue Hue Road off-set study area
Three Indigenous sites, an open artefact scatter (WC-OS1), a scarred tree (WC-ST1) and an isolated find (WC-IF1) were recorded along Wallarah Creek or its tributaries in the Hue Hue Road ecological investigation area. The location of these sites is shown on Figure 14.2 and details are presented below.

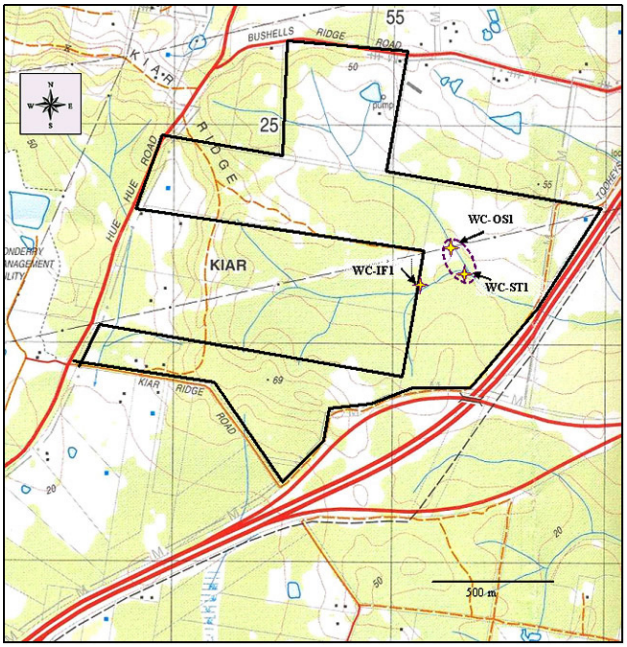

Figure 14.2 Archaeological Findings along Wallarah Creek in Potential Offset Area

WC-OS1 Dooralong 1: 25K GDA 355307-355237E 6324431-6324471 N

This open artefact scatter site is situated on the banks of Wallarah Creek at an elevation of approximately 20 m AHD. The site is located within an alluvial landform, at the base of long, low gradient slopes stretching back from the drainage line.

In general, visibility was low and in areas of better visibility, surface erosion was active, potentially removing evidence from the skeletal soils that characterize the lower slopes. The site is considered to extend at minimum approximately 150 m along the bank of Wallarah Creek on the west and extends to the east bank, at minimum beneath the electricity transmission line, although it is likely to extend further.

The artefacts were recorded in several exposures along a sandy vehicle track. The track is better established in the vicinity of the transmission line, allowing significantly better exposures in this location, coinciding with higher surface artefact visibility.

Artefacts included flakes and cores of a creamy, fine grained material, possibly an indurated mudstone / chert. Also present were artefacts of good quality silcrete (Table 14.1).

It is considered that the nature of the landform combined with the lack of visibility, makes it very likely that artefact material will be found beyond the locations at which surface manifestations exist. The confluence of a tributary into Wallarah Creek at this point is by no means an accident, as this particular environmental setting is a proven popular location for Aboriginal occupation during prehistory. Given its proximity to other sites and the suitable landform, there is potential for sub-surface deposits in this area, although their condition may be questionable due to the affects of erosion.

Table 14.1 Details of Artefacts Recorded at Site WC-OS1

Artefact Dimensions	Raw Material	Comment
Exposure 1 – west side of creek		
17 x 4.5 x 2.1 mm	Cream (indurated mudstone, chert?)	Complete flake, feather termination and 3 negative scars on dorsal surface.
7.9 x 3.5 x 1.77 mm	Reddish green chert	Broken flake
19.79 x 10.4 x 23 mm	Cream (indurated mudstone, chert?)	Core, bipolar
Exposure 2 – east side of creek		
41 x 29.2 x 12.6 mm	Yellow-red silcrete	Broken flake – transverse snap, distal portion missing. Evidence of core rotation and platform preparation (crushed).
16.8 x 12 x 2.7 mm	Silcrete	Broken flake, proximal end missing, no cortex.
30.7 x 20.2 x 8.4 mm	Cream (indurated mudstone, chert?)	Broken flake, 2 negative flake scars, small platform.
Southern exposure, west side of creek (adjacent to confluence)		
35.7 x 28.4 x 7 mm	Cream siltstone	Flake (-ve flake scars).
8.2 x 4 x 0.2 mm	Cream siltstone	Broken flake.

WC-ST1 Dooralong 1: 25K GDA 355284 E 6324324 N

This scarred tree is a Blackbutt (*E. pilularis*) located on the southern bank of a tributary flowing into Wallarah Creek and within approximately 50 m of this confluence, at an elevation of AHD approximately 25 m. The tree is situated on a sandy, creek bank landform on DP 258692.

The scarred tree is alive, approximately 25 m in height, and 2.73 m in circumference. The elongated, south-southeast facing scar has dimensions of 104 x 13 cm, with a depth of approximately 15 cm. The original dimensions, based on regrowth, may have been around 132 x 43 cm.

The scar on this tree is assessed as being of possible Indigenous cultural origin, but it must be noted that the tree is adjacent to a vehicle track and could be the result of damage from a vehicle, or from previous natural processes that have affected the tree.

Morphological characteristics of the scar, however, such as its alignment with the trunk, its elongate nature and more specifically the tapered appearance of both ends, lend themselves to an interpretation of the scar as anthropomorphic in origin. Further support for this contention comes from the presence of artefacts in direct association with the scarred tree, as there is positive evidence for the Indigenous use of the area in prehistory.

WC-IF1 Dooralong 1: 25K GDA 355124 E 6324266 N

Isolated find WC-IF1 is located on the northern bank of a tributary into Wallarah Creek. The site was recorded on a dirt track that is actively eroding. Surrounding areas are unlikely to have been ploughed but may have been grazed, and have been selectively cleared. Visibility was good on the track, but poor off it.

This is the same tributary that provides evidence of occupation at its confluence with Wallarah Creek, several hundred metres to the east (WC-IF1 and the southern portion of WC-OS1). Although this isolated find has been presented as a separate site from WC-OS1, it is in essence considered to be part of the same site complex. It is likely that visibility and erosion have influenced the appearance of the archaeological record in this area, although it is also plausible that temporal variation may also be a factor.

The artefact comprising WC-IF1 is a cream flake possibly of indurated mudstone. Given its proximity to other sites and suitable landform, it is likely to have at some point been associated with other artefacts, and there is potential for sub-surface deposits in this area, although their condition may be questionable due to the affects of erosion.

In keeping with the results of the assessment of the Tooheys Road study area, and based on the results of survey within the Hue Hue Road off-set study area, a zone of archaeological sensitivity can be delineated along Wallarah Creek and its more major tributaries.

14.2.5 Significance of Indigenous Archaeological Findings

Given the high levels of disturbance to the ground surface throughout the study area (either from clearing and ploughing/grazing, or from erosion by water or human activity), it is not surprising that more sites were not recorded.

Landscapes such as that around Wallarah Creek would not have supported large, permanent populations and so the sites remaining tend to be of transit camps, rather than large base camps. Transit camps have lower densities of lithic discard and their more ephemeral nature can be removed from the landscape altogether if disturbed by ground surface alteration and/or erosion.

Although recorded sites were few, the landform along both the north and south bank of Wallarah Creek within the Tooheys Road study area was assessed as being archaeologically sensitive. No relics were located in this 150 m wide band along the creek, even where sheet erosion gave reasonable ground surface exposure. While not assessed as a PAD, because this zone of sensitivity has no easily discernible boundaries, this archaeologically sensitive zone has been declared as the one landform within the study area that requires further investigation before full management recommendations can be advanced.

Consultation regarding the significance of the artefact scatter sites WC-OS1 and WCIF1 were held with the community representatives on site and were assessed as being of high cultural significance. The cultural significance of the scarred tree WC-ST1 is more challenging for the community due to it being deemed a "possible" scarred tree, although this site type is general as having moderate-high cultural significance.

The scientific assessment of artefact scatter sites revolves around the known local context of this site type (i.e. are there many, some or no such features known locally). Looking within a 25 x 15 km zone surrounding the study area, there are 15 artefact scatters (or 22.7% of total recorded sites) recorded on the DECCW AHIMS database. This makes artefact scatters the most common site type in the vicinity of the study area.

Sites WC-OS1 and IF1 are both assessed as comprising stone artefacts that are of Aboriginal origin. One is located on the flat and gently sloping banks of Wallarah Creek, while the other on the nearby banks of a tributary flowing into Wallarah Creek. The raw material, artefact density, site size and artefact type are all typical of previously recorded sites in the vicinity. The likelihood of there being associated, intact sub-surface deposits is considered moderate-low. As such the artefact scatter is assessed as having low-moderate scientific significance.

Scarred tree WC-ST1 is assessed as being of probable Aboriginal origin. It is located on the gently sloping bank of the Wallarah Creek and the likelihood of there being associated, intact sub-surface deposits is considered moderate, as this tree is in association with recorded artefacts. Although scarred trees are a relatively rare site type in the region, there is only a probable chance that the scar was created by human agency, as such this site is assessed as being of low-moderate scientific significance.

Artefact scatter sites WC-OS1 and IF1 are assessed as being of low public significance as the sites are hard to locate, on private land and comprise artefacts that would be challenging for the lay person to identify.

Scarred tree WC-ST1 is also assessed as being of low public significance as the tree is on private land, the scar itself is not of a rare or unusual type and is in fact only identified as a possible scarred tree.

14.2.6 Impact Assessment

Although no sites were recorded in the Tooheys Road study area, two primary zones of archaeological sensitivity were delineated along Wallarah and Spring Creeks. There are several points at which the proposed impacts of the project intersect with areas assessed as archaeologically sensitive.

The proposed impacts to Wallarah Creek are (refer to Figure 14.3):

- The creek crossings for the Eastern and Western Arms of the Rail Loop;
- The creek crossing for the Conveyor Belt;
- The creek crossing for the Access Road to the Pit Top Facility; and
- The construction of the northern portion of the Pit Top Facility.

Otherwise, all other areas of impact are more than 100 m from the banks of Wallarah Creek. It is assessed that the impacts to Wallarah Creek will be localised, but severe, with little chance of heritage items surviving the construction process. As ground surface visibility was low, hampering the detection of site, a test excavation program has been designed in described below, to determine the nature and extent of any subsurface deposits.

It is estimated that proposed impact to landforms in the study area that are assessed as archeologically sensitive will total 30,375 m^2. This includes areas to the north and south bank of Wallarah Creek, namely: Eastern Arm Rail Loop (11250 m^2), Conveyor crossing (3000 m^2), Western Arm Rail Loop (11250 m^2), Pit Head Facility and road area on south bank (2625 m^2) and north bank access road to the Pit Top Facility (2250 m^2). The level of impact from the proposed works is assessed as high to any potential archaeological deposits.

As no sites or areas of archaeological sensitivity were identified in either the Buttonderry or Western shaft study areas, there will be no direct impacts to Indigenous heritage and consequently there are no constraints to the proposed impacts in the assessed locations on the grounds of cultural heritage. If the location and extent of impacts alters significantly, some limited re-examination of the area may be required.

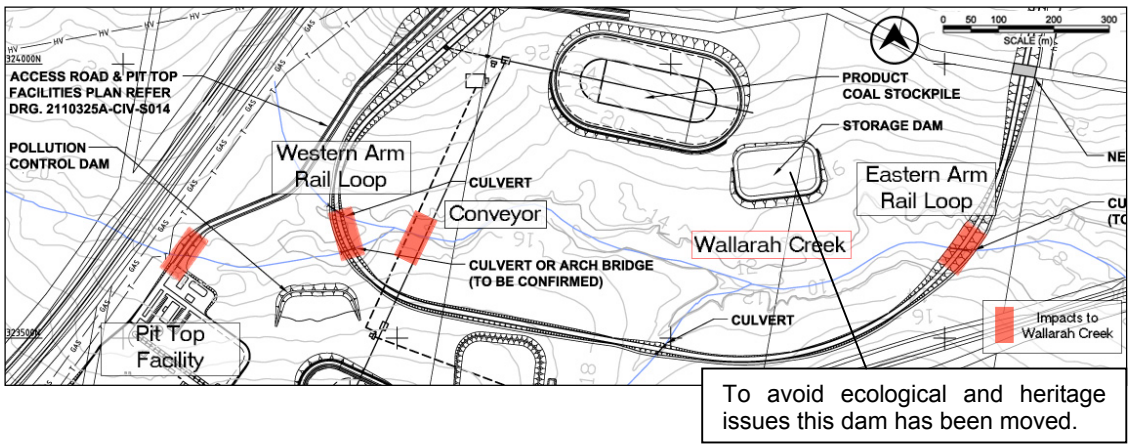

Figure 14.3 Potential Impact Areas in the Vicinity of Wallarah Creek

14.2.7 Management

The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigative measures against individual site disturbance. The management outcomes will be employed through all aspects of the operation:

- Avoid impact by altering the development proposal where practicable;

- If impact is unavoidable then further investigation or site destruction from the construction of project infrastructure may occur and are documented in the Statement of Commitments for the project (Chapter 16). These then form the basis of the Conditions that the Minister for Planning may place within the Project Approval for the project, which often take the form of a requirement for a Cultural Heritage Management Plan (CHMP).

  The way sites are managed, in accordance with the conditions of the project approval, will depend on many factors including the site's assessed significance. Sites of moderate to high significance and/or potential may require either test or salvage excavation, or more detailed recording. Sites of low significance may be impacted with no further archaeological assessment being required, or with an approved monitoring program. The local Aboriginal communities may wish to collect or relocate artefacts, whether temporarily or permanently, if necessary.

Tooheys Road Test Excavation

The preferred management recommendation for the Tooheys Road study area is to conduct test excavations at a number of locations along Wallarah Creek. These locations are either in areas that will be directly impacted by the proposed works, or nearby. This work will be undertaken during the project assessment phase so that the results will be available prior to project determination

The aims of the test excavation program are to determine the presence, nature, extent and integrity of subsurface deposits such that appropriate management recommendations may be formulated.

It was determined that a test excavation program was not recommended for the other area of archaeological sensitivity at Spring Creek. This was due to the high degree of disturbance the north-eastern bank of the creek has suffered, where the landform was most conducive to retaining intact subsurface deposits. This disturbance is either from the previous construction of the rail line and bridge, or from the numerous vehicle tracks in the area. In particular, the track along the side of the north-eastern bank is heavily rutted from bogged vehicles. The south-western bank of Spring Creek is heavily eroded, in places quite steep and also criss-crossed with vehicle tracks, mostly from motocross bikes. As such it was assessed that there would be few places on the south-western bank that would have soil depth to preserve intact subsurface deposits.

Another area that was noticed during the survey, but has not been included in the test excavation program, was the junction between Wallarah Creek and the un-named tributary from the south. Creek junctions such as this were often the focus of Indigenous activity and it is common to locate sites in such landforms. However, as this creek junction is outside any proposed impact, it was assessed that this portion of the archaeologically sensitive area should not be part of the test program. As

conservation is always the desired management outcome, excavation will be avoided while this creek junction remains outside any areas of proposed impact.

The testing program will sample six transects; both in areas of direct impact, as well as in adjacent areas (Figure 14.4). Three transects will be 150 m long and dissect Wallarah Creek north-south, sampling deposits on the north and south banks. One north-south transect is confined to the south bank only as the north bank has low potential for intact deposits. These north-south transects are located at the points where creek crossings will be directly impacted. In addition there are 2 east-west transects that, in places, link the north-south transects and generally allow a fuller examination of the southern bank of Wallarah Creek, an area that will be impacted more severely than the north bank.

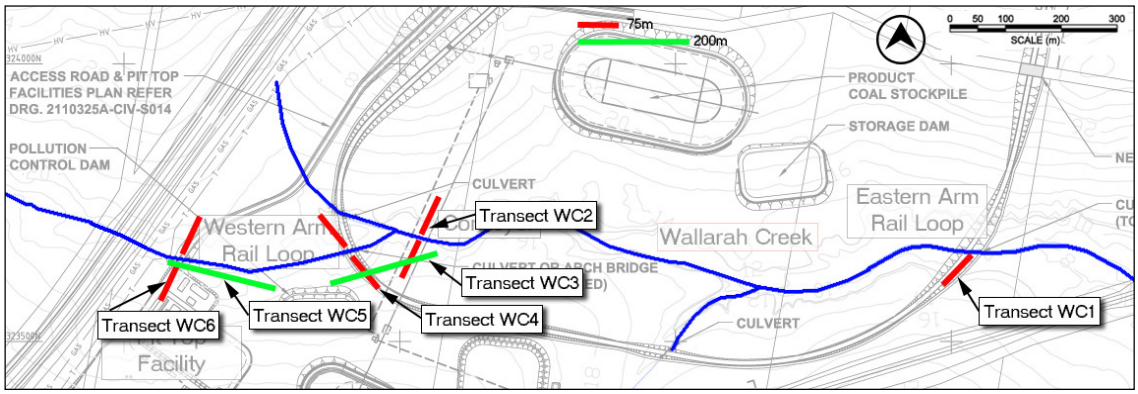

Figure 14.4 Proposed Transect Lines in the Vicinity of Wallarah Creek

The test excavation program methodology is provided in detail in the specialist report contained in Appendix R. This work will be undertaken prior to project determination.

Buttonderry and Western shaft study areas
As no sites or specific areas of archaeological sensitivity in terms of Indigenous site location were delineated in these areas, there are no specific management recommendations and no constraints to the proposed development on the grounds of cultural heritage. Should the predicted impacts alter significantly from those assessed for the current project, then further investigation may be required.

Potential off-set areas
Three Indigenous sites were located at the Hue Hue Road study area along Wallarah Creek and its tributaries. The preferred management of these sites and indeed the entire creek line which encompasses the delineated area of archaeological sensitivity, is to see the area formally conserved through a mechanism such as a covenant on the title of the land.

14.3 Non-Indigenous Heritage – Surface Facilities

14.3.1 Historical Background

The Wyong area was settled in the early 1820s, though timber getters worked and lived here from the 1790s, when large grants over 1000 acres were given in the Dooralong Valley and in Wyong township. In the 1840s land grants were given in

the Ourimbah, Wyong and Jilliby areas in 1000 acre parcels. The poorer land of Warnervale and Gorokan was not 'taken up' until the 1870s.

The timber industry has been a major influence of the Wyong Valley since the 1800s. During the 1820s, timber getters came into the Valley to fell cedar, forest oak and rarer rainforest trees. This practice occurred in both the Dooralong (since the 1820s) and Yarramalong (since the 1830s) valleys, with timber often being and shipped to Sydney. By the 1880s, there were three timber mills operating in the Yarramalong Valley producing rims for wagon wheels, fruit cases and house timber.

The timber industry also opened up the valleys and attracted farmers and settlers who cleared the river flats in the 1850s. These were mainly subsistence farmers growing fruit and vegetables and grazing stock. By the 1860s there was an influx of settlers along the Wyong River, its tributaries and Jilliby Jilliby Creek, attracted by settlement incentives offered as part of the Robertson Land Acts. By 1880s much of the river flats of the valleys were cleared and under cultivation.

With the opening of the Sydney/Newcastle railway in 1889, Wyong's population increased and a quicker link to Sydney was created encouraging agriculture and fishing (supplying the Sydney markets), encouraging the development of Wyong as a railway town and initiating tourism. After 1889, new timber mills built in Wyong and in the valleys, opened the timber industry and local vegetable and dairy producers to overseas markets as a result. The height of timber industry was in the early 1900s when exports boomed, however by the late 1920s, much of the local timber had been felled and the area exhausted.

Farming remains the second biggest industry in the Wyong region. By the late 1880s many citrus orchards were planted in Wyong and the valleys. The industry peaked in 1970s. Dairy farming was also a major industry in 1930s, peaking 40 years later when there were roughly 100 operational dairies in the area. However, dairy farming declined in the 1980s, and by 1995/6 no dairy farms were operational in the Wyong Valley. Poultry farming remained a smaller industry, which peaked in the 1960s. Fishing was significant from the earliest days.

Residential development increased with opening of the Sydney Freeway in 1987. An influx of hobby farmers and rural residential development has centred in the Yarramalong Valley (Wyong Valleys Planning Report, 1998). Traditional large acreage agriculture has given way in the last twenty years to smaller hobby farms, rural weekend retreats, market gardens, orchards, nurseries, horse studs and turf farms.

Turf farming, which occurs mostly in the Yarramalong and Dooralong Valleys in the wider floodplains, is the primary agricultural output of the area. Orchards are usually located on the footslopes where the soil is relatively rich and deep and outside the flood zone, confining this to the lower half of the valleys. Stud and beef cattle are common in the valleys along the floodplain and low slopes.

The Wyong region has been subject to a wide variety of documented land use practices since European settlement. As a result of the timber industry and agricultural practices in and around the study area substantial parts of the landscape, especially along river flats and low slopes along the Dooralong and Yarramalong Valleys, have undergone significant modifications.

14.3.2 Previously Identified Items

During the non-Indigenous survey of the Tooheys Road study area, four features of potential interest were identified. Namely:

- 24/NI Possible old fence line along Wallarah Creek (south of Tooheys Road and west of the Freeway within survey unit A);
- 25/NI Rig and furrow with associated old dam (north of Tooheys Road and south of the transmission line within survey unit B;
- 26/NI Possible foundations of old property with drainage gully, introduced plants and possible foundation stones (south of Tooheys Road within survey unit C);
- 27/NI Two old dams possibly in association with 26/NI (on the south side and adjacent to Tooheys Road within survey unit C)

The surveyors concluded that no features of high significance were identified during the survey of the Tooheys Road study area (ERM 2001c). However, the authors noted that the features that were identified may indicate further archaeological remains that were not immediately evident during the survey.

In 2000 a non-Indigenous heritage survey was also conducted by ERM (2001d) that surveyed a much larger area of land that included the mine subsidence area and the construction areas at Kiar Ridge.

During the survey, 23 features were identified of potential value. Table 14.2 lists the 23 items recorded. No item from this list is within the current study area, but all are within close proximity.

Table 14.2 Summary of Sites of Potential Heritage Significance Identified by ERM in 2000

ID Number	Site Type	Location
1/NI	Residential property	1136 Yarramalong Road
2/NI	Residential property	1150 Yarramalong Road
3/NI	Residential property	1152 Yarramalong Road
4/NI	Bridge	Yarramalong Road
5/NI	Residential property	1163 Yarramalong Road
6/NI	Community Hall	Yarramalong Road
7/NI	House with associated dairy and cattle run	1182 Yarramalong Road
8/NI	Residential property	Jilliby Road
9/NI	Residential property	50 Jilliby Road
10/NI	Residential property	686 Jilliby Road
11/NI	Residential property	Jilliby Road
12/NI	Residential property	Jilliby Road
13/NI	Residential property	Little Jilliby Road
14/NI	Residential property	Little Jilliby Road
15/NI	Residential property	Little Jilliby Road
16/NI	Residential property	Little Jilliby Road
17/NI	Bridge	Little Jilliby Road
18/NI	Bunya Pine	Little Jilliby Road
19/NI	Farm buildings and silos	Durren Road

Table 14.2 Summary of Sites of Potential Heritage Significance Identified by ERM in 2000

ID Number	Site Type	Location
20/NI	Picket fencing	724 Durren Road
21/NI	Residential property	Durren Road
22/NI	Farm buildings and silos	Dickson Road
23/NI	Pottery sheds	Kiar Ridge Site

14.3.3 Survey Results

Tooheys Road study area
No items of non-Indigenous heritage items were recorded within the Tooheys Road study area. Items noted by ERM from within the current Tooheys Road study area were relocated and assessed. The current survey's observations of the items noted by ERM are:

- 24/NI This fence line is outside the current study area and was not visited;
- 25/NI There had been recent earthworks in this area and it was hard to discern the rig and farrow noted by ERM;
- 26/NI This feature was revisited and while at the site the present property manager told the archaeologists that the site was once a large chicken shed with runs once belonging to the McCloud family. Very little remains above ground today and what is remaining suggests that it was an insubstantial building when first constructed. Very unlikely to be over 50 years old;
- 27/NI ERM gives little information on why these dams were noted and the present survey could find nothing remarkable about them today. Very difficult to date, but probably less than 50 years old.

Buttonderry study area
No items of non-Indigenous heritage were recorded within the direct impact zones of the Buttonderry study area. Generally across the site, stumps of cut down trees are evidence of prior logging of the area, although visual inspection of the stumps indicates the use of a chainsaw rather than a cross-saw.

Close to Hue Hue Road, in the direct impact area, there is cleared land that appears to have been pasture improved and grazed for dairy cattle over a considerable period. The remnants of cattle yards are still present in the low-lying portion of the study area, outside the area of direct impact.

Western shaft study area
No items or places of non-Indigenous heritage significance were recorded in this study area. The small scale of the Western shaft study area and its location in a State Forest are considered adequate explanative factors for this negative result.

Buttonderry off-set study area
As noted earlier, this property, like the adjacent impact area (the Buttonderry study area), has undoubtedly been used for selective logging over a considerable period of time. Remnant stumps in this area have apparently been cut down using a chain saw and although timber cutting may have occurred in earlier times in this area, no evidence for the use of the cross-saw was noted during survey.

Hue Hue Road Ecological off-set study area
No places of non-Indigenous heritage significance were recorded within the Hue Hue Road off-set study area. It should be noted that full pedestrian survey was not undertaken here and there were certain portions of the study area, notably the western part of DP791157, that were not accessible during the survey as they are currently leased.

14.3.4 Significance of Non-Indigenous Heritage Items

The non-Indigenous heritage items re-examined during the present survey are considered to be of limited importance at a local level and not important in the broader context of NSW's historical development. There are no known associations with significant people, or groups of people, only to the development of the local area for farming. The items do not have any particular aesthetic, technical or scientific characteristics which make them important to NSW or the local area. The items are unlikely to yield any further information about the cultural or historical development of NSW that is not already known. The items, however, may hold some value for the local community, representing an aspect of the historical development of the area for settlement through grazing.

No items within the study area are listed on the Register of the National Estate, the National Heritage List or the Commonwealth Heritage List, the NSW State Heritage Register, NSW National Trust, and the Wyong Local Environmental Plan 1991 Schedule of Heritage Items.

14.3.5 Non-Indigenous Heritage Mitigation

No items of non-indigenous heritage were located within the direct impact areas for the W2CP. Consequently, no mitigation measures have been developed.

14.4 Indigenous Heritage – Predicted Subsidence Area

OzArk Environmental and Heritage Management Pty Ltd (OzArk) were commissioned to undertake heritage assessments for the Wallarah 2 Coal Project (W2CP). This report (contained in Appendix T) is specific to areas where subsidence related impacts are predicted. A separate assessment was undertaken on the potential impacts to archaeological sites associated with surface infrastructure development and proposed conservation off-sets, and is summarised in Section 14.2.

14.4.1 Previously Identified Sites within the Subsidence Area

A search of the DECC AHIMS within the area predicted to be subsided revealed six previously recorded Aboriginal sites in this area (Search date: 29.5.2007). However, three os the six sites have been afforded incorrect co-ordinates on the DECCW AHIMS database. Table 14.3 displays the site information for the three sites that lie within the study area which were all relocated during the latest field survey in January 2010. The sites are shown on Figure 14.5.

Table 14.3 Previously Recorded Sites within Predicted Subsidence Area (Co-ordinates in AGD)

Site ID	Site Name	Easting	Northing	Site Types	Recording
45-3-3040	Myrtle Creek/Maculata Road #3; Wyong State Forest	346850	6322700	Axe Grinding Groove	Donovan, Welsh
45-3-3041	Myrtle Creek/Maculata Road #1;Wyong State Forest	346600	6323180	Axe Grinding Groove	Donovan, Welsh
45-3-3042	Myrtle Creek/Maculata Road #2; Wyong State Forest	346750	6322930	Axe Grinding Groove	Donovan, Welsh

These axe-grinding groove sites are located along the base of the deeply incised Myrtle Creek, which is a tributary into Little Jilliby Jilliby Creek. These sites were recorded by State Forests during a site recording exercise. Site # 45-3-3040 is comprised of 14 grooves in three groups within a 15–20 m area. The first group with two grooves, the second with nine grooves and the third with three grooves, all measuring between 16 and 43 cm in length, 5–17 cm wide and 1–4 cm deep. This groove area is located 10 m west of the confluence of a minor tributary with Myrtle Creek.

Site # 45-3-3041 is comprised of 30 grooves in two groups on a flat rock surface. The first group with 22 grooves, the second with eight grooves, all measuring between 11 and 47 cm in length, 3–34 cm wide and 0.5–6 cm deep. The variation in dimensions and shape indicates that the sharpening of different tools was taking place here and also possibly the preparation/grinding of particular foodstuffs, for example in a ground area measuring 42 x 34 x 3 cm.

Site # 45-3-3042 is comprised of five grooves in one group on a small rock surface c. 250 m southeast of Myrtle Creek/Maculata Rd #1.

Plotting of these sites in terms of surface geology indicates that all three sites are located on Patonga Claystones. It is noteworthy that axe-grinding grooves are once again the predominant site type (as was the case within the broader search of the Western Area). The lack of modified (scarred) trees in the vicinity is undoubtedly reflective of the early and complete logging of the region.

14.4.2 Predictive Model for Site Location

Proximity to a permanent water supply is the primary factor appearing to determine the location of Aboriginal campsites. In the Sydney region, stream ordering has been used to predict the potential for site occurrence, and further to indicate the possible nature of these sites in terms of their complexity. Results of an integrated series of studies including a serious excavation component suggest a high correlation between the permanence of a water source and the permanence and/or complexity of the areas' Aboriginal occupation. This was further reflected in the lithic assemblages from sites close to permanent water, which suggested that a greater range of activities was represented (e.g. tool use, manufacture and

maintenance, food processing and quarrying). Sites near ephemeral water sources had evidence for one-off occupation (e.g. isolated knapping floors or tool discard), and creek junctions were also proven to be foci for site activity.

The size of the mining study area is such that a variety of landform features are present, although these can be broadly classed into two main groups: predominantly cleared valley floors/toe slopes on alluvial/colluvial deposits and steep sided forested ridges of the Wyong State Forest.

The majority of the valley floors have been cleared and intensively used for agriculture while the hills have been logged. These land use impacts, as discussed in greater detail in previous chapters, have undoubtedly had a significant impact on Indigenous site preservation and hence on the type of sites and their distribution that can be predicted within the Subsidence Study Area.

The following points summarise the landforms of the Study Area and their potential:

Hilly landforms (ridge caps) of Terrigal Formation sandstones and mid-hillslopes of the Patonga Claystones (Wyong Forest Study Area):

- A significant portion of the outcropping geology of the Wyong Forest Study Area is comprised of these formations.
- Headwaters for many tributaries into Wyong River, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek start in these hills.
- The results of previous research indicate that Hawkesbury Sandstone formations are favoured over Narrabeen Group sandstones (including Terrigal formation) in terms of rock shelter site location. However, as no Hawkesbury Sandstone is present within the Wyong Forest Study Area, a greater emphasis is likely to have been placed on the available shelters of the Terrigal Formation and the Patonga Claystone.
- Research as presented in Appendix T covering an area greater than the Wyong Forest Study Area yet including it, shows that sites are most common (60%) in the Terrigal Formation/Watagan soil landscapes and that sites in these areas may be axe-grinding grooves, artefacts sites or shelters. Sites recorded on Patonga Claystone comprise 23% of the total and only include shelters or axe-grinding grooves. This pattern is thought to reflect the fact that the Patonga Claystone tend to outcrop mid hillslope while the Terrigal Formation comprises ridge caps as well.
- Of previously recorded sites within the Wyong Forest Study Area, 33.3% are located on Patonga Claystone — one sandstone axe-grinding groove site — while 66.6% are situated on the Terrigal Formation, comprising two axe-grinding groove sites. This combination of site type and geological formation is parallel to that of the broader Western Area and similar percentage frequencies relating to site density and surface geology are to be expected in the Wyong Forest Study Area. If results were extrapolated from the broader Western Area, one may expect to find more sites in the Terrigal Formation than the Patonga Claystone in the Wyong Forest Study Area.
- It must be kept in mind that the results from previous assessment within the Wyong Forest Study Area are not the result of methodological survey but more the result of incidental recordings. Consequently, site distribution within this area can only be interpreted as a snapshot, not as the results of a meaningful test of surface geology in relation to site location.

Using this data, the following conjectures may be made about Aboriginal sites in the hilly Terrigal Formation and Patonga Claystone that characterise the Wyong Forest Study Area:

- ❒ Further Indigenous sites are to be expected this Study Area;
- ❒ Site types are most likely to be rock shelter sites or axe-grinding grooves. Shelters may have deposits including midden material, but art sites have not been previously recorded in this area, although this does not discount limited potential for their location;
- ❒ There is some evidence that sites will be more frequent on ridges between major catchments than on ridges within major catchments, although the distinction of major versus minor is somewhat arbitrary. Nevertheless, within the relation to the Wyong Forest Study Area, all the ridges are within a major catchment and not between and hence if this model were adopted we may expect less sites per km^2 than further afield on major catchment dividing ridges;
- ❒ Some artefact sites (open sites or isolated finds) may be located at the foot of slopes where the Patonga Claystones are close to the valley alluvials or on ridge tops of the Terrigal Formation;
- ❒ Burial sites and ceremonial sites are considered unlikely as suitable landforms are absent from the Wyong Forest Study Area; and
- ❒ Modified (scarred) trees are considered extremely unlikely due to the intense clearing and logging the region has experienced.

Valley floor landforms (flood plains and alluvial terraces) of Quaternary alluvium (Honeysuckle Study Area):

- ❒ Quaternary alluvium comprises the valley floors of the Yarramalong, Dooralong and Jilliby Jilliby Valleys (the Honeysuckle Study Area is located on Jilliby Jilliby Creek).
- ❒ The waterways of the Wyong River, Jilliby Jilliby and Little Jilliby Jilliby Creeks are fourth order and permanent waterways within this landform.
- ❒ The results of previous research over the Western Area recorded only one site in this formation, and that was on the edge of the developed valley floor. None have been previously recorded within the Subsidence Study Area.
- ❒ As a result of both hydrological and natural erosion/sedimentation regimes coupled with intensive land-use practices, intact Aboriginal sites are considered extremely unlikely in the valley floor landforms such as the Honeysuckle Study Area.
- ❒ There may be small pockets of land remaining less disturbed than others, but the location of these is challenging to predict.

Using this data, the following conjectures may be made about Aboriginal sites in the flat to gently sloping valley floor alluvial landforms within the Subsidence Study Area (Honeysuckle Study Area):

- ❒ Virtually no intact Aboriginal sites are to be expected in valley floor alluvial landforms due to natural and anthropomorphic impacts;
- ❒ If site material such as Aboriginal stone tools were found in these landforms it is likely they will be one-off, isolated items that are no longer *in situ*;

- There are no predictive tools for the location of such sites as isolated finds and nor is this type of evidence particularly meaningful on a scientific level.

14.4.3 Indeginous Survey Results – Subsidence Area

Four Aboriginal axe-grinding groove sites were recorded within Wyong State Forest as part of the heritage assessment of Wyong Forest Study Area. These sites are described in Table 14.4 Three are clustered together on the one watercourse in the very north of the Study Area (WSF-AG1–3), while WSF-AG4 is located in the southwest of the Study Area.

Table 14.4 Aboriginal Sites Recorded in Subsidence Area in 2010

Site designation	Site Type	GDA Zone 56 Easting	GDA Zone 56 Northing
Wyong State Forest – Axe groove 1 (WSF-AG1)	Axe-grinding groove site	345580	6325095
WSF-AG2	Axe-grinding groove site	345649	6325056
WSF-AG3	Axe-grinding groove site	345744	6324833
WSF-AG4	Axe-grinding groove site	345784	6318982

WSF-AG1 – Axe-grinding groove site
Located on the creek bed of an unnamed tributary to Little Jilliby Jilliby Creek that runs east and parallel to the main branch of the creek near its headwaters. The location of WSF-AG1 is shown in Figure 14.5.

WSF-AG1 is a cluster of 12 axe-grinding grooves of which five are of definite Aboriginal origin. They are located next to a natural rock pool on a slab of bedded sandstone at the confluence of a minor waterway into the larger tributary. The axe-grooves range in size between 20–30 cm and are about 7 cm deep on average.

WSF-AG2 – Axe-grinding groove site
Located on the creek bed of an unnamed tributary to Little Jilliby Jilliby Creek that runs east and parallel to the main branch of the creek near its headwaters. WSF-AG2 is about 50 m south of WSF-AG1 on the same creek. The location of WSF-AG2 is shown in Figure 14.5.

WSF-AG1 is one axe-groove of definite Aboriginal origin. It is located next to a small natural rock pool on a slab of bedded sandstone. The axe-groove is 35 cm long and about 6 cm deep in a shallow v-shaped groove.

WSF-AG3 - Axe-grinding groove site
Located on the creek bed of an unnamed tributary to Little Jilliby Jilliby Creek that runs east and parallel to the main branch of the creek near its headwaters. WSF-AG 1 and WSF-AG2 are located on the same creek as WSF-AG3. The location of WSF-AG3 is shown in Figure 14.5.

WSF-AG3 is two axe-grooves of definite Aboriginal origin along with three shallower grooves of probable Aboriginal origin. They are located next to a natural rock pool on a slab of bedded sandstone in the middle of the creek. The axe-grooves range in size between 25–35 cm and are about 7 cm deep on average.

WSF-AG4 - Axe-grinding groove site
Located on the creek bed of an unnamed tributary to Wyong Creek that runs roughly north–south to the east of Smithys Road West. The location of WSF-AG4 is shown in Figure 14.5.

WSF-AG4 is five axe-grooves of definite Aboriginal origin in an area of rock pools in the middle of the creek. They are located on a slab of bedded sandstone. The axe-grooves range in size between 20–38 cm and are about 5 cm deep on average.

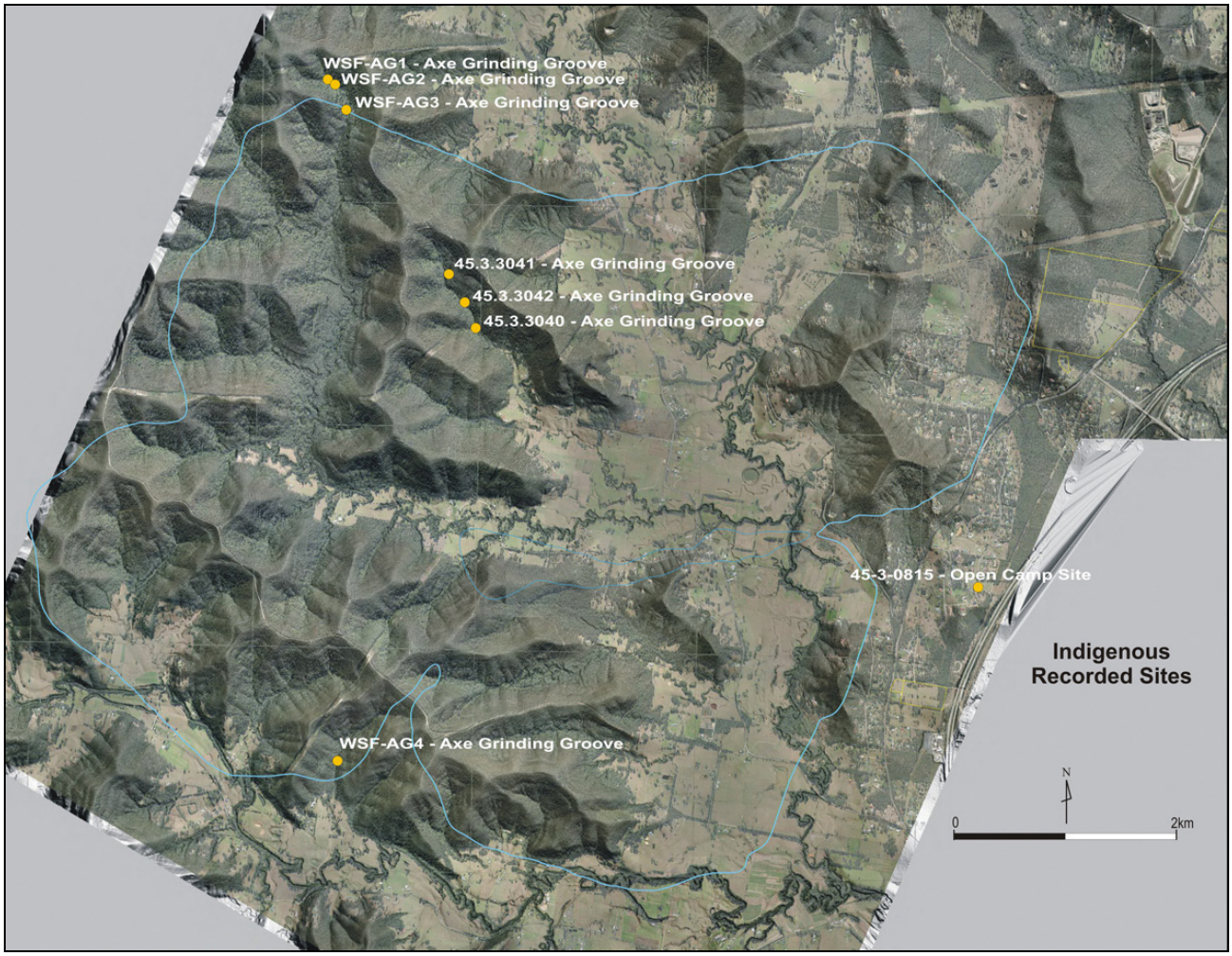

Figure 14.5 Aerial Mosaic Showing the Location of Recorded Aboriginal Sites

14.4.4 Assessment of Significance of Indigenous Heritage

Conversations held with the representatives of the Registered Stakeholders determined that all site types are culturally significant to the Aboriginal community because they provide physical evidence of Aboriginal occupation of the local area.

In the opinion of the Aboriginal representatives who accompanied the survey team, the recorded sites WSF-AG1–4 hold high cultural significance as they had manifest attributes that could be identified by present-day Aboriginals with the past presence of their people.

The overall location of sites discovered during the current assessment conforms to the general archaeological settlement pattern that has already been established throughout the broader region.

The axe-grinding groove sites (WSF-AG1–4) are a common feature in the broader region and are representative of other sites previously recorded within the Study Area.

The sites have good integrity and while natural erosion is a threat, there have been no artificial disturbances to the sites.

As axe-grinding groove sites can provide information about past settlement patterns, tool manufacture and food processing, the sites recorded as part of this assessment are held to possess low-moderate scientific significance.

Axe-grinding groove sites are obvious aspects within the landscape whose use can be easily appreciated by the layperson. However, the inaccessible nature of the sites recorded here diminishes the ability of the layperson to visit and appreciate these sites. The recorded sites are therefore assessed as holding low-moderate public significance.

Table 14.5 summarises the assessment of significance given above.

Table 14.5 Assessment of Significance for the Recorded Sites

Site Name	Cultural significance	Scientific significance	Public Significance
WSF-AG1	High	Low-Moderate	Low-Moderate
WSF-AG2	High	Low-Moderate	Low-Moderate
WSF-AG3	High	Low-Moderate	Low-Moderate
WSF-AG4	High	Low-Moderate	Low-Moderate

14.4.5 Potential Impacts from Subsidence

Subsidence associated with longwall mining involves a complex suite of effects on the landform that is influenced by geological factors, landform and topography as well as mining design factors such as depth of mining, height of extraction and panel layout. Among the effects that can have a bearing on the land surface condition, and therefore upon the status of archaeological sites and features, are vertical subsidence (which is overall lowering of the ground surface) and other ground movements including tilt, compressive and tensile strains, and upsidence.

Vertical subsidence in itself is not typically a damaging effect where it relates to relatively uniform lowering of the ground across a wide area. However, the strain effects provide for horizontal movements and it is these compressive or tensile forces in the ground which mainly influence the risk level for impacts involving cracking of certain rigid components in the landscape such as rock outcrops, particularly in confined geological settings and where ground stress is concentrated such as steeply-sided, rock-lined streams in the floors of major canyon-like valleys where upsidence damage results from excessive localised compression forces.

These types of conditions occur in some parts of the Southern Coalfields but not in the landscape of the W2CP area. Further, strain effects are expected to provide

less risk to such rock features if there is already a well developed joint and fracturing system in the smaller scale rock outcrops in unconfined geological settings such as usually found at hillsides and some higher gradient drainage lines along hillside slopes. This is because some level of tolerance to movement may be provided due of the existing weathering and stress-relief jointing already established.

In summary, the types of impacts that may be anticipated to affect archaeological sites over the W2CP study area are as follows.

Subsidence: The vertical movement of the earth as a direct result of certain underground mining activities. These measurements show the amount by which the surface of the landscape will be lowered by after mining has occurred.

Tilt: The movement of earth on a slope directly related to subsidence, that is, the portion of land at the edge of an area of subsidence that drops at one end but not the other. An important note about tilt is that it may occur progressively as each long wall panel is mined out. Once the panel has been mined out, the tilt areas along the longitudinal sides of the panels will drop to become areas of flat subsidence.

Strain: Occurs at the top of the tilted land portion (tensile strain) and the base of the tilted land portion (compressive strain). Overall, these strains will have varied impacts depending upon the surface geology and soil landscapes. Like tilt, strain is also a progressive impact which, particularly along the longitudinal longwall sections, will change with progressive removal of longwall panels.

Rock fracture: The cracking of outcropping stone. Most likely to occur as a result of subsidence or strain in areas where stone is in massive formation, i.e. escarpments.

Landslip: The displacement of earth down slope. Obviously this occurs on hill slides that have been impacted by subsidence.

Water-related impacts: These include alteration of the flow paths of water courses, flooding, ponding and possible erosion and siltation related to these factors.

Predicted subsidence, tilt and strain impacts are shown in Figure 14.6 to Figure 14.9 with measurement being provided in metres (m) for subsidence and millimetres per metre (mm/m) for tilt and strain. As can be seen by these predictions, the direct physical effects of these factors are variable over the underground extraction area. All factors demonstrate a direct relationship to the layout of the longwall panels underneath, with impacts occurring along linear trajectories. As may be expected, the impacts of all factors, but especially tilt and strain, are greatest at the boundaries of the mined area.

The two areas of highest predicted overall mining impacts (around 2 to 2.5 m of subsidence, 12 mm/m of tilt and 2.5 mm/m of strain) are those associated with the more elevated terrain in the Wyong State Forest. These include the western portion of the northern mine section (in colluvial landscapes such as Watagan and Mandalong), which will primarily affect from above Little Jilliby Valley to the north, and the west and central portions of the southern mine area, mostly affecting colluvial Watagan landscape and the lower-lying alluvial Yarramalong landscape.

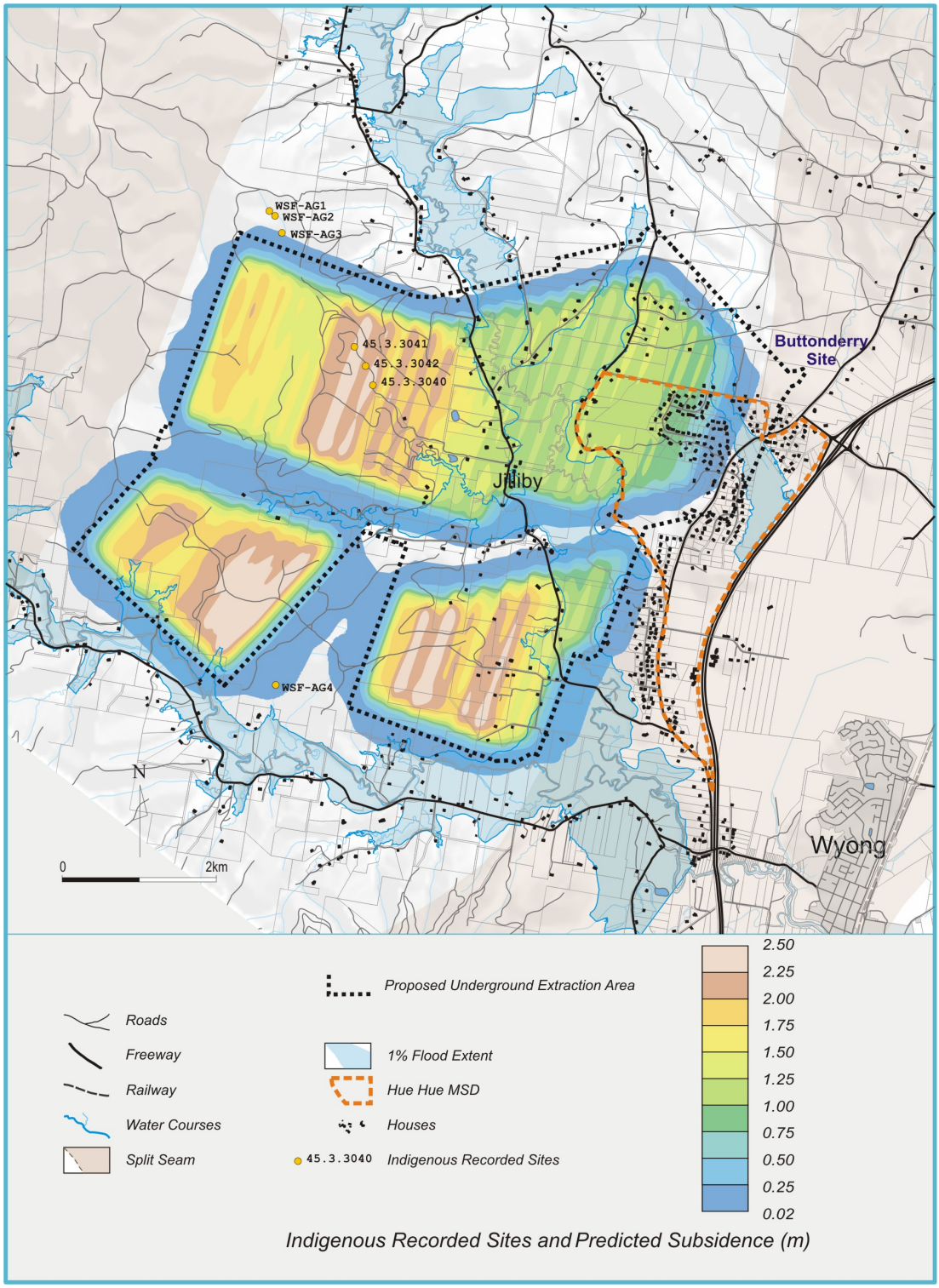

Figure 14.6 Indigenous Recorded Sites and Predicted Subsidence

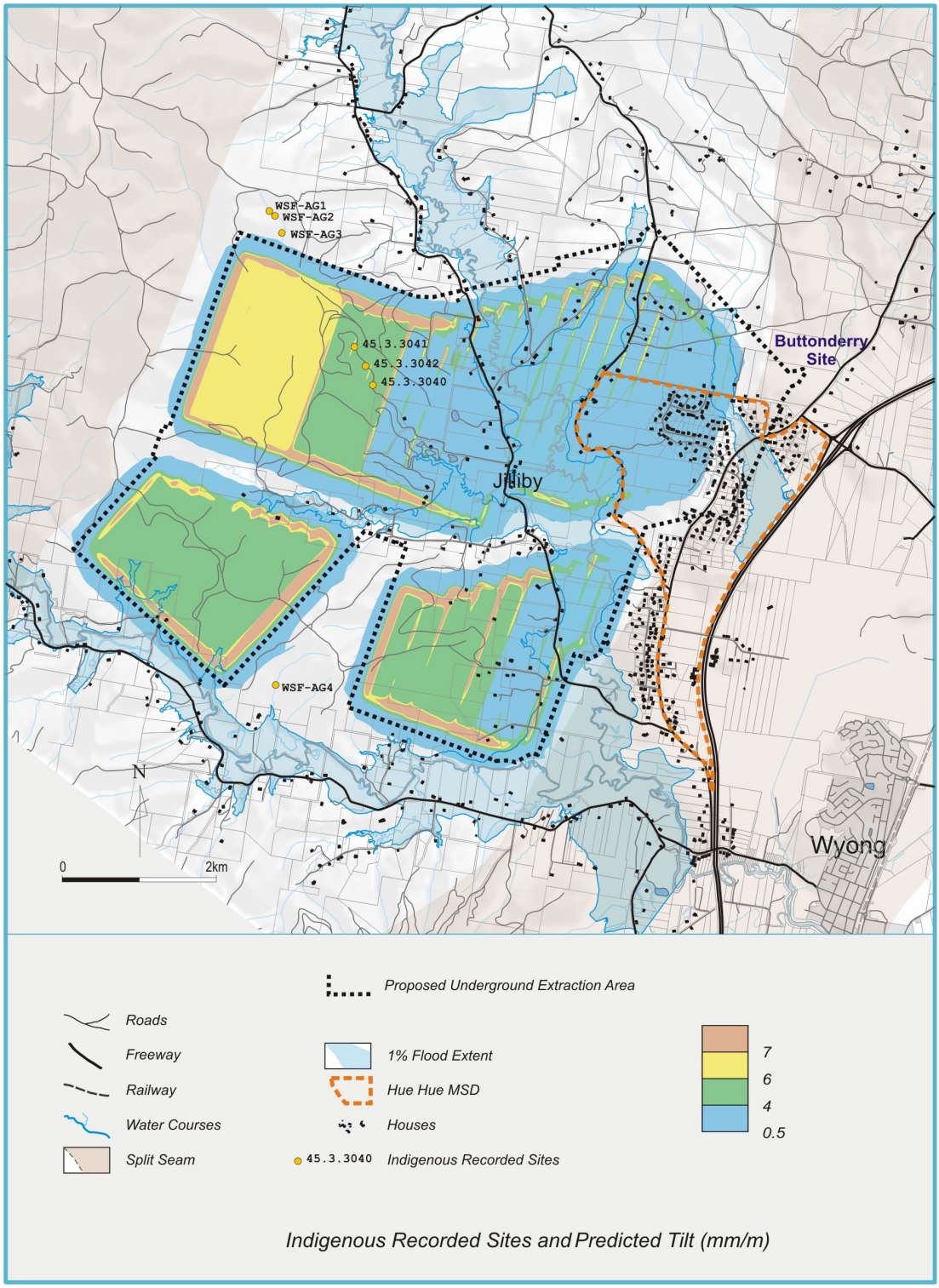

Figure 14.7 Indigenous Recorded Sites and Predicted Tilt (mm/m)

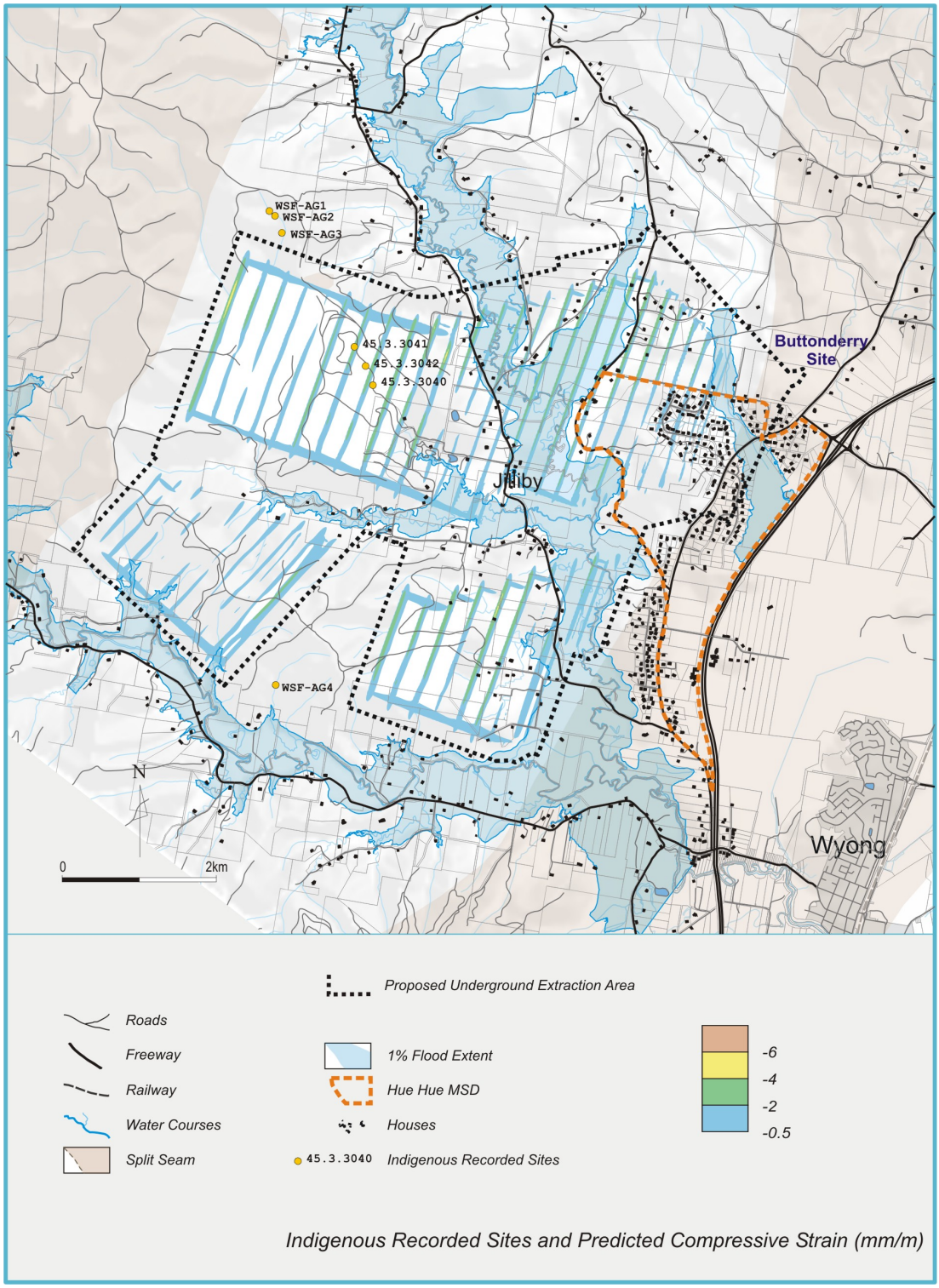

Figure 14.8 Indigenous Recorded Sites and Predicted Compressive Strain

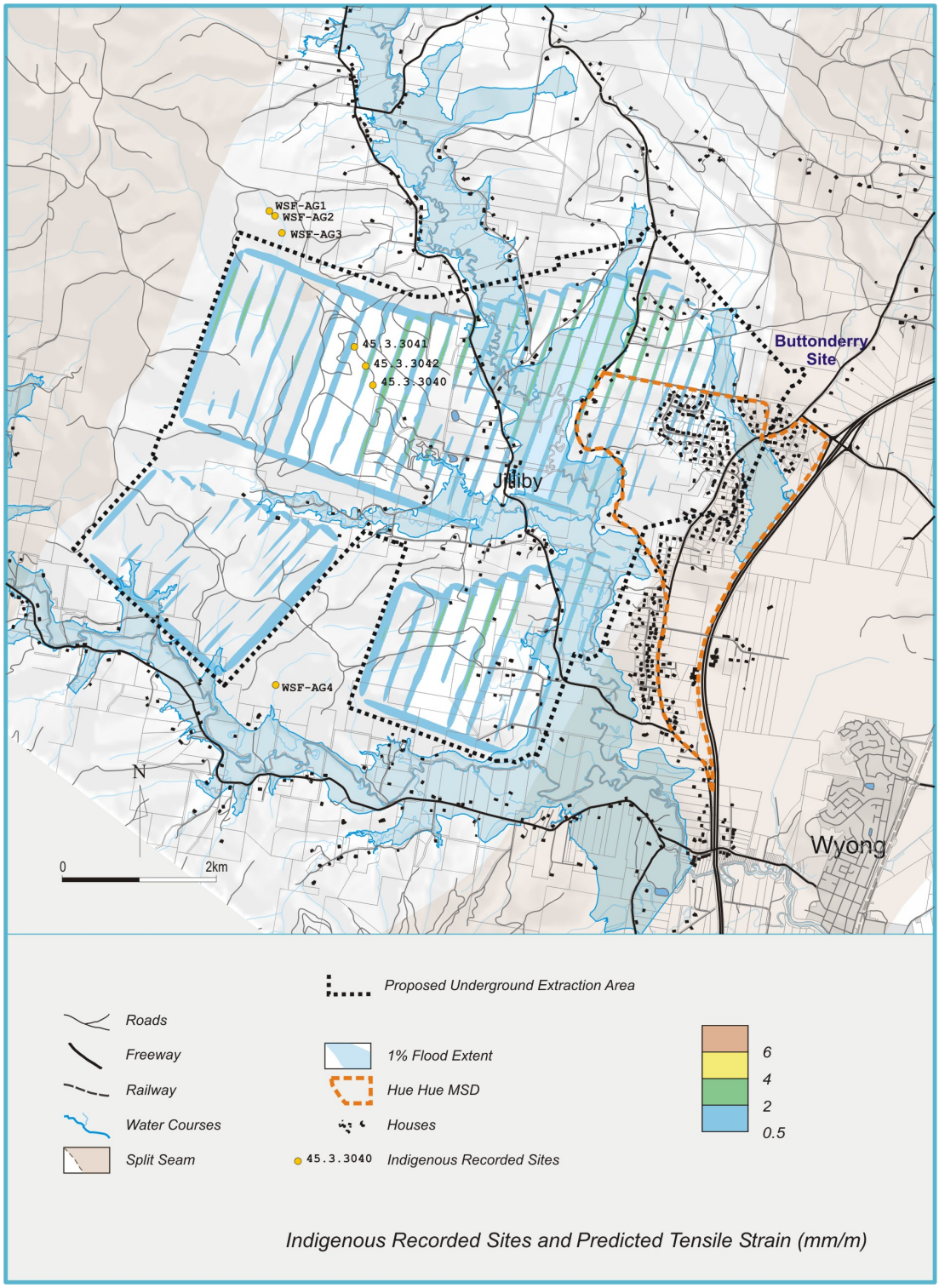

Figure 14.9 Indigenous Recorded Sites and Predicted Tensile Strain

The above figures illustrate the location of the seven recorded Aboriginal sites in relation to the four major subsidence related impacts. The previously recorded axe-grinding groove sites (# 45-1-3040–3042) are all likely to be affected by over 2 m in subsidence, around 4 mm/m tilt and approximately 0.5 mm/m in strain. Definitive physical impacts to these sites cannot be accurately predicted, only a risk-based consideration of likely impact levels. However, it is likely the low strain impacts may serve to preserve the sandstone on which the grooves are located from cracking.

There is, however, potential for minor increased siltation along beds of Myrtle Creek if significant alteration to run off patterns occurs and if localised soil erosion develops. This possible siltation process may cover the grooves from view. It is noteworthy that this process occurs naturally, for example following bush fire, and is not an impact only generated as a result of longwall mining.

Regarding sites recorded as part of the current assessment, all sites (WSF-AG1–4) are beyond expected extent of compressive and tensile strain as well as tilt. Two sites (WSF-AG3 and WSF-AG4 are on the very boundary of the subsidence area and may suffer from subsidence in the order of 0.02 m.

The axe-grinding grooves are typically in well-jointed sandstone bedrock units although in geologically confined circumstances. Although some of the axe-grinding groove sites are outside the zone of influence of compressive or tensile strains some may be affected by minor areas of vertical subsidence and tilt from the proposed mining activity. These effects are considered to be at negligible to very low risk of damage to the site's integrity.

Based on their geological and landscape settings and the predicted range of subsidence effects, the individual axe-grinding sites along Myrtle Creek are likely to be at a generally low level of risk of damage.

Axe-grinding groove sites featuring scattered instances of individual rock grooves differ in their inherently lower risk of damage to their integrity arising from the proposed works when compared with other rock outcrop-based archaeology sites such as caves, significant shelter sites or rock art sites. There has been no evidence of such sites in the Subsidence Study Area.

In terms of changes to inundation levels, the predicted alteration to overall flooding levels shows very minor areas that will be newly impacted, both within the Dooralong and Yarramalong Valleys. No sites have been recorded within the valley floor landforms of the mining area and predictive modelling of site location suggests that site material of any integrity is unlikely in the valleys. Possible alteration to the paths of waterways and or erosion modification also has the potential impact Aboriginal sites; however, the ability to predict either these factors or the location of Aboriginal sites in relation to them is low.

Although there are no other known Aboriginal sites or features within the Subsidence Study Area, this is not because further sites do not exist, but simply reflects practical survey limitations.

From the results of the current assessment, it is concluded that axe-grinding groove sites will form the majority of sites that remain to be recorded in the Wyong Forest Study Area. While other site types are always possible, it is assessed that there will a low possibility of locating open sites and modified trees due to landform and disturbance patterns. It is also assessed that the topography does not allow suitable shelters that can be used for habitation.

Therefore the impact from the proposed works in relation to known sites in the Wyong State Forest Study Area is the same as the possible impact on currently unknown sites: i.e. the effects of subsidence, tilting and strain on axe-grinding groove sites.

As these sites are likely to be located within the Wyong Forest area where the effects from the proposed works will be the greatest, further targeted survey work should be undertaken in the Wyong State Forest prior to mining occurring in these locations. The general nature and focus of this subsequent work is documented in Appendix T and should form the basis for the Indigenous component of the CHMP that will be included as part of the SMP.

14.5 Non-Indigenous Heritage – Predicted Subsidence Area

A search made of the Australian Heritage Database (2/8/07) revealed eleven items of heritage significance within Wyong Shire. None of these items are located within the predicted subsidence area for the W2CP.

Review of the Wyong Shire LEP 1991 (which includes all listings on the NSW Heritage Office inventory) revealed several items of non-Indigenous heritage significance either within or close to the areas to be impacted by subsidence from the W2CP. Figure 14.10 shows the location of these sites in relation to the areas where subsidence from the W2CP is predicted, while Table 14.6 lists them together with information regarding their location in relation to the W2CP.

Table 14.6 Heritage Items Listed on the Wyong LEP

Number	***Description***	***Subsidence Zone***
Items of Regional Significance		
1	Brick & Iron Silo	✓
2	Jilliby Cemetery	×
3	Dwelling "Bangalow"	✓
4	Dwelling "Gracemere"	×
5	Wyong Creek Community Hall	×
6	Dwelling (Former "Ebenezer Cottage")	×
7	Dwelling "Hillview"	×
8	Dwelling "Marabilla"	×
9	Silos and Farm Shed	×
10	Wyong Creek Public School	×
Items of Local Significance		
11	Jilliby Public School	×
12	Road Bridge, Kidman's Lane	×

During field assessment, ERM (2000) identified nineteen additional items of potential heritage significance. This additional survey was undertaken in reference to changes that had been made to the *Heritage Act 1977* regarding the relationship of places to State historical themes. These items are located on Figure 14.10 (letter designations) and listed in Table 14.7. It is noteworthy that the identified structures are primarily private dwellings, although two bridges, two silos, a picket fence and a cattle / dairy run were also nominated.

In January 2010 a further field assessment for Historic heritage items in the Wyong Forest and valley floodplain study areas was undertaken. The only items of historic heritage significance were located on the eastern bank along the lower reaches of Little Jilliby Jilliby Creek. These items were a disused forestry road along with infrastructure such as culverts, loading areas and road cuttings. The road is

washed-out in places but is still a discernable feature in the landscape, particularly due to the frequent road cuts which have been made in the hill slope. The road is used by recreational walkers at present and is in a fragile state in places with trees growing through the earthen road and wash-outs destroying evidence of the engineering efforts. Historic features, spread along about 1–2 km include road cuttings, axe-marks in trees used to hold supports for timber-getters in a less-mechanised days and evidence of repairs and upgrades being made to the road in the form of different styles of culverts.

Table 14.7 Items of Potential Heritage Values Identified by ERM

Number	*Description*	*Subsidence Zone*
A	Dwelling	×
B	Dwelling	×
C	Dwelling	×
D	Bridge (Yarramalong Road)	×
E	Dwelling	×
F	Dairy and Cattle run	×
G	Dwelling	✓
H	Dwelling	×
I	Dwelling	×
J	Dwelling	✓
K	Dwelling	✓
L	Dwelling	×
M	Little Jilliby Road Bridge	✓
N	Bunya Pine	✓
O	Keegan's Silo	✓
P	Picket fence on Durren Road	✓
Q	Silos	✓
R	Dwelling	✓
S	Dwelling	✓

Table 14.6 provides data on whether listed items are within the longwall mining potential impact zone. Of the heritage items from the Wyong LEP, only two are now within the subsidence zone of the mine plan. This has been reduced from five items as a result of the altered mine plan layout. Impacts at these locations have also been significantly reduced as a result of the redesign. Those that will be potentially impacted comprise one dwelling (Item 3) and a silo (Item 1), as shown on Figure 14.10.

The silo (Item 1) is predicted to experience a tilt of less than 6.0 mm/m and subsidence of between 0.5 m to 0.75 m. This item will also be impacted by the new extent of the 1:100 year flood zone, possibly registering an additional 0.4 m depth of inundation beyond current inundation levels in the 1:100 year flood.

Item 3 (Bangalow, a private dwelling) will experience similar potential impacts although less vertical subsidence. Remedial action may be required at this property to ensure that its heritage value, assessed as regional, and condition, is not significantly compromised. As this item is also a domestic dwelling, issues of subsidence impact will be addressed as part of the broader community consultation programme and the Property Subsidence Management Plan (PSMP).

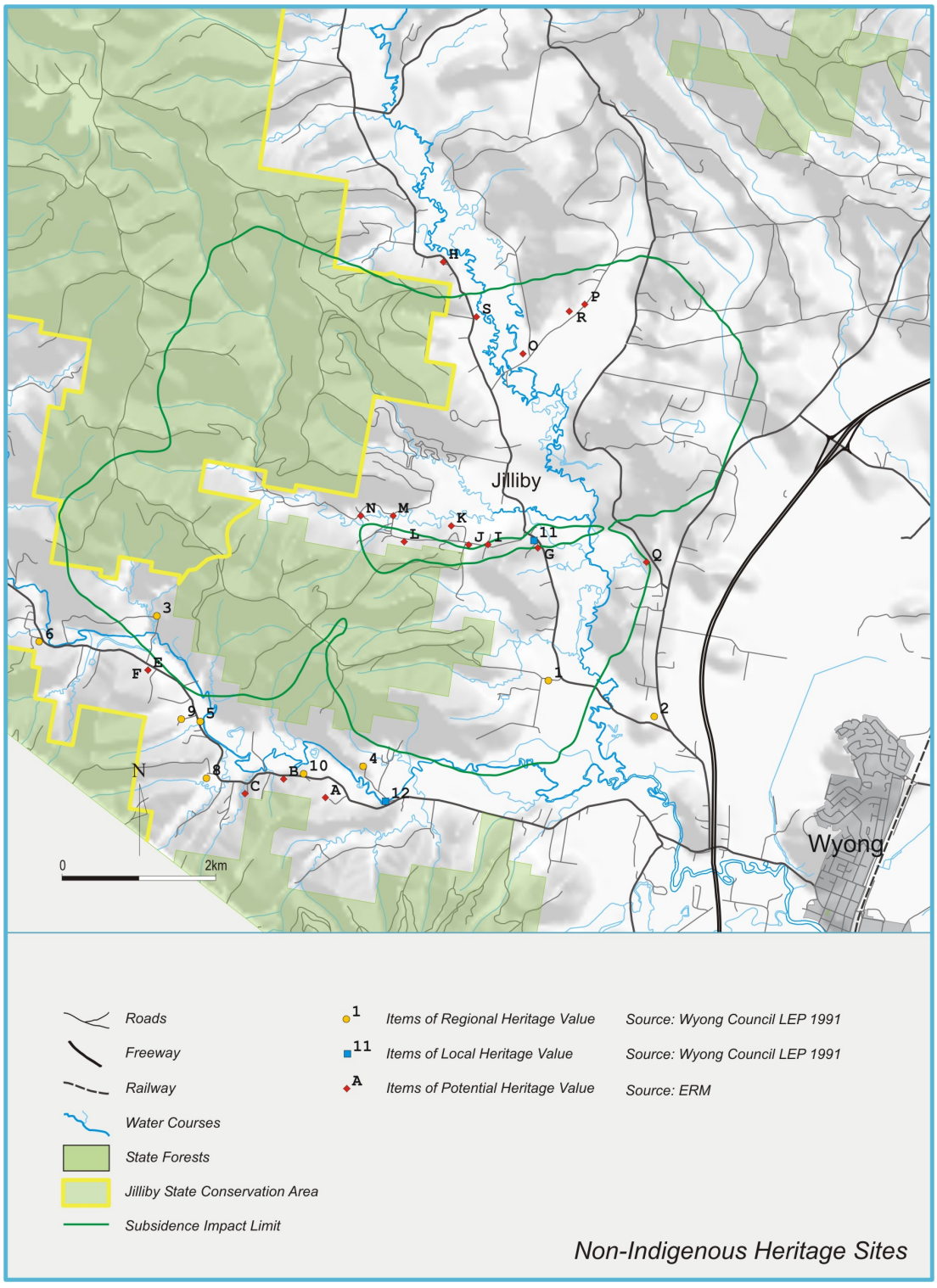

Figure 14.10 Location of Items of Non-Indigenous Heritage within the Predicted Areas of Subsidence

Importantly, Item 11 (Jilliby Public School) is located outside of the subsidence impact zone and therefore will experience nil to very negligible tilt and subsidence and also will not be impacted by the new extent of the 1:100 year flood zone. Nevertheless, the potential impacts and risks to this item (if any) and any appropriate management measures will be addressed as part of the broader

community consultation programme and (if necessary) by a Property Subsidence Management Plan (PSMP) as with the Bangalow residence noted above.

In addition, a component of the Archaeological and Cultural Heritage Management Plan (ACHMP) to be prepared with the SMP will provide for the monitoring of any potentially affected structures over the ensuing years to assess the degree of impact and instigate additional mitigative measures should they be required.

14.5.1 Items Recorded During Field Survey

The Historic relics recorded during the current assessment (forestry road and infrastructure) are scattered along an earth-built roadway over an area of almost 2 kilometres. While the area will be subject to subsidence and other effects from the mining activity, it is assessed that there is only a low risk that the overall fabric of the complex would be destroyed by these actions. The road itself is already in a bad state of repair with large washouts frequently along its path while the other Historic items noted are small and unlikely to be impacted by mining-induced earth movement. The heritage significance of these items is considered to be limited only to a local level.

Table 14.7 provides data on whether items recorded during the ERM 2001 survey are within the longwall mining impact zone and an indication as to the degree of likely impact. Of these items, ten of nineteen are within the subsidence zone of the current mine plan. The potential for subsidence effects to cause significant impacts at these locations has also been significantly reduced as a result of the mine plan redesign.

The heritage significance of these items is considered to be limited to a local level. More detailed assessment will be done as part of the ACHMP component of the relevant SMP following project approval. This will enable further assessment of the impacts to the heritage significance/values of these items as a result of the actual longwall mining and subsidence experience at the mine and will incorporate specific management measures for each affected item.

14.5.2 Recommendations for Cultural Heritage Items in Subsidence Area

Further significance assessments will be applied to the list of potential heritage locations recorded by ERM in 2001 (Table 14.7). Such assessments will be undertaken as part of an Archaeological and Cultural Heritage Management Plan (ACHMP) prepared under the SMP. The assessments will be undertaken through applying the NSW Heritage Office criteria, and if necessary, undertaking landholder consultation and as well as investigation through historical societies, Shire Council and other stakeholders. This will enable further understanding of the heritage values/significance of these locations and allow the development of appropriate mitigative measures closer to the time when future mining and subsidence will occur in those areas. This process for the SMP will be the main detailed assessment process to evaluate potential impacts and provide appropriate and contemporary mitigation measures developed in consultation with the landowner.

With regards to the two items on the Wyong LEP that will be impacted by the potential subsidence effects longwall mining in the Subsidence Study Area (a silo and a house: Table 14.6) further assessment and the development of appropriate mitigative measures will be required. As these items are privately owned, impacts to them will also be addressed in the SMP process. Consultation with the Wyong Shire Council and the Heritage Office may also be required.