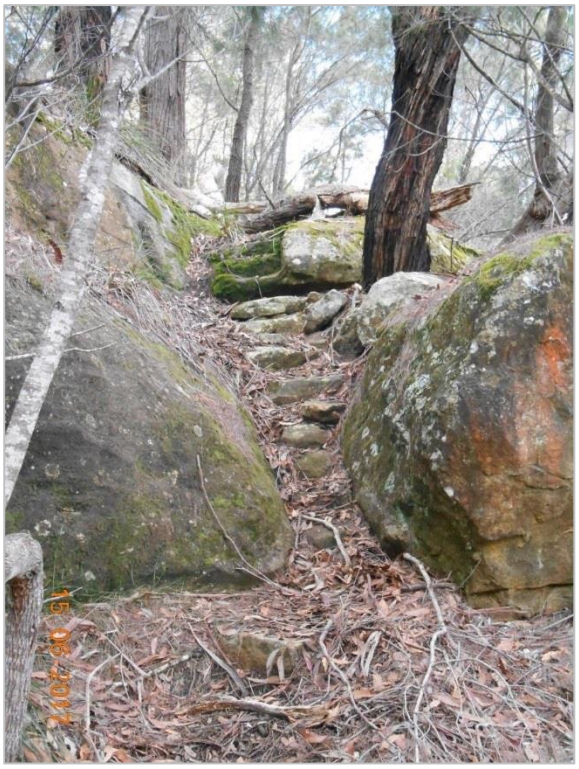


Plate 31: Stone steps leading from the railway terrace up to the cottage locations (Niche 2017)

Upper Picnic Area & Bridge

The roadway which leads away from the dam wall (and continued all the way to the railway station at Bargo) was constructed in 1918-1921 prior to construction of the Dam and provided all the transportation needs for Avon Dam, unlike the other Metropolitan Dams which used a combination of road, tram and ropeway for moving men and material. This road continues to be used for the main access to both the dam wall and picnic grounds today. It includes a bridge across the deep excavated spillway to the upper picnic area (**Plate 32**) – originally the site of the construction township.

Plate 32: The bridge across the spillway channel (Niche 2017)

The picnic area features landscaped gardens within retaining walls (**Plate 343 and Plate 34**), large areas of lawn and modern amenities and shelters. One remaining element from the construction township is a large riveted steel or cast iron elevated water tank which is carried on riveted plate-web girders and cast steel or iron posts (Plate 35).

Plate 33: Terraced lawn and landscaping (Niche 2017)

Plate 34: Gardens within retaining walls (Niche 2017)

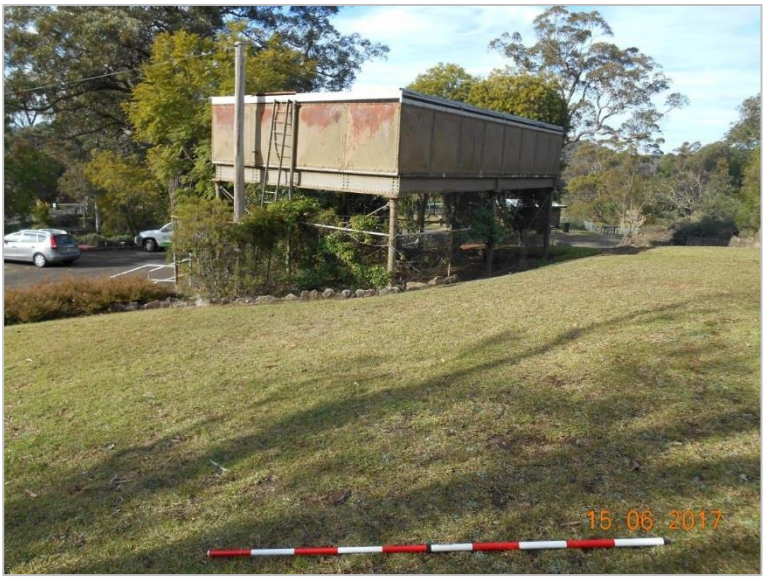


Plate 35: The elevated water tank (Niche 2017)

The elevated terraces of the upper picnic ground afford the public multiple scenic views over the upstream reservoir, with a dedicated lookout platform on the fence line overlooking the spillway channel (**Plate 36**). The views from this point include a vista back towards the lower picnic area (although the dam wall is not in view), but the ridgelines surrounding the reservoir are high enough that there is no visibility beyond the dam to the proposed ventilation shaft sites.

Plate 36: The view from the lookout, looking south-east (Niche 2017)

Given the current vegetation and past rehabilitation works, ground surface visibility was low. Despite this, no evidence of further historical archaeological relics was noted during the inspection and the potential for such relics was considered low.

Ventilation Shaft Sites

The Project includes the development of supporting infrastructure at four proposed ventilation shaft sites (Shaft Nos 5A, 5B, 6A and 6B), as shown in **Figure 6**. Three of the four sites are located in excess of 1 km from the dams and their curtilages. The exception to this is Shaft No 6B which is located off a current high voltage corridor in bushland (**Plate 37**).

Plate 37: The hillside location of Shaft No 6B (Niche 2017)

The remaining sites are located on, or nearby to, currently maintained fire trails in densely vegetated bushland (**Plate 38**).

Plate 38: The proposed location of Shaft No 5A alongside Firetrail No. 6 (Niche 2017)

In order to confirm whether infrastructure at the ventilation shaft sites would be visible, an analysis model was produced by Peter Crowe and Elizabeth Moylan, GIS Analysts at South32 (**Figure 7**, **Figure 8** and **Figure 9**). The analysis used surface topography and elevations to determine the viewshed of a person standing at the dam walls of Cordeaux and Avon Dams, and measured whether the 35 m tall drill rig (during the construction phase), or 15 m tall enclosed flare stacks and 8 m fans (the tallest structures during operation) at the shaft sites would be visible to the public.

Infrastructure at all four ventilation shaft sites and the associated superstructures would be hidden from view from Avon Dam due to the surrounding topography.

From Cordeaux Dam there would be a number of visible structures, as described below:

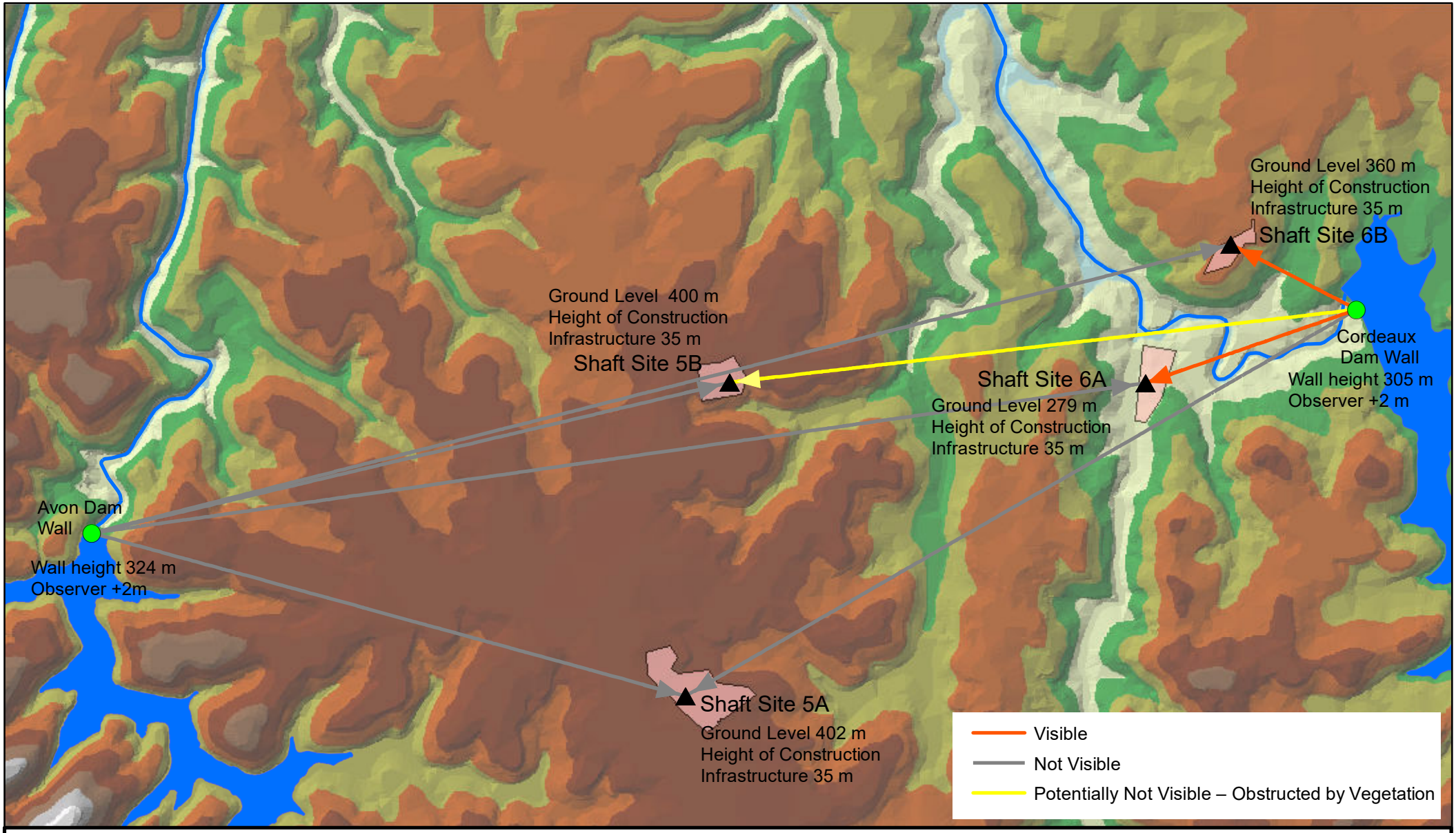
- During the construction phase (up to approximately 2 years), drill rigs and other construction infrastructure would be visible at two of the ventilation shaft sites (Shaft Nos 6A and 6B), while these structures may be obstructed by vegetation at Shaft No 5B. Two of these sites are located on top of plateaus or ridgelines (Shaft Nos 5B and 6B), while the third (Shaft No 6A) is located in a low lying gully to the west of the dam wall (**Figure 7**).

- Following construction, views of the ventilation fans from Shaft No 6B may be obstructed by vegetation. Enclosed flare stacks may also be obstructed by vegetation at Shaft Nos 6A and 6B. The remaining sites would be hidden from view (**Figure 8** and **Figure 9**).

Shaft No 6A is located in a low lying area of ground, and although the superstructures may be visible within the landscape they would not be outlined against the sky – they would have a backdrop of vegetation. Existing Cordeaux Colliery vent shafts can be seen from the dam wall (see **Plate 21**).

Another aspect of the ventilation shafts which may potentially be visible is condensation plumes which may occur temporarily during periods of low temperature – the underground mine air being vented would be approximately 20 degrees centigrade, and on winter mornings the surface air has the potential to be much cooler.

Following the completion of underground mining operations for the Project, the ventilation shafts and other supporting infrastructure would be decommissioned and removed, and the site rehabilitated.



SOUTH32
Illawarra Coal

Line of Sight from Avon and Cordeaux Dams to Construction Infrastructure (source: Illawarra Coal)

Dendrobium Plan for the Future: Coal for Steelmaking. Historical Heritage Assessment

FIGURE 7

0 500 1,000 2,000 3,000 Metres

Dendrobium Mine Plan for the Future
Visibility Analysis
Proposed Ventilation Shaft Sites
Construction Infrastructure Visibility

Date: 09 October, 2018
Author: B. Moylan
Approved: G.Brassington

Version 4
Horizontal Datum
MGA - Zone 56

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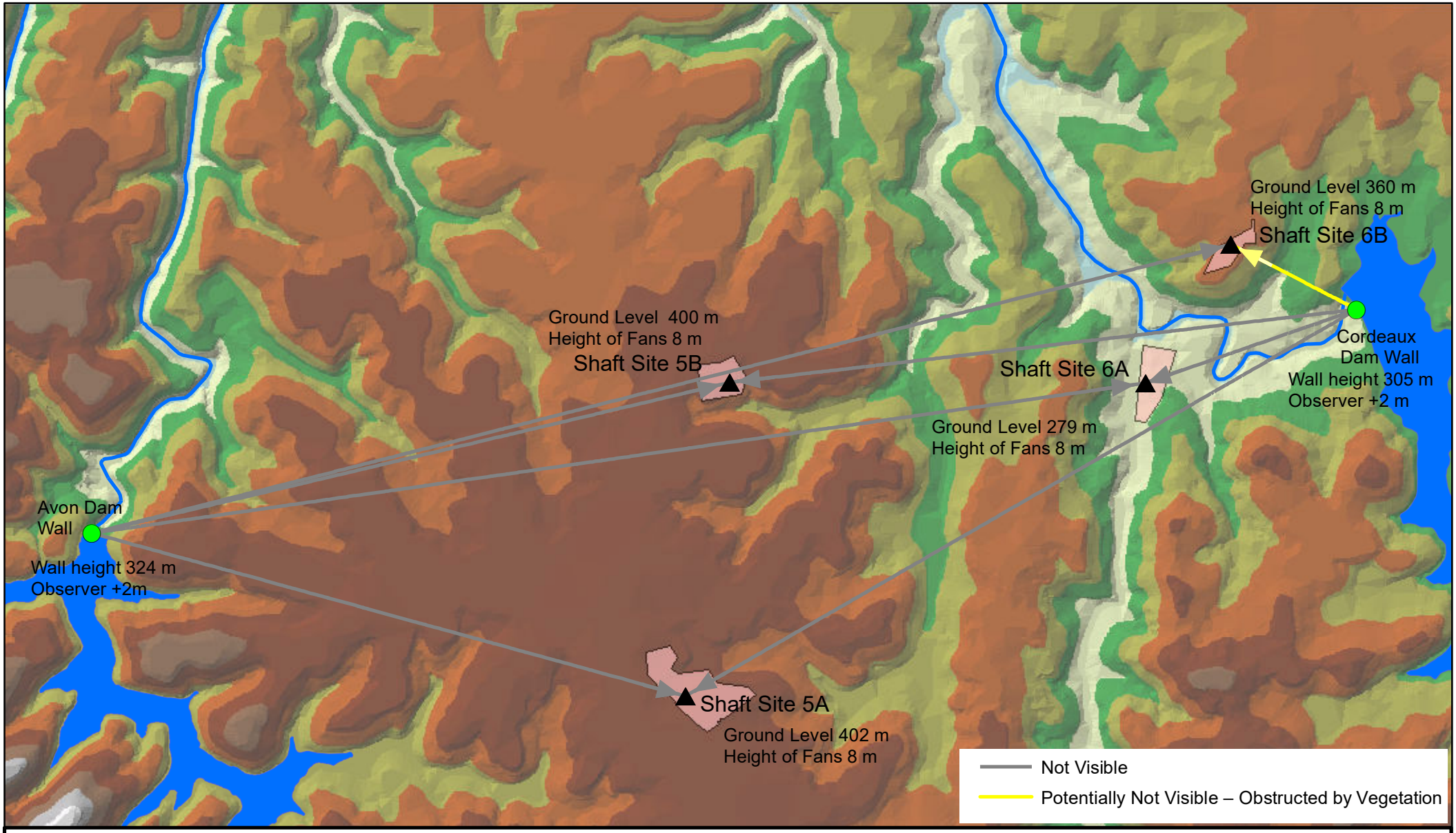

SOUTH32
Illawarra Coal

Line of Sight from Avon and Cordeaux Dams to fans
(Source: Illawarra Coal)

Dendrobium Plan for the Future: Coal for Steelmaking. Historical Heritage Assessment

FIGURE 8

0 500 1,000 2,000 3,000 Metres

Dendrobium Mine Plan for the Future
Visibility Analysis
Proposed Ventilation Shaft Sites
Fans Visibility

Date: 09 October, 2018
Author: B. Moylan
Approved: G.Brassington

Version 4
Horizontal Datum
MGA - Zone 56

N
W E
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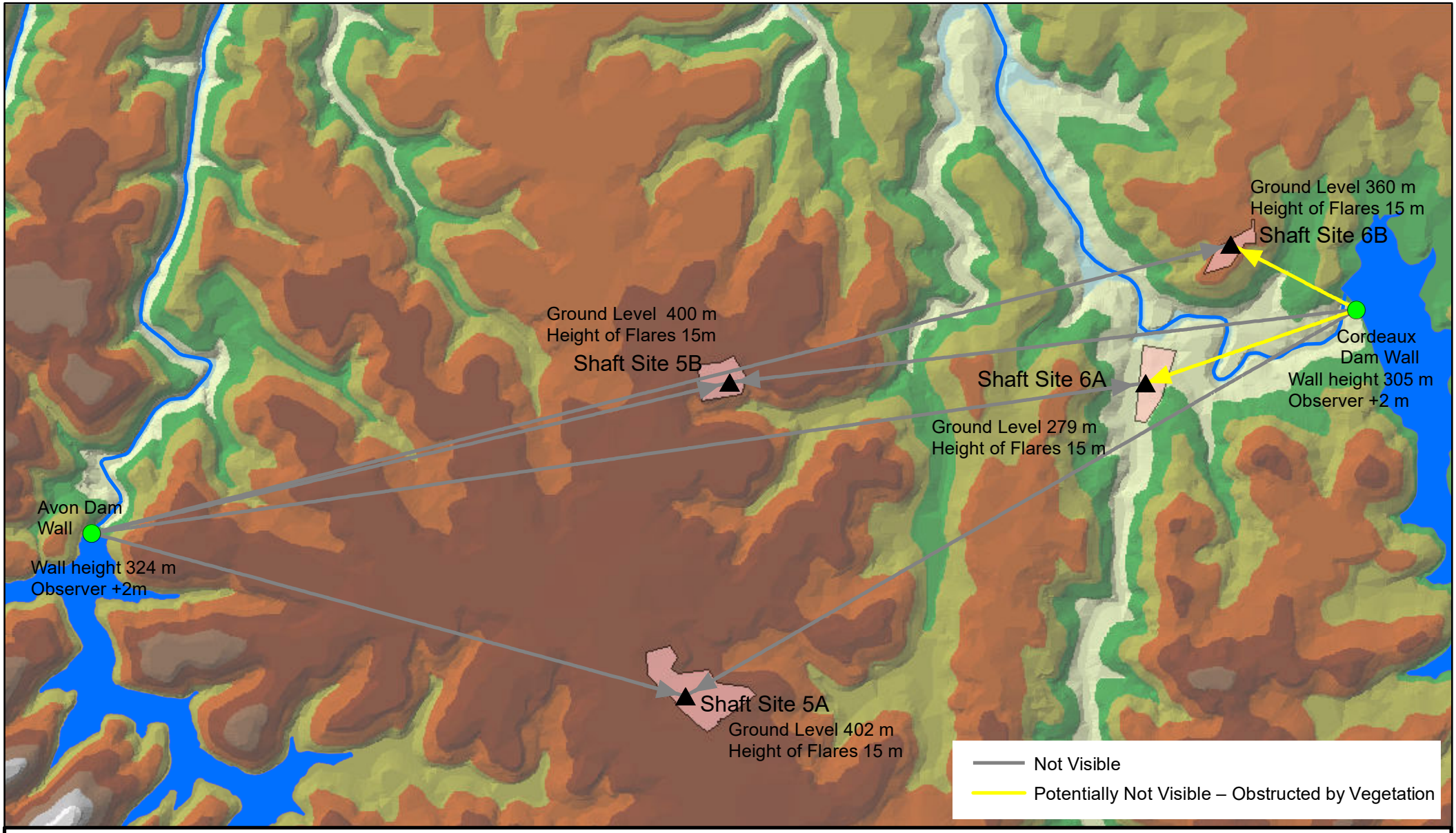

SOUTH32
Illawarra Coal

Line of Sight from Avon and Cordeaux Dams to Flares (source: Illawarra Coal)

Dendrobium Plan for the Future: Coal for Steelmaking. Historical Heritage Assessment

FIGURE 9

0 500 1,000 2,000 3,000 Metres

Dendrobium Mine Plan for the Future
Visibility Analysis
Proposed Ventilation Shaft Sites
Flares Visibility

Date: 09 October, 2018
Author: B. Moylan
Approved: G.Brassington

Version 4
Horizontal Datum
MGA - Zone 56

N W E S

5.3.3 Dendrobium Pit Top

Proposed Carpark Expansion

The proposed carpark site is located on the southern boundary of Cordeaux Road directly south-east of the Dendrobium Pit Top (on the opposite side of Cordeaux Road from the Dendrobium Pit Top site). The site has been subject to landform alteration with a primarily gravelled surface. A modern corrugated iron building is located in the centre of the site. The entrance to the proposed carpark extension is heavily vegetated and has been subject to erosion and disturbances (**Plate 39** and **Plate 40**) (**Figure 2**).

Plate 39: View of the proposed carpark entrance and ramp

Plate 40: View north overlooking the proposed car park

Proposed Electrical Transfer

The location of the proposed electrical transfer site is the site of the current electrical substation and car parking site. The location has been landscaped and contains concrete blocks outside the substation which is cordoned off from the location of the proposed electrical transfer (**Plate 41**) (**Figure 2**).

Plate 41: Overlooking the proposed location of the electrical transfer and the existing substation (Niche 2019)

Proposed Extension and Redevelopment of Office/Stores/Garage Facility

The office stores/storage/garage facility is a corrugated sheet metal building on a concrete pad. The building is located directly north east of the primary Nebo office building and workshop/stores building and directly east of the original 1946 mine building (**Plate 42** and **Plate 43**).

Plate 42: View north-west overlooking the existing building (Niche 2019)

Plate 43: View north-west overlooking the existing building (Niche 2019)

Proposed Bathhouse and Support Facilities

The proposed facilities would be located north-east of the proposed office/stores/garage building extending along much of the eastern boundary of Dendrobium Pit Top. The area is tarmacked and currently used as an open storage area (**Plate 44**).

Plate 44: Overlooking the tarmacked open storage area (Niche 2019)

Proposed Bathhouse Extensions

The proposed bathhouse extension would be located directly north of the proposed office/stores/garage facility above the existing diesel re-fuel area and adjacent to the existing modern sheet metal bathhouse/offices. The area is raised above the existing bathhouse 'drop off' area with the modern offices raised above the existing sheet metal roof (**Plate 45**). The proposed bathhouse located directly west of the office/stores/garages building would abut the side of the existing bathhouse/offices and 'drop off'. The location is currently a tarmacked surface that extends across the Dendrobium Pit Top area.

Plate 45: View of the location of the proposed northern bathhouse extension (Niche 2019)

6. Significance Assessment

6.1 Introduction

The *NSW Heritage Manual*, prepared by the former NSW Heritage Office and Department of Urban Affairs and Planning, provides the framework for assessing significance in NSW. These guidelines incorporate the five aspects of cultural heritage value identified in the *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 1999* (Burra Charter) into a framework currently accepted by the NSW Heritage Council. The following Section presents a significance assessment for the Cordeaux and Avon Dams. No other heritage items were identified by the background reviews or field surveys.

6.2 Avon Dam

The following significance assessment (**Table 3**) and Statement of Significance have been reproduced from the SHR listing for Avon Dam (SHR ID: 01358).

Table 3. Significance Assessment for Avon Dam (SHR ID: 01358).

SHR Criterion	Significance
(a) An item is important in the course, or pattern, or NSW's cultural or natural history (or the cultural or natural history of the local area)	Avon Dam is constructed within the Upper Nepean Catchment Area which was developed with the completion of the Cataract and Nepean tunnels in 1888 as the fourth source of water supply for Sydney. The potential of the Upper Nepean Catchment Area to supply water was fully developed through the construction of four major dams between 1903 and 1936. Avon Dam is the third of these dams to have been completed. The Upper Nepean Catchment Area continues to supply the regions of Sydney and the Illawarra, with Avon Dam providing a supply to the Illawarra region through the Upper Avon water pumping station. Avon Dam was the fifth of the major water supply/irrigation dams constructed in NSW during the first half of the twentieth century. The design and technologies used in the construction of the dam are representative of methods developed by the Public Works Department of NSW at the time. In conjunction with the completion of Cordeaux Dam in 1926, the impounded water of the Avon Catchment Area provided one of the major sources of water for domestic and industrial consumption in metropolitan Sydney, the largest city in NSW. In providing water for metropolitan Sydney during this era the dam, in ensuring security of supply, contributed to the extensive residential, commercial and industrial development of Sydney during the 1920s and 1930s.
(b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in the cultural or natural history of NSW (or the cultural and natural history of the local area)	The design and construction of Avon Dam was undertaken by the Water Supply and Sewerage Branch of the NSW Public Works Department. The construction of the dam drew upon the knowledge and experience of a number of the engineers employed in the Branch at the time including Ernest M. De Burgh (engineer in chief), the successful completion of the dam and its continuation of use as a water supply dam are a lasting testament to the professional capabilities of the Federation/Inter War era generation of engineers of the Public Works Department. The former official quarters at Avon Dam has provided for a number of generations, a holiday type residence for the board members of the Water Board. The buildings and grounds have some associations with past identities of the board, which was until comparatively recently one of the major government departments in NSW in regard to its economic and political influence.

	The tract of West Australian gum trees situated to the north west of the former official quarters was planted out by board members of the Water Board in 1928. The trees have particular memorial associations with past identities of the Board.
(c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievements in NSW (or the local area)	The wall of Avon Dam is an engineering work imbued with a sense of high aesthetic value expressed through the long curved wall set within the steep valley of the Avon River. The design and finishes of the crest house, entry pylons and lower valve house in the Inter-War Egyptian style were undertaken by the Government Architects Branch of the Public Works Department at that time headed by George McCrae. The architectural detailing of the superstructures evokes a romanticised vision of the 'Ancient Near East' at a time when many Australians had first-hand experience of the area through military service, and through knowledge of archaeological finds reported in the popular press. The dam is set within the valley of the Avon River. Upstream of the dam wall, this setting is characterised by the broad expanse of the pool of water bordered by the crests of the valley sides. Downstream of the dam wall the setting is characterised by the steeper inclines that graduate into the river gorge. The topography, at times of high water level, imparts a picturesque scene when viewed from selective vantage points above and on the dam wall. The former resident officer's cottage erected at the time of construction is an excellent, albeit much modified, example of the high standard of accommodation provided for resident Public Works Department for its senior staff. The landscaping of its lower picnic grounds exhibits a high level of design awareness through its planning, evolution and association with the Botanic Gardens on the original layout and selection of species.
(d) An item has a strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	The dam and grounds are recognised by the National Trust of Australia (NSW) as being a place which is part of the cultural environment of Australia which has aesthetic, historical, architectural, archaeological, scientific and social significance for future generations, as well as for the present community of NSW. The dam and grounds are recognised by the Heritage Council of NSW as a place which is of significance to NSW in relation to its historical, scientific, cultural, social, archaeological, natural and aesthetic values.
(e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)	The cyclopean masonry of the dam is an excellent and early example of gravity dam construction in the Inter-War era incorporating inspection galleries, contraction, joints and foundation drainage system which collectively demonstrate the principal characteristics of the state development of this technology at the time. The double level discharge, penstock gates and roller gates collectively demonstrate the principal characteristics of the state development of this technology at the time.

	The terraces and platforms adjoining the dam abutments demarcate the location of plant and equipment used to in the construction of the dam, in particular the location of the cableway head towers, the quarry railway terrace, the motor vehicle garage, and the electricity substation. The grounds of the dam retain numerous tree plantings undertaken from the time of the completion of the dam in 1928. Collectively the diversity of these trees present a good record of past horticultural practices. The catchment area in being relatively untouched bushland in close proximity to a major urban area has a high potential for further research into natural ecosystems.
(f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area); and	The basin of the reservoir of Avon Dam is the area of the largest impoundment within the Upper Nepean Catchment Area. Avon Dam is one of three dams in NSW which incorporate extensive Inter-War Egyptian Architectural detailing. Avon Dam is however unique in always retaining remnant landscape features that continue to evoke the imagery of an Egyptian revival landscape. Avon Dam is one of two dams in NSW which incorporate pedestrian and vehicular entry pavilions to the crest wall. The crest and valve houses and inlet works retain original ironwork and machinery such as the roller gates and penstock gates and operating mechanism which represent a substantial repository of water supply delivery technology of the era. The spillway channel was the largest in terms of the depth and width constructed up to that date within the Sydney metropolitan area. The purpose built road of access to the dam wall from the railhead at Bargo is unique within the context of the four metropolitan Dams in being the principal means by which the general supplies, men and raw materials were transported during the construction process. The dam wall retains evidence for a scour outlet operating system which was unique to Avon Dam. The dam incorporates cyclopean masonry which is a construction technique unique to the Metropolitan Dams in Australia.
(g) An item is important in demonstrating the principal characteristics of a class of NSW's (or the local area's) ***(i) cultural or natural places; or*** ***(ii) cultural or natural environments.***	Avon Dam is representative of a type of dam (cyclopean masonry gravity dam) constructed in NSW by the Water Supply and sewerage Branch of the Public Works Department during the first half of the twentieth century. Key representative attributes of the dam's design and construction include the use of cyclopean masonry bedded in sandstone concrete, use of blue metal concrete in facing the upstream face, use of sandstone concrete in the facing of the downstream face, use of a spillway set away from the gravity wall, lower valve/crest house attractively designed and finished to a high standard, the use of an array of upstream intakes to regulate the quality of water supply, the internal inspection galleries, the foundation drainage system, the contraction joints, and the internal drainage system.

	The upgrading works to the spillway and dam wall with the compacted rock embankment and spill weir redesign, competed in 1971 to make the dam meet modern safety requirements, are representative of engineering practice of the day. The upgrading of the valves within the dam wall and ancillary monitoring and operating equipment is representative of modern dam safe operating practice. The construction technologies used at Avon Dam are representative of dams constructed in NSW through the first half of the twentieth century by the Public Works Department. Key representative attributes of the dam's construction techniques include the use of cableways, the building of temporary camps to house labourers and tradesmen, building of permanent cottages to house salaried staff, the construction of terrace platforms to house plant and machinery, mechanisation of concrete production, the construction of a purpose built road of access to transport men, supplies and materials from the nearest railhead to the construction sites, the building of permanent infrastructure such as water supply for plant and men and houses, the use of electricity to power plant and equipment. The rehabilitation of tracts of scarring in the construction process employed at Avon Dam through beautification works is representative of practices undertaken at other dams throughout NSW. Key representative attributes of this practice include utilising the former camp as a picnic area, utilising the former terraced construction platforms as picnic areas and lookouts, and utilising the former construction roads for vehicular access to the dam site and dam wall. The practice of ongoing maintenance of the wall after completion through resident staff and workshop facilities is representative of procedures undertaken at other dams and weirs constructed in NSW.

6.2.1 Statement of Significance (SHR ID: 01358)

The Avon Dam was the third and the largest of the four water supply dams built as part of the development of the Upper Nepean Water Supply Scheme, one of the most important engineering works and items of public infrastructure in Australia, and is still the second largest of all the NSW water supply dams in terms of storage capacity. It was designed by the NSW Public Works Department under the direction of one of Australia's leading water supply engineers, E.M. De Burgh. The completion of the Avon Dam was a significant step in the continuing process of providing a reliable water supply for Sydney and surrounding areas as part of the Upper Nepean Scheme. Even by the international standards of the time, Avon was a high dam with a large impoundment of water and was a significant work of engineering in its day. It continues to play an important role as the major source of supply for the Wollongong, Port Kembla and surrounding towns and areas.

Additionally, the Avon Dam is a handsome, well-proportioned structure with strong Egyptian style architectural character which complements the monumental nature of the structure and its attractive natural surroundings.

The roadway was constructed prior to the Dam between 1918 and 1921, and was used to transport all materials, stores and labour and significantly provided the sole route of transportation, other dam sites relying on a combination of road, tram or ropeway, and continues to be used as the main access to the present time.

The Avon Dam includes a range of ancillary structures which form components of the overall site. One building is believed to be the original Residential Engineers residence and is a fine example of an Interwar Bungalow. The other residential buildings associated with the dam are relatively modern replacements for the original set of houses, but are representative of their type.

The grounds associated with the Avon Dam are of considerable aesthetic and social value.

They contain an important, substantially intact interwar landscape design - including ornamental ponds, grottoes and rustic picnic structures - particularly incorporating various Egyptian Revival references to compliment the thematic treatment of the architecture associated with the main dam structures. The immediate dam area is of distinction as a scenic landscape.

6.3 Cordeaux Dam

The following significance assessment (**Table 4**) and Statement of Significance have been reproduced from the SHR listing for Cordeaux Dam (SHR ID: 01360).

Table 4. Significance Assessment for Cordeaux Dam (SHR ID: 01360).

SHR Criterion	Significance
(a) An item is important in the course, or pattern, or NSW's cultural or natural history (or the cultural or natural history of the local area)	Cordeaux Dam is constructed within the Upper Nepean catchment area which was developed with the completion of the Cataract and Nepean tunnels in 1888, as the fourth source of water supply for Sydney. The potential of the Upper Nepean Catchment Area to supply water was fully developed through the construction of four major dams between 1903 and 1936. Cordeaux Dam is the second of these dams to have been completed. The Upper Nepean Catchment Area continues to supply the regions of Sydney and Illawarra. Cordeaux Dam was the fourth of the major water supply dams constructed in NSW during the first half of the twentieth century. The design and technologies used in the construction of the dam are representative of the methods developed by the Public Works Department of NSW at the time. In conjunction with the completion of Avon Dam in 1927, the impounded water of the Cordeaux catchment area provided one of the major sources of water for domestic and industrial consumption in metropolitan Sydney, the largest city in NSW. In providing water for metropolitan Sydney during this era the dam, in ensuring security of supply, contributed to the extensive residential, commercial and industrial development of Sydney during the 1920s and 1930s.
(b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in the cultural or natural history of NSW (or the cultural and natural history of the local area)	The design and construction of Cordeaux Dam was undertaken by the Water Supply and Sewerage Branch of the NSW Public Works Department. The construction of the dam drew upon the knowledge and experience of a number of engineers employed in the Branch at the time, including Ernest M. de Burgh (Chief Engineer). The successful completion of the dam and its continuation of use as a water supply dam are a lasting testament to the professional capabilities of the Federation/Inner War era generation of engineers of the Public Works Department. The tract of Eucalyptus bordering the encircling road of the upper picnic area was planted out by Board members of the former Water Board in 1928. The trees have particular memorial associations with past identities of the Board.

(c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievements in NSW (or the local area)	The wall of Cordeaux Dam is an engineering work imbued with a sense of aesthetic values expressed through the long curved wall set within the valley of the Cordeaux River. The design and finishes of the crest houses, entry pylons and lower valve houses in the Inter Egyptian style were undertaken by the Government Architect's branch of the Public Works Department at the time headed by George McCrae. The architectural detailing evokes a romanticised version of the Ancient Near East at a time when many Australians had first-hand experience of the area through military service, and through knowledge of archaeological finds reported in the popular press. The dam is set within the valley of the Cordeaux River. Upstream of the dam wall this setting is characterised by the broad expanse of the pool of water bordered by the crests of the valley sides. Downstream of the dam wall the setting is characterised by the steeper inclines that graduate into the gorge created by the river's flow over time. Collectively this topography at times of high water imparts a picturesque scene when viewed from selective vantage points above and on the dam wall. The former resident officer's cottage erected at the time of the dam's construction to house the resident engineer, is an excellent and intact example of the high standard of accommodation provided for Public Works Department senior staff.
(d) An item has a strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	The dam and grounds are recognised by the National Trust of Australia (NSW) as being a place which is part of the cultural environment of Australia, which has aesthetic, historical, architectural, archaeological, scientific and social significance for future generations, as well as for the present community of NSW. The dam and grounds are recognised by the Heritage Council of NSW as a place which is of significance to NSW in relation to its historical, scientific, cultural, social, archaeological, natural and aesthetic values.
(e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)	The cyclopean masonry of the dam is an excellent early example of gravity dam construction in the Inter War era. It incorporates inspection galleries, contraction joints, and foundation drainage systems which collectively demonstrate the advanced state of this technology at the time. Terraces and platforms adjoining the dam abutments demarcate the location of plant and equipment used in in the construction of the dam, in particular the location of the cableway head towers, and concrete batching plant. The plateau of the upper picnic area was the site of the original construction township and retains a road formation, culverts and drainage lines and tennis court from that era. The grounds of the dam retain numerous tree plantings undertaken for the opening of the dam in 1927. Collectively the diversity of these trees present a good record of past horticultural practices.
(f) An item possesses uncommon, rare or endangered aspects of NSW's	The wall of the Cordeaux Dam is the longest of all the dams constructed in the Upper Nepean Catchment Area. Cordeaux Dam is one of three dams in NSW which incorporate extensive Inter-War Egyptian architectural detailing.

cultural or natural history (or the cultural or natural history of the local area); and	Cordeaux Dam is one of two extant dams in NSW which incorporate pedestrian and vehicular entry pavilions to the crest wall. The crest and valve houses and inlet works retain original ironwork and machinery such as roller gates, penstocks and penstock opening system which represent a substantial repository of water supply delivery technology for the era in NSW. The dam incorporates the first instance of multiple level water discharges and valve houses, and emergency roller gates in NSW. The ensemble of plant buildings either associated with the construction or completion of the dam, such as weatherboard machine shed (adapted to a double garage) and the corrugated iron blacksmiths, are unique *in situ* examples within the broader context of the four Metropolitan Dams. The dam incorporates cyclopean masonry which is a construction technique unique to the Metropolitan Dams in Australia. The dam incorporates the first instance of internal inspection galleries and connecting pipework and V notch weirs in a dam in NSW.
(g) An item is important in demonstrating the principal characteristics of a class of NSW's (or the local area's) ***(i) cultural or natural places; or*** ***(ii) cultural or natural environments.***	Cordeaux Dam is representative of a type of dam (cyclopean masonry gravity dam) constructed in NSW by the Department of Public Works during the first half of the twentieth century. Key representative attributes of the dam design and construction include the use of cyclopean masonry bedded in sandstone concrete, use of blue metal concrete in facing the upstream face, the use of sandstone concrete in facing the downstream wall, use of a spillway that is an extension of the gravity wall, upper and lower valve/crest houses attractively designed and finished to a high standard, the use of an array of upstream intakes to regulate the quality of water supply, the internal inspection galleries, the foundation grouting system, the contraction joints, and the internal drainage system. The upgrading of the valves within the dam wall and ancillary monitoring and operating equipment is representative of modern day safe operating practice. The construction technologies used at Cordeaux Dam are representative of dams constructed in NSW through the first half of the twentieth century. Key representative attributes include the use of cableways, the building of temporary townships to house labourers and tradesman, building of semi-permanent cottages to house salaried staff, the construction of terrace platforms for plant and machinery, mechanisation of concrete production, the construction of a purpose built road of access and tramway to transport men, supplies and materials from the nearest railhead to the construction site, the building of permanent infrastructure such as water supply for plant, men and horses and the use of electricity to power plant and equipment. The rehabilitation of tracts of land scarred in the construction processes employed at Cordeaux Dam through beautification works is representative of practices undertaken at other dams throughout NSW. Key representative attributes of this practice include utilising the former township as a picnic area, utilising the former terraced construction areas as picnic areas and lookouts, and utilising the former construction roads and tramway for vehicular access to the dam wall.

	The practice of ongoing maintenance of the wall after completion through surveillance provided by resident staff and workshop facilities is representative of procedures undertaken at other dams in NSW. The provision of public amenity at the dam site is representative of the use of large water supply and irrigation dams in NSW as places for recreation by the greater community.

6.3.1 Statement of Significance (SHR ID: 01360)

Cordeaux Dam was the second of the four water supply dams built as part of the development of the Upper Nepean Water Supply Scheme, one of the most important engineering works and items of public infrastructure in Australia, and still has the longest wall of all the NSW water supply dams. It was designed by the NSW Public Works Department under the direction of one of Australia's leading water supply engineers, E.M. De Burgh. The completion of the Cordeaux Dam was a significant step in the continuing process of providing a reliable water supply for Sydney and surrounding areas as part of the Upper Nepean Scheme. Even by the international standards of the time, Cordeaux was a large dam and was a significant work of engineering in its day. It continues to play an important role as a major source of supply for the Sydney region.

Cordeaux Dam is a handsome, well-proportioned structure with strong Egyptian style architectural character which complements the monumental nature of the structure and its attractive natural surroundings. Cordeaux Dam includes a range of ancillary structures which form components of the overall site, including residential cottages of various ages for operational staff, one of which appears to date from the construction of the dam. This latter is associated with the Residential Engineer for construction and operation of the dam and is a fine example of a late Federation Bungalow style building. The other residences are representative of their age and type.

The public picnic grounds and gardens attached to the Cordeaux Dam contain a cultural landscape resource - including remnants of its interwar period plantings, layout and detailing, and extensive areas of bushland. There is evidence in the landscape design, particularly in the use of palms and tree ferns and battered stonework retaining walls, of an intention to continue the Egyptian Revival references apparent in the design of the main dam structures.

6.4 Dendrobium Pit Top

The following significance assessments have been reproduced from the SHR and Wollongong City Council Development Control Plan (DCP) for the Nebo Colliery and the Kembla Heights Heritage Conservation Area.

6.4.1 Nebo Colliery

The following statement of significance has been reproduced from the SHR listing for Nebo Colliery LEP number 7104 and listed as an archaeological item.

This site is significant as it was the first mine to be opened as a fully mechanised mine in 1947. It was a green field mine development and its surface facilities were of the most modern design being fully mechanised upon opening. It is also significant for its association with Mt Kembla village and the surrounding area, for its relationship between mines, mining companies and their workers and for the joint ownership of the mine and the associated steel works. It is also significant for its association with the new Dendrobium Mine for which its facilities were chosen to support.

6.4.2 Kembla Heights Heritage Conservation Area

The following Significance assessment has been taken from the Wollongong City Council DCP (2009) Part E – General Controls – Environmental Controls Chapter E11: Heritage Conservation (20.4)

Kembla Heights is the most intact mining village in the Wollongong Local Government Area with its simple, consistent late Victorian and early Federation period cottages characterised by simple "home renovations".

The pattern of development of the town reflects the type and size of the local mining industry, particularly in terms of its rapid expansion during the 1880s and 1890s following the establishment of the first large coal mine (Kembla Colliery, 1883). Mining relics and remnant buildings have the potential to provide archaeological evidence in and around the settlements of Kembla Heights. The provision of housing by the Mount Kembla Mine to encourage workers to the site demonstrates the early recognition by industries in isolated areas of the need to provide accommodation where transport was limited or non-existent.

The subsequent development of recreational and service facilities such as clubs, halls and the post office, and the development of a close knit community demonstrate the way in which isolation bonds inhabitants and encourages them to develop and fight for services in their community. This is further demonstrated by the pain felt by the local community in response to the Mount Kembla mining disaster (1902) in which many local men and boys were killed. The disaster involved the largest loss of life in mainland Australia in a work place disaster.

7. Impact Assessment

7.1 Preamble

The following section assesses the potential impacts of the Project on the Cordeaux and Avon Dams and Dendrobium Pit Top and their associated heritage values.

7.2 Potential Impacts

The Cordeaux Dam (SHR ID: 01358) and Avon Dam (SHR ID: 01360) have the potential to be impacted by the Project. Components of work that have the potential to impact the dams are subsidence, equipment involved in the monitoring of potential impacts, and the potential impact to views and vistas from Cordeaux Dam associated with Project surface infrastructure.

The Dendrobium Pit Top is located within the locally heritage listed item 'Nebo Colliery' (7104) and the Kembla Heights Mining Village (Heritage Conservation Area). The concept and construction designs for the proposed additions and extensions have yet to be finalised.

7.3 Cordeaux Dam

7.3.1 Impact Assessment

The NSW Heritage Manual guidelines for preparing Statements of Heritage Impacts (SoHIs) pose a range of questions to be considered when assessing heritage impacts for new development adjacent to a heritage item. Relevant considerations in relation to impacts to the Cordeaux Dam are addressed in **Table 5** below.

Table 5. Cordeaux Dam Impact Assessment.

Consideration	Response
How is the impact of the new development on the heritage significance of the item or area to be minimised?	There would be a minimum 1 km offset of any longwall extraction from the dam wall structure, which would reduce the potential for subsidence movements. Monitoring of subsidence movements and geotechnical investigations would occur at, and in the vicinity of, the dam wall as part of the management of potential subsidence impacts.
Why is the new development required to be adjacent to a heritage item?	The Project would provide for the continuation of operations at the Dendrobium Mine. The Project underground mining areas are located within an existing mining tenement (CCL 768) and were determined by the presence of economic coal resources.
How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?	The Project would not affect materially affect views to the heritage item, as public access is restricted to areas outside of the picnic areas and dam wall. The Project would involve the development of surface infrastructure to support underground mining operations, including surface ventilation. During construction, infrastructure would include an approximately 35m tall drill rig, and during operation would consist of enclosed flare stacks that are approximately 15 m high and ventilation fans that are approximately 8 m high. One of the ventilation shaft sites (Shaft No 5A) is located away from the heritage item behind high level topography such as ridgelines and crests and would not be visible from the heritage item. Two of the ventilation shaft sites (Shaft Nos 6A and 6B) would be visible during the construction phase, which would be a temporary activity. Views to Shaft Site No. 5B may be obstructed by vegetation during the construction phase. For the operational phase, Shaft Nos 6A and 6B may be obstructed by vegetation.

	The visible infrastructure of Shaft Nos 6A and 6B, its impacts and recommendations for mitigation are further addressed in Section 8.
Is the development sites on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?	The SHR entry and historical research undertaken for this assessment does not identify any areas of archaeological potential within the vicinity of Cordeaux Dam. The land was unalienated Crown Land prior to its declaration as a water supply reserve resulting in a negligible potential for historical archaeological relics.
Is the new development sympathetic to the heritage item? In what way (e.g. form, siting, proportions, design)?	The proposed Project surface infrastructure is largely sympathetic to Cordeaux Dam in that it is sited remotely from the dam itself. There would be a minimum 1 km offset of any longwall extraction from the dam wall structure. These factors, along with the recommendations of this report, would reduce any direct impact to the Dam's fabric and associated infrastructure, and limit impacts to views and vistas from the Dam.
Will the additions visually dominate the heritage item? How has this been minimised?	The proposed Project surface infrastructure would have a negligible impact on the visual amenity of the Cordeaux Dam. Views of both from Cordeaux Dam and its associated picnic areas and roadway would be substantially unaltered. Construction infrastructure would be temporary features, and would be removed after the construction phase is completed. The operational infrastructure at Shaft Nos 6A and 6B, which may be visible from Cordeaux Dam, would be partially or entirely hidden by vegetation, and further masked by the recommendations in Section 8. Following the completion of underground mining operations for the Project, the ventilation shafts and other supporting infrastructure would be decommissioned and removed, and the site rehabilitated.
Will the public, and users of the item, still be able to view and appreciate its significance?	The proposed Project surface infrastructure would have a negligible impact on the visual setting of Cordeaux Dam. Due to the large crest immediately to the northwest, the views and vistas of the dam and its landscape would be retained, and would still allow for the public and users of the item to appreciate the significance of Cordeaux Dam on multiple levels.

7.3.2 Statement of Heritage Impact

The underground mining layout has been designed to reduce potential subsidence impacts on the structural integrity or external fabric of the Cordeaux Dam wall. There would be a minimum 1 km offset of any longwall extraction from the dam wall structure. Monitoring and investigation works would be conducted at, and surrounding, Cordeaux Dam to maintain the structure in a safe and serviceable condition.

Based on the information provided by the South32, the proposed Project surface infrastructure is of a temporary nature but would have little, to no, adverse impacts on the heritage significance of the Cordeaux Dam and its associated views and vistas.

Of the three ventilation shaft sites that would have infrastructure that may be visible from Cordeaux Dam, two of those sites would be visible during the construction phase (i.e. the impact would be of a temporary nature). The remaining views to the ventilation shaft sites may be obstructed by vegetation during both the construction and operational phase. Views to Shaft No 6A would be situated in a low-lying area, would not be outlined on the horizon, and would be set on a backdrop of surrounding bush landscape. This would reduce its visual impact, and further mitigation efforts as recommended in Section 8 would reduce impacts on the views and vistas from the dam. The Project would therefore have a negligible impact on views to and from the Dam and its visual setting, and its aesthetic values could continue to be appreciated by the public and users.

7.4 Avon Dam

7.4.1 Impact Assessment

The NSW Heritage Manual guidelines for preparing SoHIs pose a range of questions to be considered when assessing heritage impacts for new development adjacent to a heritage item. Relevant considerations in relation to impacts to Avon Dam are addressed in **Table 6** below.

Table 6. Avon Dam Impact Assessment.

Consideration	Response
How is the impact of the new development on the heritage significance of the item or area to be minimised?	There would be a minimum 1 km offset of any longwall extraction from the dam wall structure, which would reduce the potential for subsidence movements. Monitoring of subsidence movements and geotechnical investigations would occur at, and in the vicinity of, the dam wall as part of the management of potential subsidence impacts.
Why is the new development required to be adjacent to a heritage item?	The Project would provide for the continuation of operations at the Dendrobium Mine. The Project underground mining areas are located within an existing mining tenement (CCL 768) and were determined by the presence of economic coal resources.
How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?	The Project would not affect materially affect views to the heritage item, as public access is restricted to areas outside of the picnic areas and dam wall. The Project would involve the development of surface infrastructure to support underground mining operations, including surface ventilation. This surface infrastructure would not be visible from Avon Dam.
Is the development sites on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?	The SHR entry and historical research undertaken for this assessment do not identify any areas of archaeological potential within the vicinity of Avon Dam. The land was unalienated Crown Land prior to its declaration as a water supply reserve resulting in a negligible potential for historical archaeological relics.
Is the new development sympathetic to the heritage item? In what way (e.g. form, siting, proportions, design)?	The proposed Project surface infrastructure is largely sympathetic to Cordeaux Dam in that it is sited remotely from the dam itself and would not be visible. There would be a minimum 1 km offset of any longwall extraction from the dam wall structure. These factors would reduce any direct impact on the Dam's fabric and associated infrastructure and avoid any impacts on views and vistas from the Dam.
Will the additions visually dominate the heritage item? How has this been minimised?	The proposed Project surface infrastructure would have no impact on the visual amenity of the Avon Dam. Views both to and from Avon Dam, its picnic areas, trackways and its main access roadway would be retained.
Will the public, and users of the item, still be able to view and appreciate its significance?	The Project surface infrastructure would have no impact on the visual setting of the heritage item. The views and vistas of the dam and its landscape would be retained, and still allow for the public and users of the item to appreciate the significance of Avon Dam on multiple levels.

7.4.2 Statement of Heritage Impact

The underground mining layout has been designed to reduce any subsidence impacts on the structural integrity or external fabric of the Avon Dam wall. There would be a minimum 1 km offset of any longwall extraction from the dam wall structure. Monitoring and investigation works would be conducted at, and surrounding, the Avon Dam to maintain the structure in a safe and serviceable condition.

Based on the information provided by the South32, the Project surface infrastructure would have no adverse impacts on the heritage significance of the Avon Dam and its associated views and vistas. The Project surface infrastructure would have no impact on views to and from the Dam and its visual setting, and its aesthetic values could continue to be appreciated by the public and users.

7.4.3 Dendrobium Pit Top

The Dendrobium Pit Top is located within the 'Nebo Colliery*' (7104) a locally listed archaeological item, and the Kembla Heights Mining Village (Heritage Conservation Area). Operations at the Dendrobium Pit Top (and therefore the current use of historic Nebo Colliery buildings) are approved as part of the Dendrobium Mine in accordance with Development Consent DA 60-03-2001, and would continue under the Project (if approved).

The site has previously been recorded as part of the process of conducting the previous range of site upgrade works authorised under Development Consent DA 60-03-2001.

The proposed upgrades and construction of additional structures at the Dendrobium Pit Top would be designed to minimise potential impacts to the values and significance of the Nebo Colliery and the Kembla Heights Mining Village (Heritage Conservation Area).

The Dendrobium Pit Top has been subject to a series of archaeological excavations prior to the re-commencement of mining activities in 2003. The archaeological excavations identified a number of archaeological remains across the Dendrobium Pit Top area. However, the majority of the remains were identified to the east and south of the proposed new infrastructure locations. The proposed works would be designed to minimise sub-surface impacts.

Based on the draft conceptual designs, it is unlikely that the heritage values of the Nebo Colliery would be significantly adversely impacted by the Project. The Project represents continued and adaptive use wholly consistent with the nature of the item, which is an operational colliery.

8. Conclusion & Recommendations

8.1 Conclusions

The Dendrobium Mine is owned and operated by Illawarra Coal Holdings Pty Ltd (Illawarra Coal), a wholly owned subsidiary of South32 Limited (South32). South32 is seeking to extend the current underground mining operations into proposed Areas 5 and 6 for the Project. The proposed extension would be serviced by above ground infrastructure within Area 5 and Area 6. Further, South32 propose the development of supporting infrastructure and the use and augmentation of existing Dendrobium Mine surface facilities to support the Project.

8.1.1 Cordeaux and Avon Dams

- The two items of historical heritage significance identified in the vicinity of Area 5 and Area 6 are Cordeaux Dam and Avon Dam. Both are State significant heritage items listed on the SHR (Cordeaux Dam SHR ID: 01358 and Avon Dam SHR ID: 01360).
- The underground mining layout has been designed to reduce potential subsidence impacts on the structural integrity or external fabric of the Avon and Cordeaux Dam walls.
- The proposed Project surface infrastructure located within Area 5 and Area 6 would be located remotely from the dams themselves and would not result in any direct impacts to their fabric or associated infrastructure. The Project Area 5 and Area 6 surface infrastructure would be located in dense bushland in low lying areas or sites hidden by natural topography or vegetation. The infrastructure would result in a negligible visual impact to the heritage items provided mitigation efforts are undertaken where possible at Shaft Nos 6A and 6B.
- The potential for *in situ* archaeological deposits to be present in the subject areas is considered to be very low, given the absence of development in the area aside from activities associated with the construction of the two dams. If any archaeological deposits survive in the subject areas they are likely to be Aboriginal in nature (an assessment which has been conducted separately to this report).

8.1.2 Dendrobium Pit Top

- The Dendrobium Pit Top is located within two locally listed heritage items including; Nebo Colliery* (7104) (archaeological item) and the Kembla Heights Mining Village (Heritage Conservation Area).
- South32 propose to:
    - expand the existing carpark and entrance located on the southern side of Cordeaux Road;
    - extend and redevelop existing office/stores/garage building;
    - extend the existing bathhouse/office;
    - construct a new electrical transformer;
    - construct a bathhouse and support facilities building; and
    - construct a new bathhouse.
- Concept designs have yet to be finalised, however, based on the current conceptual designs it is unlikely that the heritage values of the Kembla Heights Mining Village and Nebo Colliery* would be significantly adversely impacted by the Project. The Project represents continued and adaptive use wholly consistent with the nature of the item, which is an operational colliery.

8.2 Recommendations

8.2.1 Cordeaux and Avon Dams

- No further historical heritage assessment for Area 5 and Area 6 is considered necessary prior to the commencement of Project works.
- In order to minimise the potential visual impacts of Shaft Nos 6A and 6B, it is recommended that the enclosed flare stacks, fans and any other structural features (fencing etc.) be coloured either environmental green or black where possible, rather than silver or galvanised surfaces.
- The installation of any monitoring, surveying and/or access equipment or infrastructure or investigative works at Cordeaux or Avon Dams should avoid any greater than negligible impact to the heritage fabric and structural integrity of the structures. The design of these works should be based on the advice of an appropriately qualified heritage expert.
- In the unlikely event that historical archaeological relics were to be discovered during ground disturbance for the Project, work in the immediate area would need to cease and a suitably qualified archaeologist be engaged to assess the condition, extent and likely significance of the remains. Depending on the results of this assessment, the Heritage Council may need to be notified of the discovery in accordance with section 146 of the *Heritage Act 1977*.

8.2.2 Dendrobium Pit Top

- Prior to the commencement of works, a CMP should be developed by a suitably qualified heritage consultant. The CMP would provide guidance for the management and conservation of heritage items moving forward including, during the detailed design, construction and operational phases of the Project.
- Significant heritage features should be recorded to appropriate standards (if not previously recorded during the 2001 and 2003 archival recording of the Dendrobium Pit Top) in accordance with the CMP if subject to potential demolition works or material alteration.

To manage any potential impacts on the conservation area, the following should be considered during the final design phase:

- Building form – building form should, where practicable, be consistent with the existing Dendrobium Pit Top structures.
- Fabric – building materials, where appropriate to building function, should be in keeping with existing Dendrobium Pit Top building materials and building fabrics.

In order to minimise impacts to the archaeological item (Nebo Colliery*), the design should consider construction techniques that do not require sub-surface excavations.

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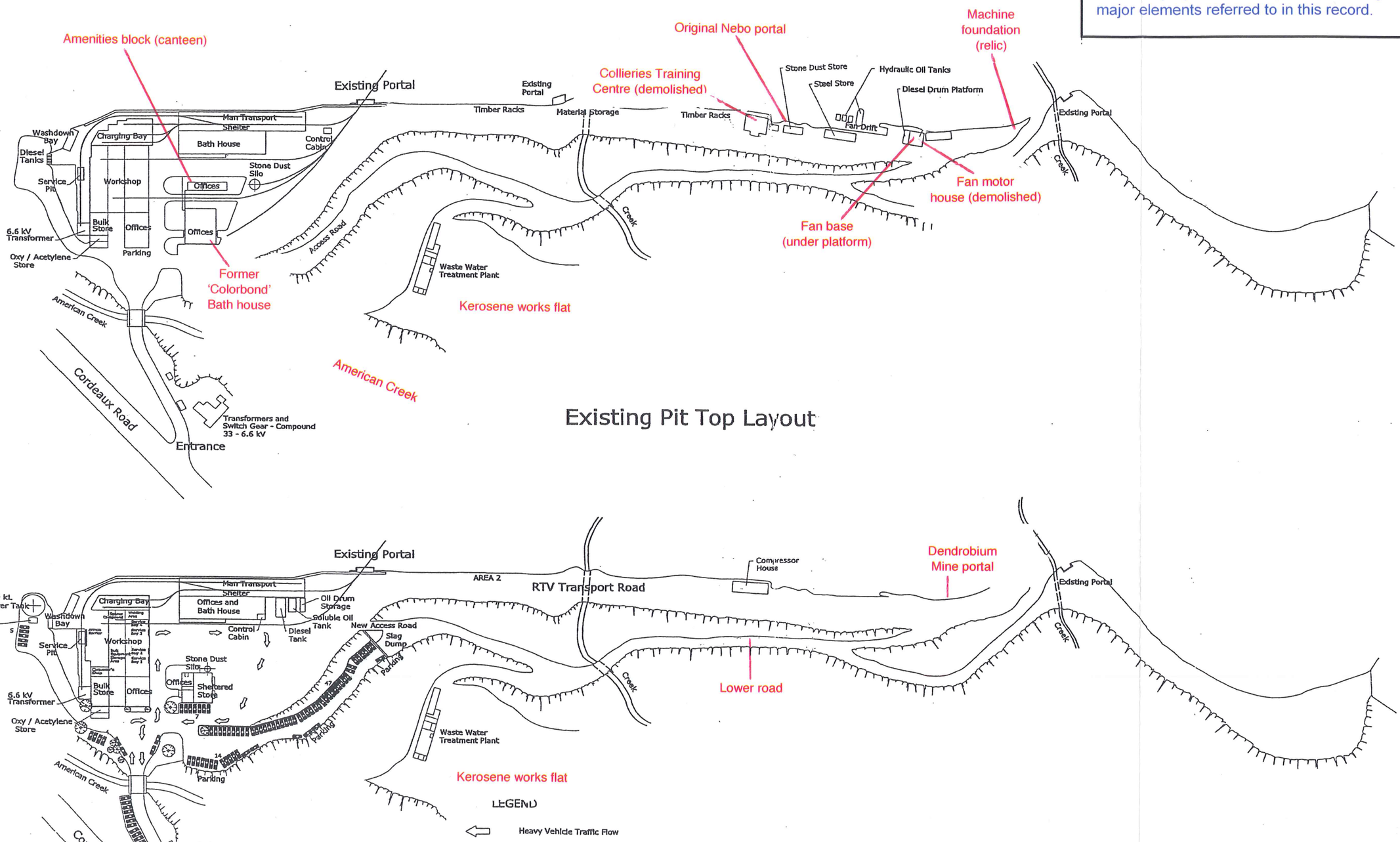
Appendix A 2003 Archival Plans

Figure 2.
Layout of Nebo/ Dendrobium pit top prior to reconstruction and after proposed development, showing location of major elements referred to in this record.



REFERENCE DRAWINGS

9912431	Main Pit Top Area
9912432	Workshop and Stores Area
9912433	Office and Bath House Layout
9912434	Pit Top Layout - Initial Development

Metres
0 10 20 50 100
SCALE

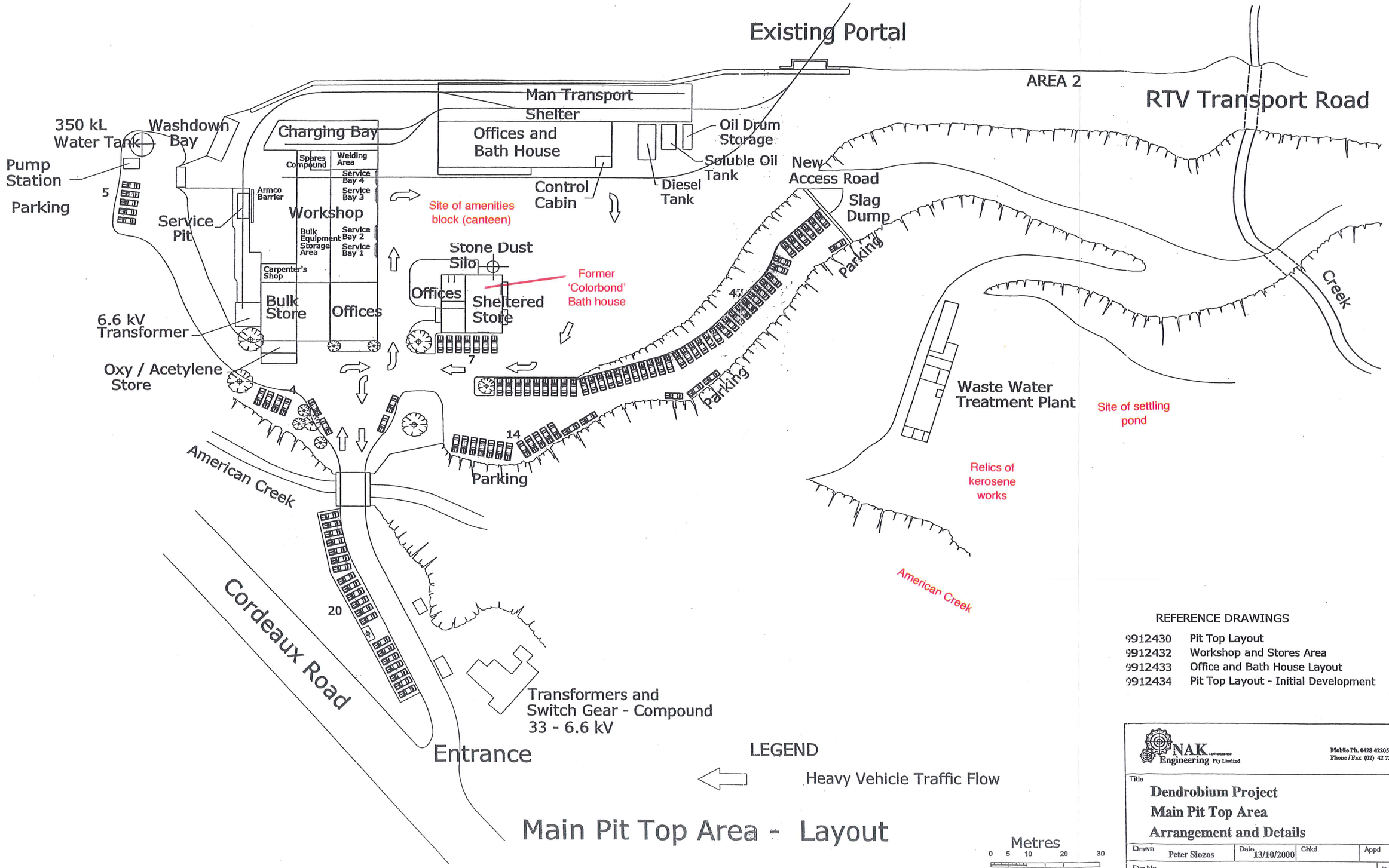
NAK Engineering Pty Limited
Mobile Ph. 0428 422053
Phone / Fax (02) 42 726676

Title
Dendrobium Project
Pit Top Layout
Arrangement and Details

Drawn	Date	Chkd	Appd
Peter Slozos	13/10/2000		

Drg No. 9912430 Rev.

Figure 3.
Southern end of Nebo/ Dendrobium pit top showing layout after proposed reconstruction.



REFERENCE DRAWINGS

9912430	Pit Top Layout
9912432	Workshop and Stores Area
9912433	Office and Bath House Layout
9912434	Pit Top Layout - Initial Development

NAK Engineering Pty Limited
Mobile Ph. 0428 422053
Phone / Fax (02) 42 726676

Title
Dendrobium Project
Main Pit Top Area
Arrangement and Details

Drawn	Date	Chkd	Appd
Peter Siozos	13/10/2000		

Drg No. 9912431 Rev.

Figure 4.
Nebo/Dendrobium pit top showing extent of proposed reconstruction in the workshop/stores area. (Shaded areas indicate items to be demolished.)

New 350 kL Water Tank
Grit Trap
Pump Station
Washdown Bay
Remove Diesel Tanks
Remove this section of charge bay and support with 3 columns - leave side open
Remove Rail
Remove Rail
Remove Rail
Remove low section of Roof
Man Transport Shelter
Offices and Bath House
Drg 9912433
Remove back corner for better RTV access around back of charge bay
Charging Bay
Existing Sanders To Be Removed
Remove Rail
Relocate 2 x 2 sets of chargers to here
Servicing Spares Compound
Welding Cutting Bench Area
Radial Drill
Grinder
Service Bay 4
Roller Door For RTV Access
Workshop extension (demolished)
Service Bay 3
Roller Door For RTV Access
Site of amenities block (canteen)
Service Pit
Armco Barrier
Remove this section of workshop
Build wall in workshop
Fitting Bench Area
Workshop
Service Bay Areas to be cleared i.e. Remove lathe, shaper etc
Western half of awning to remain - Eastern half to be removed
Bulk Equipment Storage Area
ie Motors Panels Gearboxes etc
Service Bay 2
Roller Door For RTV Access
Shallow pit to be filled in
Service Bay 1
Roller Door For RTV Access
Former 'Colorbond' Bath house
Stone Dust Silo
Small Awning to remain
Shop
Surface Power "Machine Testing Outlets" 415V - 1000V - 3.3kV
Raise Existing Roof Level
Install New Roller Doors
Shallow pit to be filled in
Sheltered Store
make existing wall solid
Offices
6.6 kV Transformer
Bulk Store
Offices
Oxy / Acetylene Store

REFERENCE DRAWINGS

9912430	Pit Top Layout
9912431	Main Pit Top Area
9912433	Office and Bath House Building
9912434	Pit Top Layout - Initial Development

Metres
0 5 10 15
SCALE

Workshop and Stores Area

NAK Engineering Pty Limited
Mobile Ph. 0428 423053
Phone / Fax (02) 42 726676

Title
Dendrobium Project
Workshop and Stores Area
Arrangement and Details

Dawn	Date	Chkd	Appd
Peter Siozos	13/10/2000		

Dg No. 9912432 Rev.

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Contact Us

Niche Environment and Heritage
02 9630 5658
info@niche-eh.com

NSW Head Office – Sydney
PO Box 2443 North Parramatta
NSW 1750 Australia

QLD Head Office – Brisbane
PO Box 540 Sandgate
QLD 4017 Australia

Sydney
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Brisbane
Cairns

Our services

Ecology and biodiversity
Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management
Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals
Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)