ARCHAEOLOGICAL ASSESSMENT OF PROPOSED DEVELOPMENT, SITE OF SMELTER NO. 1, OLD CADIA ROAD, CADIA, N.S.W.

Edward A K Higginbotham,
MA (Cambridge), PhD (Sydney),
MAACAI.

EDWARD HIGGINBOTHAM
& ASSOCIATES PTY LTD.

Archaeology • History • & Heritage

A.B.N. 79 072 316 968

ARCHAEOLOGICAL ASSESSMENT OF PROPOSED DEVELOPMENT, SITE OF SMELTER NO. 1, OLD CADIA ROAD, CADIA, N.S.W.

Edward Higginbotham
MA (Cambridge), PhD (Sydney), MAACAI.
EDWARD HIGGINBOTHAM & ASSOCIATES PTY LTD
140 Smith Street
SUMMER HILL, NSW 2130.
PO Box 97
HABERFIELD, NSW 2045.
Phone. (02) 9716-5154
Fax. (02) 9716-8547.

For
Cadia Holdings Pty Limited.

April 2001

CONTENTS.

ACKNOWLEDGMENTS.

The author would like to thank:

Client: Mr. Bob Drury and Mr. Russell Squire, Cadia Holdings Pty Limited.

1. INTRODUCTION.

1.1. Background.

This report was commissioned by Cadia Holdings Pty Limited on 23 March 2001. The archaeological assessment report is required in order to obtain an excavation permit for the excavation of the site of Smelter No. 1 before mineral exploitation of Cadia Hill Gold Mine.

The site of Smelter No. 1 is part of the listing for Cadia Copper Mine, including Engine House and Ruins, as gazetted on the LEP for Cabonne Council. Cadia Engine House and Surrounds is also listed on the State Heritage Inventory.[1]

The archaeological remains of historical mining at Cadia were the subject of a conservation plan in 1995, in advance of the existing Cadia Hill Gold Mine.[2]

1.2. Brief.

The purpose of this report is to identify historical archaeological sites within the study area, to assess their archaeological significance and to make recommendations for their management and conservation prior to and during the proposed development.

1.3. Location of site.

The subject site is located beside the former alignment of Old Cadia Road at Cadia, between the road and Cadiangullong Creek, south of Hoares Creek. (Figure 1.1).

1.4. Study methodology and limitations.

This report has been prepared in accordance with the Heritage Office and Department of Urban Affairs and Planning *NSW Heritage Manual*, as follows:

1. Historical research.

[1] Search results of State Heritage Register and Inventory, 27 March 2001.
[2] Godden Mackay, Cadia Mining Project, Final Conservation Plan. Newcrest Mining Limited. 1995. Volumes 1-6.

2. Site survey.
3. The assessment of the archaeological and heritage significance of the site.
4. The assessment of the impact of the proposed development.
5. Recommendations for management and conservation, appropriate to the present proposal for redevelopment.[3]

The historical background has been summarised from previous reports, with minimal addition al research.

No research or site survey for Aboriginal sites has been undertaken.

1.5. Author identification.

This report was prepared by Dr. Edward Higginbotham.

[3] Heritage Office and Department of Urban Affairs and Planning. 1996. *NSW Heritage Manual*.
Heritage Office and Department of Urban Affairs and Planning. 1996. *Heritage Assessments*.
Heritage Office and Department of Urban Affairs and Planning. 1996. *Archaeological Assessments. Archaeological Assessment Guidelines*.

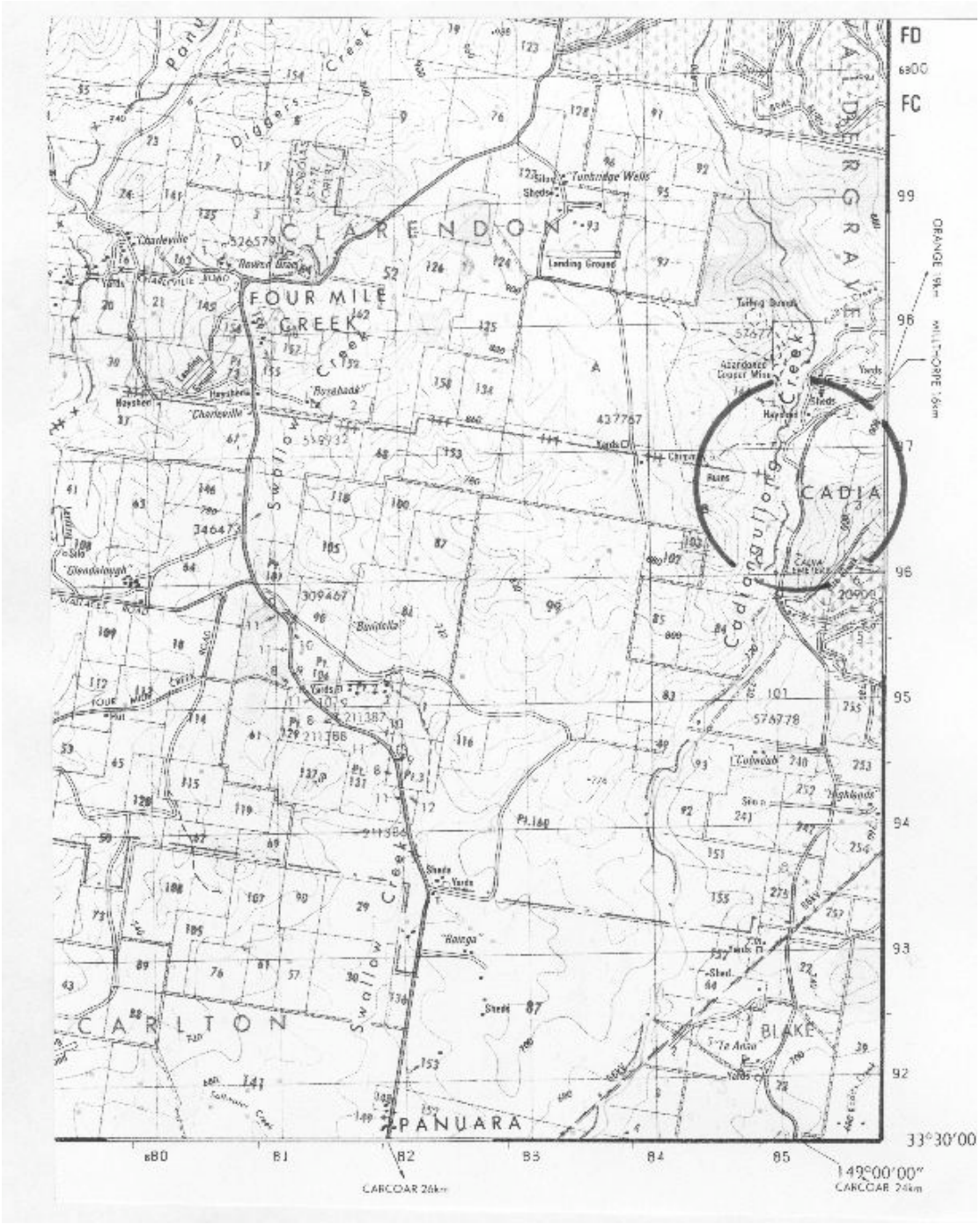

Figure 1.1 Location plan of the historical mine at Cadia, NSW, showing the site of Smelter No. 1.

2. SEQUENCE OF DEVELOPMENT.

2.1. Introduction.

This report provides and overview of the history of mining at Cadia, as well as an overview of copper mining in New South Wales to place the Cadia copper mine in context. Most of the text may be found in previous reports on Cadia, with the exception of detailed references to the Smelter and additional material from Carne.

2.2. The emergence of copper mining in Australia and New South Wales.

Copper mining commenced in South Australia in 1842. The discovery of the rich copper lodes at Burra in 1845 opened up a major copper producer, which was to continue in production for many years. It also alerted potential investors to the possibility of copper in other parts of Australia. In NSW, most of the early copper finds were of smaller ore bodies and often of poorer quality ore. In later years, rich copper lodes were found at Cobar and Cangai. The first mines in NSW were opened in 1844 and 1845 at Copper Hill, near Molong, and at Lipscombe Pools Creek, near Canowindra. Another mine was in progress at Summerhill Station, near Rockley, in 1847. As the Bathurst Copper Mining Company it published its prospectus in the *Bathurst Advocate* in 1848.[4]

The first ores mined in South Australia and New Zealand were shipped to England for smelting. The first official record of smelting is at the Newcastle Copper Smelting Works in 1846, using ores from South Australia. The nature of the copper finds ensured that few mines could support a major processing facility. Hence, concentrating furnaces, which produced a semi-finished product, were established at some of the richer finds, where the copper ore could be reduced to copper matte before it was shipped overseas for final processing.[5]

Carne listed the major copper finds in NSW (until 1908), as well as showing which of them possessed reverberatory furnaces.[6]

---

[4] J E Carne, *Copper Mining* 1908, p. 6-7.
[5] E Carne, *Copper Mining* 1908, p. 7-9.
[6] J E Carne, *Copper Mining* 1908, p. 10-11.

(* = furnace established).

Date	Mine	Mining District	Division
* 1845	Copper Hill	Lachlan[7]	Molong
1845	Little Copper Hill	Lachlan	Molong
1845	Belubula	Bathurst	Canowindra
* 1846	Summerhill	Bathurst	Rockley
1847	Summerhill	Bathurst	Rockley
1848	Good Hope	Southern	Yass
* 1849	Good Hope	Southern	Yass
* 1850	Coombing Park	Bathurst	Carcoar
* 1850	Carangera (Cornish Settlement)	Bathurst	Orange
* 1851 to 1865	**Cadia**	Bathurst	Orange
1851 to 1865	**Cadia Extended**	Bathurst	Orange
* 1851 to 1865	Icely	Bathurst	Orange
* 1852	Ophir	Bathurst	Orange
1851 to 1865	Britannia	Bathurst	Orange
1851 to 1865	Belmore	Bathurst	Orange
1851 to 1865	Moonta	Bathurst	Orange
1851 to 1865	Nelson	Bathurst	Orange
1851 to 1865	Geurophian	Bathurst	Orange
* 1872	Essington	Bathurst	Rockley
* 1874	Frogmore	Southern	Frogmore
* 1874	Pride of Frogmore	Southern	Frogmore
1874	Lobbs Hole	Tumut & Adelong	Kiandra
* 1874	Snowball	Tumut & Adelong	Gundagai
* 1874	Belara	Mudgee	Wellington
* 1875	Apsley	Bathurst	Bathurst
* 1875	Belmore	Bathurst	Bathurst
1875	Glamorgan	Clarence & Richmond	Copmanhurst
1875	Bobby Whitlow	Peel & Uralla	Bingara
* 1876	Burraga	Bathurst	Burraga
* 1876	Wertago	Albert	White Cliffs
1877	Burley Jacky	Bathurst	Cowra
1877	Esmerald	Bathurst	Bathurst
* 1877	Bundarra	Peel & Uralla	Bingara
* 1878	Mount Hope	Cobar	Mount Hope
* 1878	Great Central	Cobar	Mount Hope
1878	Cyclops	Tambaroora & Turon	Stuart Town
1878	Mount Ragan	Bathurst	Orange
1878	Green Swamp	Bathurst	Bathurst
* 1879	Nymagee	Cobar	Nymagee
* 1880	Girilambone	Cobar	Nyngan
* 1881	Blayney	Bathurst	Blayney
* 1881	Eurow & Vychan	Lachlan	Forbes

[7] Carne incorrectly gives the Mining District as Bathurst, when Molong is in Lachlan.

* 1881	Trough Gully	Peel and Uralla	Nundle
* 1881	Lake George (Captain's Flat)	Southern	Bungendore
1888	Pluck	Clarence and Richmond	Copmanhurst
* 1886	Mount Boppy Copper	Cobar	Canbelego
1887	Mount Jasper	Hunter and Macleay	Port Macquarie
1888	Sydney-Wallaroo	Mudgee	Dandaloo
1890	Mount Laut	Mudgee	Denison Town
1891	Willi Willi	Hunter and Macleay	Kempsey
* 1894	Mount Everest	Peel and Uralla	Bingara
* 1895	Gulf Creek	Peel and Uralla	Barraba
* 1895	Mountain Run	Bathurst	Rockley
* 1895	Phoenix	Bathurst	Oberon
1897	Tuglow	Bathurst	Oberon
1897	Christmas Gift	Mudgee	Dandaloo
1898	Elizabeth	Mudgee	Dandaloo
1898	Mount Pleasant	Mudgee	Dandaloo
1898	Bob's Mount	Bathurst	Orange
1898	Monaro	Tumut and Adelong	Cooma
1899	Kangiara	Southern	Yass
* 1899	Sugarloaf	Bathurst	Rockley
* 1900	Crowl Creek	Cobar	Nymagee
1900	Lobb's Hole Central	Tumut and Adelong	Kiandra
* 1901	Cangai	Clarence and Richmond	Copmanhurst
1901	King of England	Lachlan	Cowra
1901	Canbelego	Cobar	Canbelego
* 1902	Queen Bee	Cobar	Cobar
1902	Attunga	Peel and Uralla	Tamworth
* 1903	Mount Royal	Mudgee	Dandaloo
1903	Underlay	Mudgee	Dandaloo
1903	Namoi	Peel and Uralla	Tamworth
1903	A1 Tinby	Tambaroora and Turon	Stuart Town
* 1905	Bogan River	Mudgee	Dandaloo
1905	Cowfell	Lachlan	Cowra
1905	Cash (Essington)	Bathurst	Rockley
1905	Lucky Hit	Southern	Goulburn
1906	Native Bee	Mudgee	Wellington
1906	Orange Plains	Mudgee	Dandaloo
1906	Ace	Mudgee	Dandaloo

(* = furnace established).

Cadia thus followed a series of other copper finds, all of which were worked with lesser or greater success. At Cadia itself there were four smelters in operation at one

time or other. The number of smelters at other site has not been researched, although between 1845 and 1908 a total of 37 mines were recorded as possessing smelters.[8]

2.3. The development of mining at Cadia.

The earliest discovery of copper traces at Cadia has been attributed to the Geological Surveyor for NSW, Samuel Stutchbury, who located copper traces near Oakey or Cadiangullong Creek on 18 July 1851. This discovery coincided with the discovery of gold in NSW. His report was published in the *Votes and Proceedings of the Legislative Council*, for 1851, thus alerting potential investors to the deposit. At that time, however, the discovery of gold in the same area attracted the bulk of popular interest.

When land near the future Cadia was advertised for sale in the *Sydney Morning Herald* on 2 May 1851, the presence of some copper traces on the land was noted in the advertisement. This land was later purchased as Portion 41, Parish of Waldegrave on 28 July 1859 by William Tom, George Hawke, Richard Lane and Edward Nicholls as trustees for the Canoblas Copper Mining Company.

Portions in the two parishes in which copper traces were found, the Parishes of Waldegrave and Clarendon, County of Bathurst, were taken up by various groups of investors, mainly from pastoral, mercantile or professional backgrounds. Portion 162 of the Parish of Waldegrave, was taken up by J S Rodd, and the two Portions to the north, Numbers 83 and 87, were taken up by Saul Samuel, R J Want and Thomas Icely. Further east, Portion 41 of Waldegrave was taken over by the Trustees of the Canoblas Copper Mining Company. Portions 147, 148 and 149 of the Parish of Clarendon, where the Cadiangullong Copper Company operated from the 1860s and where the Cornish Engine House was later built, were taken up by William Lawson, Thomas Icely, William Jones and J S Rodd. These Portions were originally advertised for sale on 22 May 1855 and were bought by J S Rodd on behalf of the four partners.

There were three areas of mining at Cadia, East Cadia, Little Cadia and West Cadia. The earliest mining operations appear to have been at East Cadia, which was situated on the eastern side of the creek in the Parish of Waldegrave. Portions 83, 86, 87 and 27, 29 and 30 of the Parish of Waldegrave, were taken up by a consortium consisting

[8] J E Carne, *Copper Mining* 1908, p. 10-11.

of William Lawson, Thomas Icely, William Jones and J S Rodd (Directors of the Cadiangullong Consolidated Copper Company).

The second of the mining areas was known as Little Cadia. The Canoblas Mine (later known as the Cadia Extended Copper Mine) was located on Portions 28, 37 and 38 of the Parish of Waldegrave. Portions 37 and 38 had been purchased by Saul Samuel and J S Rodd on 16 July 1856, whilst Portion 28 had been purchased on 19 May 1859. It is believed to have been on these portions that Stutchbury found evidence of copper in July 1851. This operation, named the Canoblas Copper Mine at Little Cadia, continued until June 1860 (or 1861), when the lease expired. The owners of the land then sold their interest to the Cadiangullong Consolidated Copper Company (Directors Thomas Icely, William Frederick Jones, John Savory Rodd, Saul Samuel and Randolph John Want). Ore had been carried out of the area for export, but the mine at Little Cadia was soon overshadowed by the much larger Cadia (or Cadiangullong) Copper Mine. Mining at Little Cadia had ceased by the time the North and South Section Mines were in operation at West Cadia, the latter being the third area of mining activity.

At East Cadia, mining concentrated upon Portions 83 and 87 of the Parish of Waldegrave.[9] On 15 July 1861, John Savery Rodd, Saul Samuel, Randolph John Want, and Thomas Icely (Cadiangullong Consolidated Copper Company) leased to Robert Archibald Alison Morehead & Matthew Young, Sydney, esquires, who were the Australian representatives of the Scottish-Australian Mining Company, the three portions numbered 87, 83 and 162 in the Parish of Waldegrave for 21 years from 1 July 1861 for copper mining purposes. The royalty was to be one-twelfth of all copper ore raised, dressed and ready for the furnace, or alternately one twelfth of this once refined. Work on mining was to commence before October 1861 and was to be undertaken continuously with a minimum of 6 able bodied miners. If the mines had to stop due to a "Strike of Workmen or such rise of Wages as shall in the opinion of the lessees... render it desirable temporarily to suspend the working of the mines on the said land in order to import labour", the lessees were to pay a weekly rent of £25. The land let consisted of Portions 87, 83 and 162, excepting a part in the north-west corner of Portion 87 measuring 23 chains along the north boundary of the grant, 20 chains on the east and then a line back to Cadiangullong Creek and then northwards along creek.[10] In December 1861, the *Western Examiner* newspaper of Orange noted

[9] Plan of the Cadia Properties 1881
[10] RPA 2120 in SRNSW 10/26437

that there was a large quantity of ore at "this extensive mine" and that a smelter was being erected.[11]

The Scottish-Australian Mining Company commenced their Oakey Creek Copper Mine at East Cadia, which was later renamed the Cadia or Cadiangullong Copper Mine in 1863.[12] Captain Josiah Holman was reported to have arrived to take over the operation of this mine in March 1862. On 13 May 1864, the Cadiangullong Consolidated Copper Company (Directors Thomas Icely, William Frederick Jones, John Savory Rodd, Saul Samuel and Randolph John Want) sold the mine and their land to Morehead and Young, as the Australian representatives of the Scottish-Australian Mining Company.

By 1868, the East Cadia Mine was driven down as far as 23 fathoms according to Joshua Holman, the mining captain, until waterlogging of the workings prevented any further ore being removed. Up to that time it was claimed that 1,300 tons of copper ore had been extracted from that mine.[13]

The third area of mining was located on the opposite or western side of Cadiangullong Creek in the Parish of Clarendon. Portions 147, 148 and 149 were purchased by William Lawson, Thomas Icely, William Jones and John Savery Rodd in April 1852, but sold to the Scottish-Australian Mining Company in May 1864, along with all their other holdings. It is likely that this area was mined or at least prospected before June 1861, since Robert Morehead described an adit being present by that time and also possessed a description of the mine which had been given him in 1858 by a Captain Dalley.[14] So far as is known this is the only justification for Margaret Morris' assertion that mining had taken place before 1861 at this location.[15]

The West Cadia mines were divided into the North and South Sections. The North Section was sited upon Portion 148 of the Parish of Clarendon and the South Section was on Portion 149. In his 1868 report to the Manager of the Company, Holman described the North Section as having a 12 HP portable engine, which was on Trevena's engine shaft, which was 40 fathoms deep with an adit 19 fathoms deep.. At 12 fathoms below the adit, Trevena's shaft was extended west of the shaft on Northey's lode. As well as Trevena's shaft, there were shafts named after Rodd, Hall,

---

11 *Western Examiner*, 14 Dec 1861
12 B A French, 'Cadia', April 2000, p. 46
13 C Pratten, 'A History of the Cadia Mines', typescript, p. 4.
14 B. A. French. 'A chronology of records of Cadia, 1828 - 1999', 2000, unpaginated. Report, 20 June 1861.
15 C Pratten, 'A History of the Cadia Mines', typescript, p. 4.

Gundry, Samuel, John as well as Icely's. On the South Section was erected the Cornish condensing engine with a 25 inch cylinder and a ten ton boiler, with pumping, winding, stone-breaking, crusher and jigging machinery. This is the extant Cornish engine house.

The Scottish-Australian Mining Company erected the Cornish beam engine and engine house in 1865.[16] Nearby were a smithy with two forges, as large carpenter's shop and engine-fitting shop, with a large lathe, powder magazines and mining office. Phillips' engine shaft was also in this section and went down 32 fathoms. It was connected to Lawson and Want's shafts.

In 1866, after large parts of the land surrounding the mine were closed to miners and woodcutters by a pastoral lease, Holman arranged for the preparation of a petition calling for the declaration of a Common around the mine, so that fuel could be gathered for the mine. This successfully created a Common, which operated for some years until revocation, where fuel for the mines could be gathered. Woodcutters were able to obtain their livelihood and the mines continued to operate.

Excavation of mine shafts at Cadia appears to have been based upon Cornish mine techniques with manual labour being used to work the mines. Miners concentrated on the richest lodes. At some stage by 1868, explosives were being used as Holman noted the existence of a powder magazine.

Despite the investment in mines and plant, equipment and a smelter at Cadia, the Scottish-Australian Company was losing money by 1868, when the price of copper on overseas markets fell. For the rest of the nineteenth century, the Cadia mine opened and closed with the rise and fall in copper prices. Holman reported various attempts to locate payable gold on the company's land. When production was slow, workers left the district seeking employment elsewhere. Sometimes, it was at other mines owned by the company, such as Icely.

The early smelters appear to have been built on the reverberatory principle, which could utilise timber as fuel and was simpler to build and operate. In the furnace, finely ground ore well mixed with the flux was heated for up to 24 hours until the copper matte could be extracted. This was then further refined in a more sophisticated reverberatory furnace. The technology had been developed in Wales and was widely

[16] The *Sydney Mail* of 16 September 1865 describes the engine in the course of erection. Baillier's New South Wales Gazetteer, 1866, records the engine as complete.

applied in copper mines across Australia. Thus, at Cadia, as in many copper mining settlements, there was an ethnic divide amongst the workforce. Many of the miners were Cornishmen, whilst the smelter staff were often Welsh.

Low copper prices as well as a decline in ore quality caused the cessation of production in 1868. In mid 1868, the mortgagee ordered the sale of the Cadiangullong Copper Mines, but there were no bids and the property remained in the hands of the company. Research by Brian French suggests that the years 1863-67 were a peak period of copper mining activity.[17]

In May 1870, the *Australian Town and Country Journal* reported on the Cadiangullong Mine. By this time, the journalist noted that there were 13 shafts and that almost a mile of tunnel had been dug out in various directions through the ore body. The reporter described the ore smelting process. The smelters were then reducing some ore for the Woods Flat Mine, some 32 miles to the south-west. Boys were employed to pick over the rock and separate the ore from the rock. The best ore went straight to the furnace, whilst the lesser grades were crushed and jigged. This stone was first broken by Appleton's stone breaker into smaller pieces. It was then reduced to smaller size between Cornish cast-iron rollers. Once crushed sufficiently fine, it passed through the eight jigging machines in eight slabbed pits which separated the components by gravity with the ore sands being skimmed off by boys.

Between 1872 and 1877 copper mining was again active at Cadia.[18] About 1877, there was again a spurt in production. The school records show that bricks and timber were being gathered for a new works for the Cadia Mining Company. Carne noted in the 1899 edition of his book on copper mining that a substantial stone engine and pumping house was erected at this time. Carne also noted that about 48 tons of ore was obtained in 1882 and some tributing was done in 1883, but it is not known from which mine this ore was obtained. However, from 1880 onwards, Holman occupied the mine as yearly tenant of the company and continued to work it under a royalty arrangement with the company. As well as smelting some ore, his men sought gold in the vicinity.[19]

French noted that from 1887 until 1890, there was another burst of mining activity at Cadia.[20] In the late 1880s and during the 1890s, copper mining revived at Cadia and

[17] B A French, 'Cadia', April 2000, p. 27
[18] B A French, 'Cadia', April 2000, p. 27
[19] B A French, 'Cadia', April 2000, p. 48
[20] B A French, 'Cadia', April 2000, p. 27

Carne reported that about 2,500 tons of ore of 16% copper was dug out under Holman's direction. Between 1887 and 1899, Carne also claimed that a total of 4,000 to 5,000 tons had been dug from the eastern side of the creek opposite the Iron Duke tunnel and been treated at the Cadia smelters. However, in the Mining Department's Annual Report, he was sceptical of the accuracy of this figure. The Annual Report of the Mines Department of 1889 noted that new machinery worth £1,750 had been installed by the Scottish-Australian Company at Cadia and that £8,000 had been spent on buildings. This expenditure was probably used to build Smelter No. 2, located beside Cadiangullong Creek on the north western side of the Village. A total of 50 tons of ore was dug that year. In 1890, total copper ore raised at Cadia totalled 300 tons, but by 1891, it was believed that copper production had ceased at Cadia.

In the 1890s, copper mining revived, so that Carne was able to report in his 1908 edition of several new shafts, which had been opened at Cadia. When he visited the site in February 1908, he reported that the Iron Duke lode on the western side of the creek in Portions 83, 86, 87 was open and was being "extensively" worked. On the eastern side, the East Cadia Section was being worked along with Chilcott's Shaft. A fourth furnace had been brought into operation.

By 1908, a new 60 ton blast furnace was being built at Cadia for the Cadia Extended Mining and Smelting Company, which was operating on the site of the 1859 Canoblas Copper Mine (Little Cadia). The company does not appear to have had much success.

A new venture to mine at Cadia was under way by 1904. The Cadia Gold Syndicate had been formed to work the area for gold. By late 1904, the Scottish-Australian Mining Company was again working small copper deposits. By 1905, the Cadia Copper Mining and Smelting Syndicate had taken a lease on the Cadia mine from the Scottish-Australian Company and was working it by June 1905 with 8 men, and had 86 in employment by the year's end. A furnace was to be built. By the time of Carne's visit in 1908, there were four reverberatory furnaces in operation. He reported that 200 men were employed at the copper mines, including miners, smelter staff plus wood cutters and carters.

Copper mining soon declined again. By late 1908, the Scottish-Australian Company had given up the lease and, according to the Mines Annual Reports there was no

further copper mining until 1913. However, French has identified the period 1909 until 1916 as another peak of copper mining.[21]

Some gold was also being won locally. The Cadia Hill Gold Mining Company was reported to be working a very large low grade deposit south-east of Cadia in 1908. Isolated nuggets were also found in the locality.

A new blast furnace was erected in 1912 after some years of depressed mining activity. In 1913, there were 250 men at work in Cadia and over 19,000 tons of ore was treated. Gold and silver were also obtained from this ore as well as copper. Work continued spasmodically for the next few years. In 1916 a peak of 25,000 tons of ore was treated. Copper mining operations closed down in 1917.

The presence of a large body of iron ore at the Iron Duke on Portions 147 Parish of Clarendon and Portions 83 and 87 of the Parish of Waldegrave had been widely known since 1901 at least when Jaquet described them as the most extensive deposit in the state. William Sandford Ltd, the builders of the steelworks at Lithgow had taken a lease from the Cadia Copper Mining Company to mine the ore on the Iron Duke lode, but had not used it. G & C Hoskins, who took over the Sandford Works, made arrangements to mine the Cadia iron ore. A lease for £1,000 per annum with a royalty of 6 d per ton was signed with the Cadia Copper Mining Company. Work on a rail line from Spring Hill to Cadia commenced.

From 1918 onwards, G & C Hoskins Ltd, the Lithgow iron working company, mined iron ore from the Iron Duke deposit and shipped it out via aerial tramway and railway to their works at Lithgow. By 1919, there were 130 men employed on the mine. On 10 March 1921, an accident with explosives killed nine men in the Iron Duke Mine.

When the Lithgow furnaces of G & C Hoskins closed down in 1927, the company shifted its smelting operations to Port Kembla. Production of iron ore from the Iron Duke fell. A total of 180,108 tons of ore, mostly from Cadia, was used at Lithgow in 1927. But, in 1928, only 84,206 tons was mined at Cadia and a mere 874 tons in 1929. The mines closed.

During the 1930s, there were schemes to recover gold from the Cadia district, most of which did not come to fruition. However, A T Mylecharane was able to successfully win gold from the Iron Duke in the late 1930s. This operation was bought by Cadia

[21] B A French, 'Cadia', April 2000, p. 27

Gold Mine Pty Ltd, which installed a stamp battery, bins, amalgamating tables and classifiers.

The Cadia iron ore mines re-opened during World War II to make up the shortfall in shipments of South Australian ore for Port Kembla. From about 1941 until August 1945, ore from Cadia fed the furnaces at Port Kembla. Australian Iron and Steel Ltd refurbished the old railway line from Spring Hill and began to excavate ore from the Iron Duke from August 1941 onwards. A new incline was built to replace the aerial ropeway, which was no longer functioning. The quarrying of the ore continued until 29 August 1945, after which the rails were removed.

During the 1930s and the 1940s, a Mr Tinnock dug small quantities of gold or copper ore. In 1952, the plant of the Cadia Gold Mines Ltd was dismantled and removed.

2.4. Mining and smelting of copper at Cadia.

The early mines at Cadia (Little Cadia, East Cadia, West Cadia, both North and South Sections) were worked on Cornish principles, using hammer and gad to sink shafts into the most productive ores. Blasting with gunpowder was used at an early stage, as indicated by the references to powder magazines.

Ore was processed near to the shafts, as indicated by the presence of tailings and slimes (North and South Section Mines). The ore was first sorted by “picky” boys, with the waste discarded on mullock heaps. Fine ores were sent straight to the smelter, while the remainder was spread on cobbled processing floors, splashed with water to bring out the colour and then again sorted into ore and mullock. The ore was then crushed or milled, followed by jigging (buddles or jigs).

The ore, once finely ground, was transported to the smelter. Smelter No. 1 was constructed between 1861 and 1866.

Smelting is the process whereby copper is separated from the ore in which it is found. The ore is heated in a furnace together with flux to a sufficient temperature to melt the copper. The molten copper is heavier than the ore or flux and sinks to the bottom, where it can be periodically drawn off. Two types of furnace were used at Cadia, the reverberatory or blast furnace. The reverberatory furnace (Smelters No. 1 and No. 2) was the simplest to construct and operate, but had to be carefully supervised. Timber could be used as a fuel, providing the ore was finely ground. The reverberatory

furnace possessed a firebox, a stone hearth with a brick dome over it. The furnace was charged with a well mixed supply of ore and flux. It was then fired up for a period of approximately 24 hours, before the matte (copper) and slag were drawn off at different levels of the furnace. The furnace was then cleaned out, any repairs undertaken and a new charge placed in the furnace before recommencement of the smelting cycle.

The matte, which comprised about 40 to 60 % copper, was then further refined in a smaller reverberatory furnace. The smelting works at Cadia also contained a roasting furnace or calcining furnace, where pyritic ores could be roasted to oxidise the sulphur before refining with other ores.

Smelter No. 1 was located near to a plentiful water supply in Cadiangullong Creek. It is located to the south of Hoares Creek and is the most southerly of the three smelters on Cadiangullong Creek, so as to be located intermediate between the four early mines, particularly Little Cadia and the other mines.[22] Later phases of mining and smelting are not discussed in further detail, since they post date the use of Smelters No. 1 and No. 2.

Copper Smelter	**Date Range**		**Comments.**
Smelter No. 1	1861 to 1864		Reverberatory Furnace. East side of Cadiangullong Creek, south of Hoares Creek
Smelter No. 2	1889	1908.[23]	Reverberatory Furnace. East side of Cadiangullong Creek, at northern end of Village Site.

[22] Godden Mackay, Cadia Mining Project, Final Conservation Plan. Newcrest Mining Limited. 1995. Volume 1. p. 57-60.
[23] Godden Mackay, Cadia Mining Project, Final Conservation Plan. Newcrest Mining Limited. 1995. Volume 1. p. 61, Volume 5, p. 10.

Smelter No. 3	1912	1915. [24]	Water Jacket Furnace. West Side of Cadiangullong Creek, south of Iron Duke.
Smelter No. 4	c1908.[25]		Portable Water Jacket Smelter. Located at Little Cadia. There is very little trace of slag on this site, indicating that the smelter was either not used, or was used only for a very short period.

Table 2.1. The copper smelters at Cadia.

2.5. Commercial copper ores.

Copper appears in nature in a number of combinations with other elements, but those of commercial importance are few in number. The following text is summarised from Carne.[26]

Native copper, or pure copper (Cu), was once common in NSW wherever copper ores were located, but occurred only in small quantities. Native copper was present at Cadia (probably Little Cadia).

Cuprite (Red oxide of copper) (Cu_2O) is the richest ore of copper, frequently forming the decomposed and oxidised cones of native copper. Although present at most copper mines in NSW, it has frequently been worked out.

[24] Godden Mackay, Cadia Mining Project, Final Conservation Plan. Newcrest Mining Limited. 1995. Volume 1. p. 61.
[25] Godden Mackay, Cadia Mining Project, Final Conservation Plan. Newcrest Mining Limited. 1995. Volume 6. Inventory Sheet LC09.
[26] J E Carne, *Copper Mining* 1908, p. 17-18.

Melaconite (Black oxide of copper) (CuO), although a common occurrence, has rarely been found in NSW, but is often mistaken for a partially altered and enriched sulphide ore.

Malachite (Green carbonate of copper) ($CuCO_3$ + $Cu(OH_2)$ is one of the most frequent ores, along with Azurite in the oxidisation zone, and forms the bulk of direct smelted ores.

Azurite (Blue carbonate of copper) ($2CuCO_3$ + $Cu(OH_2)$ occurs frequently in association with Malachite in the upper levels of mines (oxidisation zone), but in less quantities. It may also be direct smelted.

Chalcocite (Copper glance or grey sulphide of copper) (Cu_2S), frequently known as "grey ore" among local miners, is one of the most important copper ores and is usually the result of leaching and redeposition of copper salts from upper levels. It is found in the lower levels of mines.

Bornite or Erubescite (Variegated copper ore) ($3Cu_2S$, Fe_2S_3) is infrequently found, but probably formed from the leeching and redeposition of copper ores from higher levels. It is found in the lower levels of mines.

Chalcopyrites (yellow sulphide of copper) (Cu_2S, Fe_2S_3) is the most widely distributed ore of copper and the most persistent at depth, hence its importance. It is commonly associated with iron sulphide (pyrites), with traces of gold and silver.

Smelting of sulphide ores requires prior roasting or calcining to reduce the amount of sulphur. Alternatively oxide and sulphide ores can be mixed to provide fluxes..

2.6. Ores mined and smelted (Smelter No. 1) at Cadia.

Some of the richest copper ores were mined at Little Cadia in October 1858. On 20 August 1859, it was described in the *Sydney Morning Herald* as 'composed almost wholly or red and black oxide, native copper, and iron and copper pyrites, and, without exaggeration is one of the most magnificent deposits of copper ores ever found in any age or country.' These ores may be recognised as native copper (Cu), Cuprite (Red oxide of copper) (Cu_2O), Melaconite (Black oxide of copper) (CuO), and Chalcopyrites (yellow sulphide of copper) (Cu_2S, Fe_2S_3).

By June 1861, Mr. Robert Morehead had visited a number of mines near Bathurst and had inspected workings at Cadia, which may be those at West Cadia, because of the extensive iron outcrop described. He described the ores as predominantly carbonates and oxides and grey ores. These may be recognised as Cuprite (Red oxide of copper) (Cu_2O), possibly Melaconite (Black oxide of copper) (CuO), Malachite (Green carbonate of copper) ($CuCO_3$ + $Cu(OH_2)$, possibly Azurite (Blue carbonate of copper) ($2CuCO_3$ + $Cu(OH_2)$ and certainly Chalcocite (Copper glance or grey sulphide of copper) (Cu_2S).

The Company commenced mining at West Cadia in July 1861. By November of that year they had mined about 600 tons of ore, including a small quantity bought from the previous mining enterprise. In the month ending 15 November 1861, it was reported that 200 tons of ore was raised, which could yield as much as 40% copper, and that the entire amount of ore so far raised could yield 20%. The ore was described as native copper among other oxide ores. It was reported to the AGM in February 1862 that Captain Christoe was attempting at that time to prospect the whole of the mineral resource at the mine.

The *Sydney Mail* of 16 September 1865 described the ores being obtained from the North and South Section Mines as 'yellow sulphurets', in other words Chalcopyrites (Cu_2S, Fe_2S_3). The same report also indicated that the sulphide ore is mixed with the higher grade ores for smelting purposes, since the iron and silica in the sulphide ores act as a flux. The article also describes 'carbonate of oxide ores' being smelted at Cadia. This is more likely to be Malachite ($CuCO_3$ + $Cu(OH_2)$ rather than Azurite ($2CuCO_3$ + $Cu(OH_2)$.

The report by Captain Josiah Holman of 11 June 1868 indicated the presence of native copper thinly dispersed through the iron stone at East Cadia, while the iron pyrites contained nearly payable quantities of gold for working. Also at this mine, red oxide of copper (Cuprite (Cu_2O)) formed a superficial covering of the ore, thickly studded with native copper, though this rich ore was surrounded by less valuable ores (probably sulphide ores, since there is reference to iron and gold content). By 1868 a total of 1341 tons 8 hundred weight of ore had been raised and estimated to yield 123 tons 16 hundred weight 1 quarter 2 pounds of fine copper, averaging 9.23 per cent.

At North Section, extension of the mine had been made, while 3,000 tons of unspecified copper ore had been previously extracted.

At Phillip's Engine Shaft rich ores were encountered from the surface to the deepest levels. At 26 fathom depth a 4 ton sample of fine yellow sulphurets of copper (Chalcopyrites (Cu_2S, Fe_2S_3)) were mined. Large quantities of ore (probably sulphide) were obtained from this and neighbouring shafts on the South Section. In all about 2,000 tons of ore had been mined at South Section. The total of West Cadia (North and South Section) production was 5164 tons 12 hundred weight 1 quarter, yielding by assay 649 tons 15 pounds of fine copper, an average of 12.566 per cent.[27]

2.7. Detailed references to the first phase of copper smelting at Cadia (Smelter No. 1).

The Director's Reports of the Scottish and Australian Mining Company from 1859 to 1909 and other historical documents provide valuable information on mining and smelting at Cadia.[28]

The Scottish Australian Mining Company was formed in December 1859. It had engaged Captain John P Christoe by May 1860 to prospect mining opportunities in the Bathurst District. The Company leased land for the mine at Cadia by July 1861 and had purchased 25 acres for the erection of a smelter at a price of £2 an acre.

Mr. John P Christoe, described as a metallurgist, was an invaluable asset to the company. In a letter from Mr. Robert A. A. Morehead, dated 20 July 1861, it is stated that Mr. Christoe 'can proceed to erect furnaces, and to carry on smelting with the confidence that is engendered by his having already done all this, with perfect success, in the neighbourhood; his local expertise, therefore, will enable him to proceed with an economy and efficiency that no other metallurgist could bring to bear.'

Mr. Morehead nonetheless would proceed with caution, in order to satisfy the Directors of the Company and justify his approach. He stated that "I am, however, pretty confident that what we now contemplate will not involve an outlay of £2,000; and when I speak of the works we now contemplate, I should explain that this refers to the construction of several furnaces, and that, of course, one will be completed first

[27] B. A. French, 'Extracts from the Directors Reports of the Scottish Australian Mining Company, 1868-1909', September 2000. unpaginated.
[28] B. A. French, 'Extracts from the Directors Reports of the Scottish Australian Mining Company, 1868-1909', September 2000. unpaginated.

and the others proceeded with only if the (confidently) expected inducement from mining operations offers itself."

Mr. Morehead also described his decision to erect the engine and crusher at Cadia in this same letter. It had been imported in May 1860 for the Good Hope Mine, owned and developed by the Company, near Yass, but had been left in storage in Sydney until required.

On 27 July 1861, Captain Christoe reported that he had found 'on the Property a clay for making fire bricks, quartz in abundance, and a quarry of superior rubble stone,' all of which would assist in the construction of the smelter.

By 31 December 1861, the following inventory of expenses indicated the extensive nature of work at the Cadiangullong Mine, including the erection of Smelter No. 1. The total cost of the smelter was estimated at £2,000 and was nearly completed for the AGM held on 7 February 1862.

31 December 1861 - Cadiangullong Stock Plant, Improvements, etc. in the Cadiangullong Mine and Works.[29]

Smelting shed	120 x 60 ft	Bark roof	£95		
Refiner's House	30 x 15 ft		£21		
Double House	40 x 12 ft		£22		
2 Single Houses	20 x 12 ft		£22		
1 Single house	22 x 12 ft		£16	10s	
Assay Office (Weigh House, furnace, etc)	42 x 15 ft	Shingled	£53		
Stack and culvert			£402	3s	4d
Ore flow culvert			£38	18s	4d
Wood, 1034 tons cut and carted @ 4/1 [per ton]		[30]	£211	2s	2d
Ditto 309 tons @ 2/3d [per ton]			£34	15s	3d

[29] B. A. French, 'Extracts from the Directors Reports of the Scottish Australian Mining Company, 1868-1909', September 2000. unpaginated.
[30] This total was listed as £ 402.3s.4d and is incorrect for the rate given. It may be a transliteration from the sum for the stack and culvert above.

Lime 140 bushels burned and carted @ 2/2d [per bushel]		[31]	£15	3s	4d
Ditto 371 @ 2/1d		[32]	£38	12s	11d
Fire bricks 19,000 @ £6. 10s. [per thousand]			£123	10s	
Common bricks 25,000 @ 27/6d [per thousand]			£34	7s	6d
Quartz 17 tons @ 15/- [per ton]			£12	15s	
Plant					
1 fire brick machine			£20		
Brick maker - 8 narrow barrows @ 40/-		[33]	£16		
3 iron Nibbles			£1	4s	
2 adzes				12s	
2 spades				13s	
2 Powder cans				4s	6d
6 gimlets				2s	
	[total]		£1	11s	6d
1 can				3s	
2 brushes				2s	1d
Chisel				1s	9d
Hacksaw				7s	
	[total]			13s	10d
Mine Buildings.					
Powder Magazine			£16		

[31] This total was listed as £15. 7s. 4d and is incorrect.
[32] The total number of bushels was listed as 381 and is incorrect.
[33] The total number of barrows is listed as 6, but this would give a total of £12, not £16. Either the number of barrows or the sum of £16 is incorrect. In the table the number of barrows is corrected.

Captain's House and working office	60 x 15 ft		£52		
Closet, etc			£2		
Blacksmith's and Carpenter's shop	42 x 15 ft		£23		
Carpenter's and Engineer's House			£27		
Store and Back Shed for hay			£8		
Manager's House			£80		
Well			£8		
Dam, Race, etc for ore floors			£48		
Outlay on weir of dam @ £15		34	£63		
Grass Paddock of 330 rods			£66	3	
Cultivated Paddock			£48	18	4
Stock Yard			£8	0	6
2 Bridges, cutting of road, works and quarry			£72		
Total		35	£483	1	10

The wandering reporter for the *Sydney Mail* described the Cadiangullong Mines, including the smelting works on 16 September 1865. Mr. Holman was identified as the Mine Captain, while Mr. Christoe, the company's assayer, was in charge of the smelting works.

> "These works are situated on the eastern side of the creek, and at the southern end of the settlement. These consist of six furnaces at present at work, one in course of building, and an eighth shortly to be commenced. They are what are known as draught furnaces, the draught being furnished by the flues of the furnace being connected with a tunnel about sixty yards long, ending in a tall stack of chimney.

34 This figure appears to be incorrect.
35 The actual total for the figure given is £522. 1s. 10d. This means that there are some mistakes in the addition, or the figures have not been accurately transposed from the original or they were illegible.

> When the whole of the six furnaces are at work, the draught that this long flue causes, is very much greater than would generally be believed. In fact, so much so, that recently in clearing out the tunnel, the residuum of sulphur, &c., that hung upon the walls, gave in smelting a very large per-centage of copper, showing that even by this modification some of the metal was volatised and carried off in vapour."

Earlier in the same article, the reporter had noted the consequences of this process for the community:

> "The snort of the steam, the clang of the engine, and the roar of the furnace mingle with the hum of human voices, and give a stranger impression than that conveyed by a newly opened gold field, for above all and pervading all there is an unmistakable sulphur odour, somewhat irritating at first to persons of delicately sensitive olfactory nerves."

The wandering reporter continues to describe the smelting process in detail:

> "The first process to which the ore is submitted is that of calcining, by which the water and some of the earthy particles are removed. The second is smelting the calcined ores, by which a large portion of the silicous matter is taken out, the remainder forming with the iron into a slag that has been found to be a valuable flux for the richer ores. The third process is the melting of the results of No. 2, which gives a regulus of about 45 per cent., with the best carbonate of oxide ores, containing themselves a per-centage of from 20 to 30 of copper. This brings on the metal to about 60 to 65 per cent., and it then undergoes the fourth process by being charged into the wasting furnace, by which it is brought up to about 80 per cent. By the fifth process it is returned in blocks to the roasting furnace, where it is roasted into copper of about 98 per cent. The sixth and last process is charging the process of No. 5 into the roasting furnace, where it is converted into pure copper of standard quality. In this last instance, the charge is usually about 8 tons, and the process occupiers twenty-four hours. In the calcining furnace about 40 to 60- tons a week are roasted and prepared for the subsequent operations, the quantity of course decreasing as the various operations are gone through. The quantity of ore smelted is usually

> about 200 tons per month, and this gives a monthly yield of about thirty tons of pure copper, being at the rate of from 15 to 16 per cent. The smelting is all done with wood for fuel, and for the above quantity of ore no less than 1200 tons of firewood are consumed."

The next detailed description of the Cadiangullong Copper Mines is contained within a report by Captain Josiah Holman, who had been engaged by the Company in March 1862. The report is dated 11 June 1868.

> "SMELTING WORKS.--The large shed covered with galvanised iron is 125 by 60 feet, under which are three copper ore furnaces, one roasting furnace and a refinery furnace. One ore smelting furnace and the refinery are complete, the others having had their bottoms recently taken out, will require rebuilding above the foundations. The ironwork of these is complete, and the whole of these furnaces could quickly be put in efficient working order. A detached galvanised iron covered shed 60 by 50 feet, contains one new copper ore smelting furnace complete, by having a new bottom. A detached galvanised iron shed, 35 by 25 feet, covers a calcining furnace. Detached is a smith's shop with forge, anvil, vice and tools; also sets of smelting tools for immediate resumption of works. An assay office built of slags, with shingled roof 29 by 18 feet, contains two furnaces, assay tools, scales, weights, crucibles, chemicals and fluxes for assaying, with office furniture, stationery, &c, &c. One of Avery's large weighing machines and a weighbridge used for weighing the fuel for the works.
>
> The quantity of copper ores smelted at the works has been 7695 tons 12 hundred weight and 3 quarters, yielding a gross produce in refined copper of 837 tons 11 hundred weight and 6 pounds, viz: from East Cadia Mine 1341 tons 8 hundred weight; West Cadia 5164 tons 7 hundred weight i quarter, together estimated to yield 772 tons 16 hundred weight 1 quarter 17 pounds of copper and purchased ores from Canoblas Mine 871 tons 16 hundred weight 1 quarter; Canangara Mines 318 tons 5 hundred weight 1 quarter; and having produced as above stated 837 tons 11 hundred weight 6 pounds of refined copper. These works are capable of reducing over 300 tons of copper ore monthly"

The advertisement in the *Sydney Morning Herald* for 16 May 1868 for the mortgagee sale of the mine, which had by that time closed down, included a further but brief description of the smelting works:

> "1 Manager's house, and a large number of miners' houses, assay office, 2 blacksmith shops, 3 smelting furnaces, 1 roaster and 1 calcining furnace, 1 large shed with iron covered roof, 3 ditto covering furnaces."

2.8. Investment and mining strategy for historical copper mines.

Carne lamented that many mines in the 19th century were worked on an ad hoc basis, without any system or planning ahead. He indicated that many mines failed because they did not plan ahead by prospecting the available mineral resource or by chemical analysis of the sulphide ores which would be reached at lower levels.[36]

On the other hand, mines which adopted a system or planned approach to mining would have no reason to fail. A planned approach to mining included:

1. Exploration of the resource ahead of stopes, using shafts and winzes. These mines were able to keep in sight a considerable reserve of ore.
2. Mining at all levels of the mine, so that oxide and sulphide ores were available for judicious mixing in the smelting furnace, without over use of fluxes.
3. Analysis of both oxide and sulphide ores to determine best smelting results and mixes of ores. Early analysis would allow a mine to develop the most appropriate smelting works, so that additional capital and development were not necessary at a later stage.

Capital investment could more easily be obtained for the mining and smelting of shallower oxide ores, because it paid good dividends. Investment was more difficult to obtain for the mining and smelting of deeper sulphide ores, because the returns on investment were lower or longer term. Many mines failed once they reached the sulphide ores because of the extra capital required. Carne advocated that provision should have been made for this capital investment in the early stages of oxide mining, so that there were steady returns or dividends for both oxide and sulphide ore

[36] J E Carne, *Copper Mining* 1908, p. 14-15.

extraction, rather that a sudden demand for more capital and hence failure of the mine on reaching the sulphide ores.[37]

Captain Josiah Holman reported on 11 June 1868 that the mines had been closed due to the extraordinary low prices for copper on the English markets, to inadequate capital and to a falling off of the quality of the ores produced lately from the mines.[38] In other words, the typical faults of which Carne lamented had been important factors in the closure of the mines at Cadia. Yet it cannot be said that Captain Josiah Holman had not done sufficient to explore the resource ahead of existing stopes, as demonstrated by his 1868 report. Nor is it possible to accuse Captain Christoe of not determining the correct smelting procedures for both oxide and sulphide ores and the judicious mixing of both ores to assist in the smelting process, so adequately described by the wandering reporter for the Sydney Mail in 1865.[39] The major factor in the temporary closure of the mine in this case appears to be the drastic decline in the international market rather than the need to raise more capital, a conclusion supported by the continuation of the Company and the later reopening of the mines once prices improved.

[37] J E Carne, *Copper Mining* 1908, p. 21-22.
[38] B. A. French, 'Extracts from the Directors Reports of the Scottish Australian Mining Company, 1868-1909', September 2000. unpaginated.
[39] Sydney Mail, 16 September 1865.

2.9. Maps and plans.

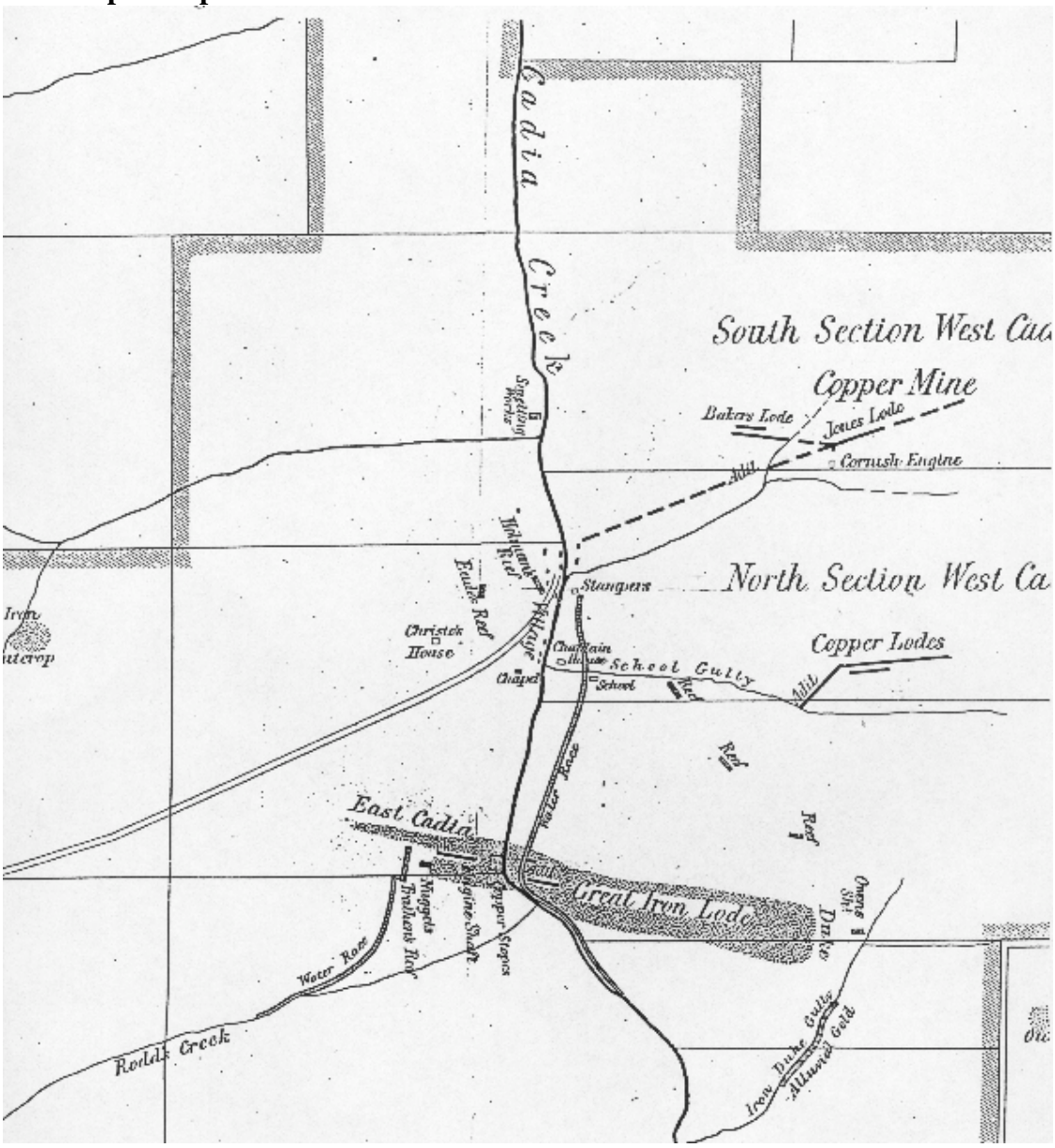

Figure. 2.1. Plan of the Cadia Properties of the Scottish Australian Mining Company, 1881, showing the location of Smelter No. 1, on the east bank of Cadiangullong Creek.

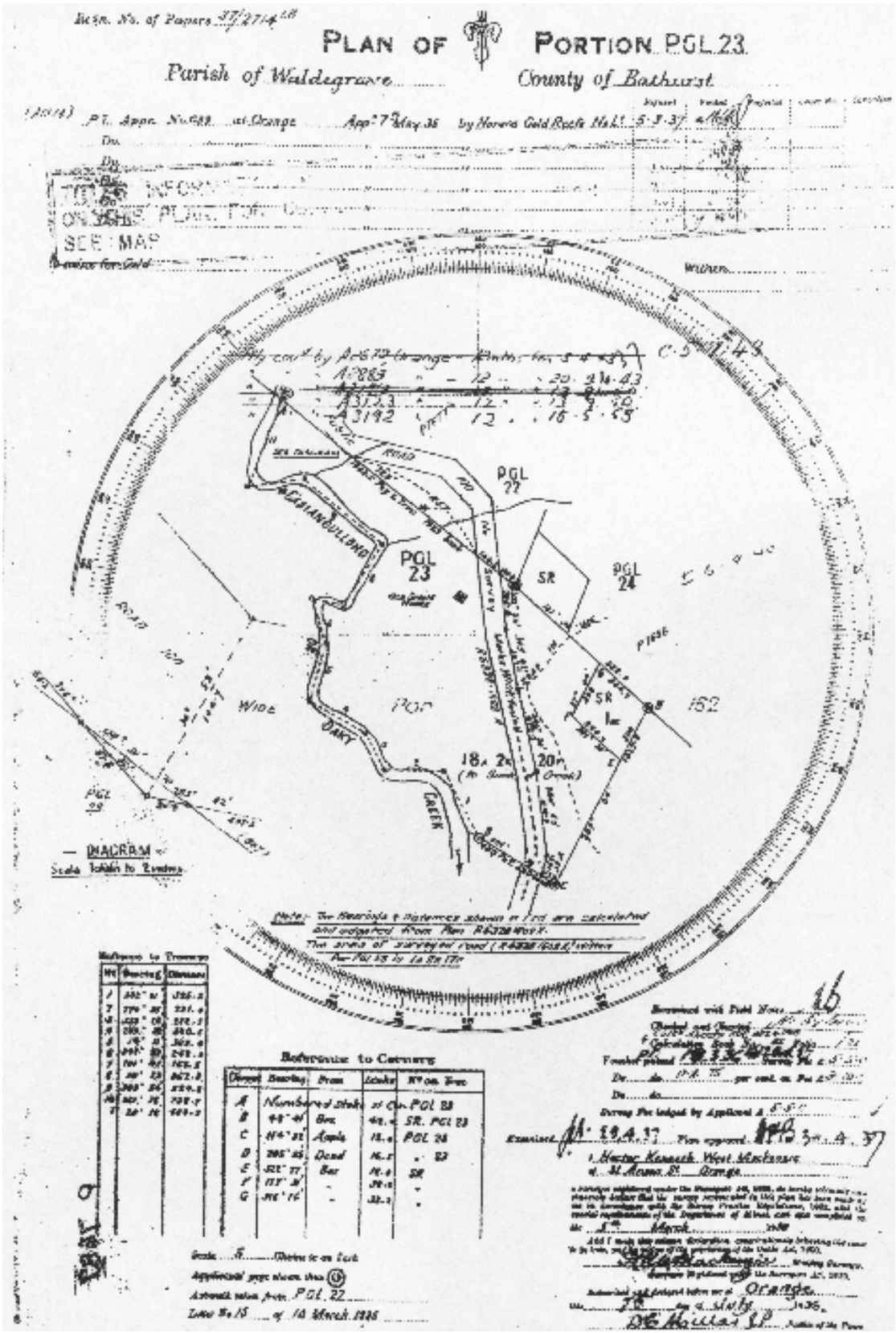

Figure 2.2. Plan of Provisional Gold Lease (PGL) 23, showing the land in the vicinity of the site of Smelter No. 1 in 1936. An old stone house, near the site of the smelter, is shown on the plan (Department of Mineral resources, P7687).

3. SITE SURVEY.

Site survey of the site of Smelter No. 1 was undertaken in June and August 2000, by Edward Higginbotham, Kevin Hickson, Martin Lawler and Tim Adams. Detailed plans and photographs have been included in a previous report.[40] The site is recorded as Inventory Number S114 on the plans and in the Inventory of Sites.

The site of smelter No. 1 is recognised largely as a scatter of slag, the waste product of the smelter. There is very little structural evidence visible on the surface, except for one of two brick or stone footings, which are insufficient to indicate the extent of nature of below ground remains. In additional there are traces of one or more processing floors, covered with mullock and slag. On the eastern side of the smelter site is an alignment of stone footings, running north to south, associated with a raised platform at its northern end. This platform may be the building indicated on the plan of PGL 23, dated 1936. It may possibly be the assay office, which had slag walls, as described in Josiah Holman's report of 11 June 1868.

While most above ground remains of the smelter site have disappeared, it is highly likely that substantial below ground remains survive intact, including processing floors, bases of furnaces, with associated flues and chimney base.

[40] Edward Higginbotham & Associates Pty Ltd. Historical and archaeological assessment of Cadia Village in advance of the proposed mining of Cadia Quarry, Cadia, NSW. Cadia Holdings Pty Limited. 2000.

3.1. Plans.

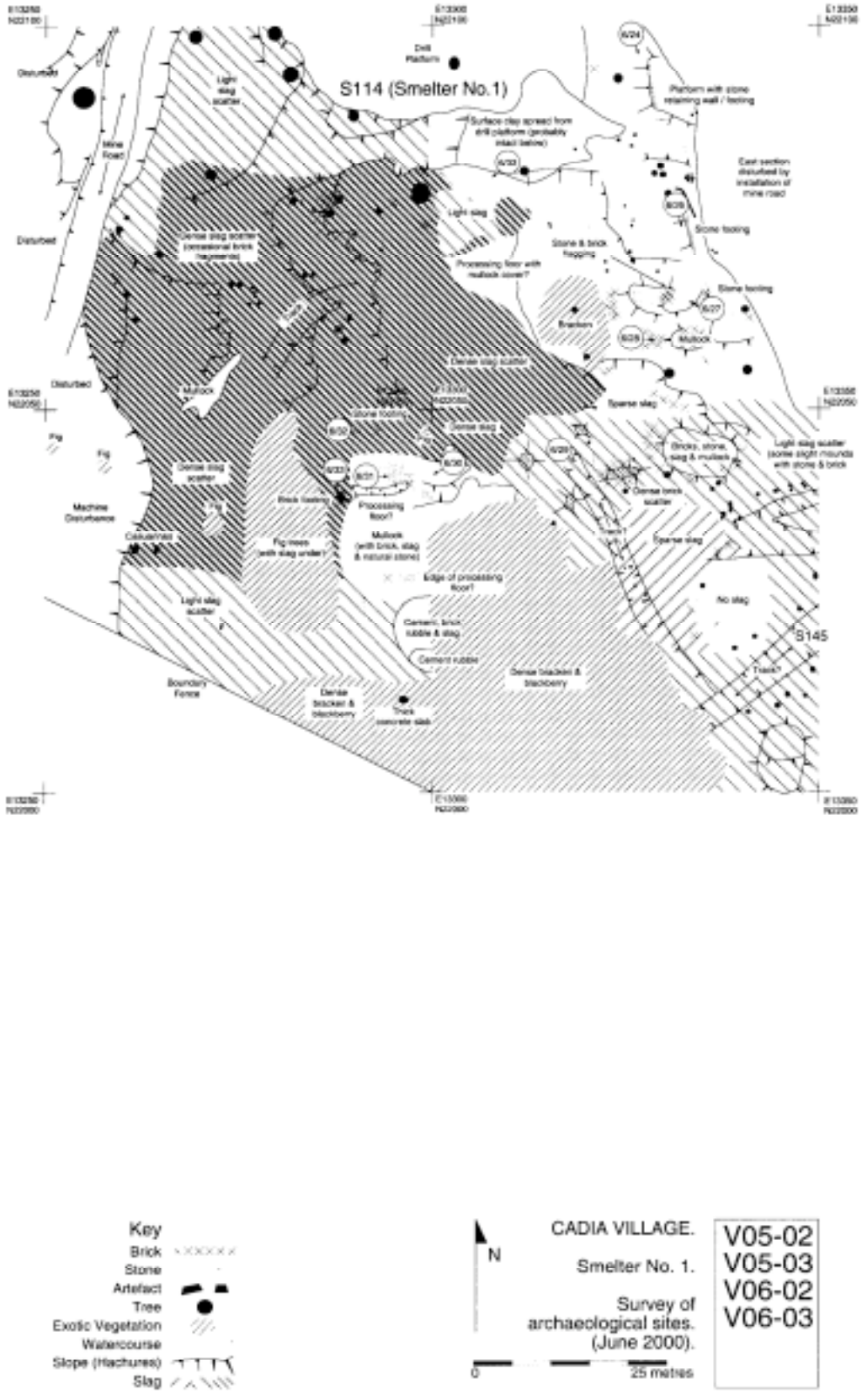

Figure 3.1. Plan of the Site of Smelter No. 1.

4. CULTURAL SIGNIFICANCE.

4.1. Cultural significance.

4.1.1. Current assessment criteria.

The importance of the subject site will be assessed in general terms according to its cultural significance. The criteria for assessment of significance have been recently updated by the heritage Office of NSW.

The State Heritage Register and the State Heritage Inventory were established under Part 3A of the Heritage Act (as amended in 1998) for listing of items of environmental heritage.[41] The State Heritage Register list items which are of state heritage significance, while the State Heritage Inventory includes items of local (or regional) heritage significance.[42]

To be assessed for listing on the State Heritage Register (state significance) or State Heritage Inventory (local or regional significance) an item will, in the opinion of the Heritage Council of NSW, meet one or more of the following criteria.[43]

a) an item is important in the course, or pattern, of NSW's cultural or natural history;

b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history;

c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW;

d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons;

---

[41] ***environmental heritage*** means those places, buildings, works, relics, moveable objects, and precincts, of state or local heritage significance (section 4, *Heritage Act, 1977*).

[42] ***state heritage significance*** , in relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific cultural, social, archaeological, architectural, natural or aesthetic value of the item (section 4A(1), *Heritage Act, 1977*).

[43] Guidelines for the application of these criteria have not been prepared by the NSW Heritage Office to date, but reference should be made to the NSW Heritage Manual, which includes the previous wording for these criteria.
Heritage Office and Department of Urban Affairs and Planning. 1996. Heritage Assessments. pp. 4-7.

e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history;
f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history;
g) an item is important in demonstrating the principal characteristics of a class of NSW's
- cultural or natural places; or
- cultural or natural environments.

An item is not to be excluded from the Register or Inventory on the ground that items with similar characteristics have already been listed on the Register or Inventory.

The NSW Heritage Manual provides for three levels of significance, namely local, regional and state. While the new criteria have abandoned the use of the term "regional", nonetheless the use of the term is still considered beneficial to differentiate between items of local and regional significance, even though both categories are only appropriate for listing on the State Heritage Inventory or Local Environment Plan (LEP).

(In criteria a to g, where an item is deemed to be of local significance, the word locality should be substituted for NSW. Where an item is deemed to be of regional significance, the word region should be substituted for NSW).

4.1.2. Previous assessment criteria, 1996.

In 1996 the assessment criteria were standardised by the Heritage Office and Department of Urban Affairs and Planning in the *NSW Heritage Manual*..[44] These previous assessment criteria are summarised below for reference purposes. Some practitioners may still prefer to use the three criteria relating to level of significance, namely local, regional and state, although there is only provision to use the levels local and state under the current guidelines.

Where there is an equivalence between the current and previous guidelines, a letter (a-g) referring to the current criteria is placed against the previous definition.

[44] Heritage Office and Department of Urban Affairs and Planning. 1996. *NSW Heritage Manual*.

Nature of significance.

Historical significance (evolution and association) (criteria a and b). An item having this value is significant because of the importance of its association with, or position in the evolving pattern of our cultural history.

Aesthetic significance (scenic / architectural qualities / creative accomplishment) (criterion c). An item having this value is significant because it demonstrates positive visual or sensory appeal, landmark qualities and/or creative or technical excellence.

Technical / research significance (archaeological, industrial, educational, research potential and aesthetic significance values) (criterion e). Items having this value are significant because of their contribution or positive contribution to an understanding of our cultural history or environment.

Social significance (contemporary community esteem) (criterion d). Items having this value are significant through their social, spiritual or cultural association with a recognisable community.

Degree of significance.

Representativeness (criterion g). Items having this value are significant because they are fine representative examples of an important class of significant items or environments.

Rarity (criterion f). An item having this value is significant because it represents a rare, endangered or unusual aspect of our history or cultural environment.

Level of significance.

Local. Comprises items significant in a local historical or geographical context or to an identifiable contemporary local community.

Regional. Comprises items significant in a regional historical or geographical context or to an identifiable contemporary regional community.

State. Comprises items significant in a state-wide historical or geographical context or to an identifiable contemporary state-wide community.[45]

4.2. Technical / research significance and archaeological significance.

The term 'archaeological significance' may be defined as the extent to which a site may contribute knowledge, not available from other sources, to current themes in historical archaeology and related disciplines.[46] 'Archaeological significance' is included in criterion e of the current criteria for assessment.

In the assessment of archaeological significance, several factors or criteria have to be taken into account. Questions include:

1. Does the site contribute knowledge not available from other sources? In this respect, the preservation of the site, the availability of comparative sites, and the extent of historical documentation should be considered.
2. Does this knowledge contribute meaningfully to current research themes in historical archaeology and related disciplines? The level of this contribution may be assessed on the same basis as other aspects of cultural significance, for example, locality, region or state.

It is clear that the determination of archaeological significance is closely related and, in fact, dependent upon the development of current research themes in historical archaeology. Research themes will be discussed in this study, thereby giving the

[45] The above assessment criteria were extracted verbatim from Heritage Office and Department of Urban Affairs and Planning. 1996. Heritage Assessments. pp. 4-7.
[46] This definition is based upon the following references; A. Bickford, & S. Sullivan, 'Assessing the research significance of historic sites', in S. Sullivan, & S. Bowdler, *Site survey and significance assessment in Australian archaeology*, Dept. of Prehistory, Research School of Pacific Studies, ANU, Canberra, 1984, pp. 19-26.; S. Sullivan, & S. Bowdler, *Site survey and significance assessment in Australian archaeology*, Dept. of Prehistory, Research School of Pacific Studies, ANU, Canberra, 1984, passim.

historical archaeologist a framework or starting point from which future research and site assessment may proceed.

4.3. Social significance and educational or public significance.

It is also necessary to clarify the significance of a site in terms of its ability to 'demonstrate a way of life, taste, custom, process or function of particular interest.'[47] This factor was given greater emphasis by J. S. Kerr in the assessment of cultural significance in the second edition of his book, entitled *The Conservation Plan*.[48] This may be described as its educational or 'public significance', and may be recognised as social significance under the current guidelines.[49]

The cultural landscape, the patchwork of human development, may possess this social significance, because of its educational value. The evidence provided by the physical remains complements historical documentation, but is often the only means whereby the ordinary member of the public may appreciate his or her surroundings.

Where an artifact, an archaeological feature or site only survives underground, it takes archaeological excavation to reveal its social or educational importance, as well as recover its archaeological significance. Providing the relics or sites are conserved in some way, then the social significance of the archaeological remains is recognised or is able to be recovered at some future date.

4.4. The significance of the cultural landscape.

Human settlement imposes on the landscape a distinctive pattern or patchwork of houses and other buildings, streets and roads, parks and reserves, communications and industry. This physical evidence enables an understanding of the landscape in

---

[47] J. S. Kerr, *The Conservation Plan. A guide to the preparation of conservation plans for places of European cultural significance*, first edition, National Trust of Australia (N.S.W. Branch), Sydney, 1982, p. 4.
[48] J. S. Kerr, *The Conservation Plan. A guide to the preparation of conservation plans for places of European cultural significance*, second edition, National Trust of Australia (N.S.W. Branch), Sydney, 1985.
[49] M. Pearson, 'Assessing the significance of historical archaeological resources', in S. Sullivan, & S. Bowdler, *Site survey and significance assessment in Australian archaeology*, Dept. of Prehistory, Research School of Pacific Studies, ANU, Canberra, 1984, p. 32.

terms of land use, sequence and nature of settlement and occupation. It complements the information that is available from historical research.

Thus all items in an inventory of sites possess **historical significance (criterion a)** as defined under current guidelines, although each will contribute in varying degree. The minimum degree of historical importance will be representative and the minimum level will be local. This means that at least an item will be important to the locality in terms of being representative of the nature of settlement. In many cases items may demonstrate a former use or continuity of use, thereby becoming important items in the historical landscape.

In as much as each item in an inventory contributes to an understanding of the human occupation and evolution of the rural or urban landscape, so too will it possess an educational role for the wider community. This is defined as **social significance (criterion d)** under current guidelines. Social significance may also extend to other values held by the community and placed upon the landscape or items within it, be they social, cultural, religious, spiritual, aesthetic or educational values.

4.5. The heritage significance of the subject site.

The heritage significance of the subject site will be discussed under the headings of the assessment criteria:

a) an item is important in the course, or pattern, of NSW's cultural or natural history;

The site of Smelter No. 1 at Cadia is associated with the pioneering or initial development stage of copper mining in New South Wales. While the copper resources of South Australia were exploited from 1842 onwards, the first copper mines in New South Wales date from 1845. Cadia was the sixth copper mine site in New South Wales to have a smelter. Only the larger and more economic mines possessed smelters, there being a total of 37 copper mine sites in New South Wales with smelters before 1908.

b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history;

The smelting of copper at Cadia has strong associations with both Cornish mining technology and Welsh smelting technology and the immigration of the Welsh and Cornish into New South Wales. John P. Christoe, a skilled metallurgist, was in charge

of the smelting of copper at Cadia. He is known to have set up other smelting works in the region before being engaged by the Scottish Australian Mining Company in 1861 to build the smelter at Cadia. The Scottish Australian Mining Company had also been responsible for the development of the Good Hope Mine at Yass in 1848-1849, and were to continue to have an ongoing involvement in copper mining in New South Wales.

c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW;
The site of Smelter No. 1 at Cadia has the potential to reveal evidence relating to traditional Cornish and Welsh mining technologies, the development of these technologies to suit Australian conditions and the use of traditional building techniques in industrial construction.

d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons;
The locations of Cornish and Welsh settlement and workplace in New South Wales have a strong association for the descendants of these communities, especially for community groups related to Cornish identity and history.

e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history;
The site of Smelter No. 1 has the potential to reveal aspects of traditional technology, particularly Cornish and Welsh mining technologies and their adaptation to local Australian conditions.

The types of copper ores found in New South Wales may also have influenced the design and construction of furnaces and the mixture of ores and fluxes for the smelting processes. These adaptations may have left archaeological traces in the layout of the smelting works, the remains of furnaces and the residues of smelting (slag, etc).

The following are some of the key research questions to which archaeological investigation of the site of Smelter No. 1 may contribute:

1. Standard aspects of the layout and construction of traditional Welsh reverberatory furnaces and smelting works.
2. Variation in the layout and construction of the smelting works, indicating adaptation to the local conditions found in Australia or New South Wales.

3. The efficiency of the smelting works as a reflection on the professional qualifications and experience of the smelter manager or the work practices of the mining company.
4. Working conditions for those employed at the smelting works.
5. Levels of environmental and workplace pollution.
6. The design and construction of the smelting works as evidence of ethnic groups at Australian mining sites.
etc.

f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history;

Smelting works were only associated with the major copper mining sites in New South Wales. Thirty seven mine sites out of a total of eighty copper mines listed by Carne before 1908 possessed smelters. The smelter at Cadia appears to have been the sixth constructed in New South Wales.

g) an item is important in demonstrating the principal characteristics of a class of NSW's

- cultural or natural places; or

- cultural or natural environments.

Welsh technology appears to have dominated the Australian copper smelting industry, while Cornish technology dominated copper mining throughout the 19th century in New South Wales. While Welsh copper smelting technology may be apparent at a number of smelter sites, no comparative analysis has been practical within the bounds of this study and it has not been established whether any other comparative sites survive in good condition.

4.6. Summary of Statement of significance.

The site of Smelter No. 1 at Cadia is associated with the pioneering or initial development stage of copper mining in New South Wales. Cadia was the sixth copper mine site in New South Wales to have a smelter, one of 37 mines to be provided with smelters before 1908.

The smelting of copper at Cadia has strong associations with both Cornish mining technology and Welsh smelting technology and the immigration of the Welsh and Cornish into New South Wales. The locations of Cornish and Welsh settlement and workplace in New South Wales have a strong association for the descendants of these

communities The Scottish Australian Mining Company was to have an ongoing involvement in copper mining in New South Wales.

The site of Smelter No. 1 at Cadia has the potential to reveal evidence relating to traditional Cornish and Welsh mining technologies, the development of these technologies to suit Australian conditions and the use of traditional building techniques in industrial construction. The types of copper ores found in New South Wales may have influenced the design and construction of furnaces and the mixture of ores and fluxes for the smelting processes. These adaptations may have left archaeological traces in the layout of the smelting works, the remains of furnaces and the residues of smelting (slag, etc).

The site of Smelter No. 1 at Cadia is therefore of regional significance, one of a small number of similar sites in New South Wales, which may possess similar features of Welsh smelting technology.

5. CONSERVATION GUIDELINES AND RECOMMENDATIONS.

5.1. Principal issues relating to the redevelopment of the subject site.

The following issues are relevant to the current proposal to redevelop the subject site.

1. Heritage legislation and other external factors.
2. The condition of the archaeological remains.
3. The nature of the proposed redevelopment.
4. The requirements for the conservation of the archaeological site.

These issues are considered separately below.

5.1.1. The Relics Provisions of the NSW *Heritage Act.*

The *Heritage Act* contains various legal measures to protect historical archaeological resources.

Where historical research has revealed the location of historical settlement, experience has shown that the discovery of relics is highly likely once the soil is disturbed. When relics are revealed the Heritage Council must be notified. This may involve delay until appropriate arrangements can be made to record the archaeological remains. As a result, developers and others are normally advised that excavation permits must be obtained prior to undertaking works, which involve excavation or the disturbance of historical sites. In this way most delays can be avoided.

The NSW *Heritage Act* defines a 'relic' as:

> *any deposit, object or material evidence -*
> *a). which relates to the settlement of the area that comprises New South Wales, not being aboriginal settlement; and*
> *b) which is 50 or more years old*

Section 139 of the *Heritage Act* provides that:

> *c). A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or*

> *is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.*
> *d). A person must not disturb or excavate any land on which the person has discovered or exposed a relic except in accordance with an excavation permit.*

If a site is the subject of an order under Section 130, an Interim Heritage Order, or is listed on the State Heritage Register, approval for an excavation permit is required under Section 60 of the *Heritage Act*.

If a site is not the subject of an order under the *Heritage Act* and is not listed on the State heritage Register, an excavation permit is required, in accordance with Section 140.

Section 146 of the *Heritage Act* requires that the accidental discovery of relics should be reported to the Heritage Council of NSW.

> *A person who is aware or believes that he or she has discovered or located a relic (in any circumstances, and whether or not the person has been issued with an excavation permit) must:*
> *e). within a reasonable time after he or she first becomes aware or believes that he or she has discovered or located that relic, notify the Heritage Council of the location of the relic, unless he or she believes on reasonable grounds that the Heritage Council is aware of the location of the relic, and*
> *f). within the period required by the Heritage Council, furnish the Heritage Council with such information concerning the relic as the Heritage Council may reasonably require.*

When an item of heritage significance comes under the ownership or control of a public authority, the authority is required to record it in a Heritage and Conservation Register, under section 170 of the *Heritage Act*. The purpose of the provision is to alert the authority whenever works are proposed, which might affect the item.

Apart from the Heritage Act, the requirements of all other legislation is outside the scope of this report.

5.1.2. The condition of the archaeological remains.

The condition of the archaeological remains is described in Chapter 3.

5.1.3. Impact of proposed redevelopment.

The site of Smelter No. 1 will be disturbed and destroyed by works associated with the Cadia Hill Gold Mine and the diversion of Cadiangullong Creek around this mine.

5.1.4. The requirements for the conservation of the archaeological site.

Since the site of Smelter No. 1 will be destroyed by mining works, it should be investigated by archaeological investigation prior to development.

5.2. General recommendations.

The above issues relating to the proposed redevelopment may be resolved by undertaking the following recommendations.

It is recommended that:

1. Prior to the commencement of works on the site, an excavation permit, under the Heritage Act of NSW, should be obtained.

The excavation permit may be obtained by a qualified archaeologist on behalf of the client.

2. The site should be subject to archaeological investigation by area trenches.