



SMEC INTERNAL REF: 30013187

Preliminary Site
Investigation

Warragamba Dam Raising - proposed construction disturbance areas

Client Reference No. 30013187
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15 July 2022

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Abbreviations and Acronyms

Abbreviation / Acronym	Description
ACM	Asbestos containing material
AEC	Area of environmental concern
AHD	Australian Height Datum
ASS	Acid Sulfate Soils
BTEX	Benzene, toluene, ethylbenzene and xylenes
CLM Act	Contaminated Land Management Act 1997
CSM	Conceptual Site Model
CoPC	Contaminants of Potential Concern
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DSI	Detailed Site Investigation
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
HAZMAT	Hazardous Materials
HDPE	High density polyethylene
m	Metres
m bgl	Metres below ground level
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
PSI	Preliminary Site Investigation
REF	Review of Environmental Factors
NEPC	National Environment Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
NSW	New South Wales
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
POEO Act	Protection of the Environment Operations Act
RAP	Remediation Action Plan
SAQP	Sampling, Analysis and Quality Plan
SKM	Sinclair Knight Merz
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total recoverable hydrocarbons

Executive Summary

WaterNSW engaged SMEC to carry out this Preliminary Site Investigation (PSI) focussing on the proposed construction areas (designated Site 1 to Site 5) located adjacent to Warragamba Dam as part of the Warragamba Dam Wall Raising project. WaterNSW also engaged Andrew Kohlrusch (EPA accredited site auditor). The locations of Site 1 to Site 5 are presented in Figure 1, Appendix A, and additional details relating to each of the sites is presented in Section 2.

The objectives of this PSI were to:

- Assess the potential for contamination to be present at the sites from past or present activities (the sites are defined as the proposed construction disturbance areas only - as shown by the coloured polygons presented in Figure 1, Appendix A)
- Provide recommendations on the need for further investigations and/or management based on the findings.

To fulfil the objectives stated above, the following scope of work was carried out:

- A desktop review of a range of historical data sources, including:
 - Review of relevant sections of previous reports and documents made available by WaterNSW
 - Review of published information relating to the site including geological, topographical, and/or land use maps
 - Review of selected historical aerial photographs
 - A search of NSW EPA Contaminated Land and licence records under the *Protection of the Environment Operations Act 1997* (POEO)
 - Search of nearby registered groundwater bores
 - Review of relevant online records
 - Site walkover to assess conditions of the site and surrounds, and potential contamination source/activities
 - Interview with a WaterNSW representative with knowledge of the Sites history.
- Preparation of this PSI report.

For the purposes of this PSI, the proposed construction areas were divided into five main Sites (the Sites), named based on their previous or proposed use, as follows:

- Site 1 – Former painters/grit blasting area
- Site 2 – Proposed vegetation clearance area
- Site 3 – Terraced gardens
- Site 4 – Haviland Park
- Site 5
 - 5a – Materials storage/former housing
 - Site 5b – Heliport/former housing.

Our current understanding of the proposed construction activities at these sites is that activities will be limited to topsoil removal followed by stockpiling of soils for later use during site rehabilitation

Site 1 – Former painters/grit blasting area

Earliest available aerial imagery from 1949 shows the Site to mostly comprise dense bush land with some cleared areas including several un-sealed roads. Structures appear on-site around 1970, with dark ground staining (possibly associated with known grit blasting activities) appearing around 1978. The 2001 bushfires caused the destruction of the majority of on-site structures, a large steel framed shed was later re-built. The shed is now predominately used for the storage of rock core.

Reports reviewed by SMEC indicated that a portion of land (approximately 8,000m²) located to the west of the existing shed structure and a smaller area to the north of the existing shed area were historically contaminated with heavy metals (copper, lead and zinc) as a result of historical grit blasting activities. In addition, hydrocarbon soil contamination was recorded in areas of visible oil staining. A remedial action plan was prepared in 1998 and remedial activities were reportedly carried out (which included scraping visually contaminated soils followed by containment into a lined cell (on-site)). Validation reports were reportedly lost during the 2001 bushfires, however, one letter report indicated that remediation was carried out as per the remedial action plan based on anecdotal information.

Site 2 – Proposed vegetation clearance area

From circa 1949 to the present day, Site 2 appears to have predominantly comprised dense bushland and steeply sloping sandstone cliffs. Several structures were constructed in the western extent of the Site to support the original dam construction (eg Tail Tower used to crane materials). Two clusters of historical structures (eastern portion and northern portion of site respectively) were formerly present at the Site until demolition, circa 1965.

In 2016, three asbestos impacted areas and an open landfill area containing approximately 20 x 44 gallon drums were observed, a portion of each of these areas appears to be located within Site 2.

Site 3 – Terraced gardens

The Terraced garden area appears to have been predominantly utilised during the original dam construction. During this period, the lower terrace appears to have been utilised for car parking. A 'Tail Tower' structure was formerly located within the second (middle) terrace of Site 2 from around 1949 to 1965, circa 1965 the middle terrace appears to have been landscaped into the park area observable today. Various smaller building structures have been constructed within Site 3 since 1949, the majority of which are still visible on site today including an electrical building, back up generator and an electrical transformer.

Site 4 – Haviland Park

Aerial imagery appears to show a portion of Haviland Park being used for storage of stockpiles during dam construction (reportedly a one-week supply of gravel and sand) to supply the concrete laboratory.

Several larger building structures appear within the eastern extent of the Site circa 1955 but are not evident in the 1965 aerial image. Circa 1965 the park appears to have undergone some landscaping works to create the present-day park area. Two small structures were formerly present within the south-west portion of the site from around 1965 to 2011. Fill material appears to have been spread across the north-western half of Haviland Park in 2009, a WaterNSW representative advised that the source of the material was from excavations associated with the construction of the WaterNSW offices and visitor centre located immediately to the north-west of Site 4. A workshop area (with known historical contamination issues associated with above and below ground fuel tanks) is located immediately off-site to the east but is considered to be topographically lower than Haviland Park and unlikely to be a contamination source for the site.

Site 5a – Materials storage/former housing

From approximately 1949 to present day, the majority of Site 5a appears to have comprised dense bushland, including a weather station and an adjacent small communications hut (suspected to be constructed using asbestos containing materials).

Some areas of possible filling and stockpiling were visible in aerial images. Some of these cleared portions appear to have been utilised for equipment storage, for example either side of the main access road (southern portion of the Site) and within the cleared area located in the south-west portion of the site. An historical explosives store is located off-site to the south (in a downslope location). Areas outside cleared areas appear to not have been used.

Site 5b – Heliport/former housing

Site 5b appears to have been predominantly utilised as a residential area comprising over 50 individual houses and associated structures (e.g. sheds) at its peak. Construction of the residential area appears to have commenced around the late 1940s and we understand they were used to house some of the dam construction workers. Demolition of the houses appears to have occurred in several stages between 1978 and 2005. It is unknown if any remediation occurred at this Site following the demolition of the residential structures. More recently, fill materials appear to have been imported to the Site and used for landscaping, some of the fill reportedly came from the auxiliary spillway

construction, and some also reportedly came from construction of the visitor centre, although other sources are possible. A heliport is visible in the aerial imagery from 2018 but the area may have been used for helicopter landing prior to 2018.

Based on the Site history and observations, eight general potential contamination sources were identified which could affect various parts of the Sites, comprising:

- Areas near former/existing building structures from weathering and/or ineffective demolition of hazardous building materials.
- Historical and/or existing equipment storage areas (from weathering of equipment stored on unsealed ground for long periods) and historical construction areas (e.g. from equipment/machinery leaks and/or other general construction practices)
- Areas of stockpiling/filling (from materials of unknown origin and/or quality)
- Fuel storage/re-fuelling from possible leaks and/or spills (at the helicopter pad and near a back up generator)
- –An electrical transformer within Site 3 from possible leaks/spills of insulation oils
- –Contamination containment cell located within Site 1 and known asbestos contaminated area located immediately off-site (to the east) of Site 2
- Area of potential metal contamination associated with former girt blasting activities within Site 1
- Core park road dump area (from potential presence of wastes such as drums)

Potential Areas of Environmental Concern associated with the above sources were identified within various Sites.

Our qualitative assessment of the potential for contamination to be present within the various identified Areas of Environmental Concern ranged from low to high (most were low to moderate). A preliminary conceptual site model was prepared in the context of the proposed use of these areas for construction lay down areas and plausible source-pathway-receptor linkages were identified.

Based on the findings of this PSI, further stages of investigation are required to assess the site with respect to contamination. Intrusive investigations will be required to assess and characterise the site with respect to contamination, fill data gaps, develop the CSM and assess the need for remediation/management with respect to the proposed use of the site during construction. This should be carried out by developing a Sampling, Analysis and Quality Plan and then implementing this plan through a Detailed Site Investigation (DSI).

Based on the anticipated depth to groundwater which is relatively deep in fractured rock, and identified relatively shallow 'top down' contamination sources, direct assessment of groundwater is not considered to be warranted at this stage.

1 Introduction

1.1 General

In 2017, SMEC Australia Pty Ltd (SMEC) was engaged by WaterNSW to prepare an Environmental Impact Statement (EIS) in relation to the proposed raising of Warragamba Dam. Chapter 22 (Soils) of the EIS included a preliminary contaminated land desktop assessment which provided a broad assessment of the upstream probable maximum flood (PMF) area, the downstream PMF and the proposed construction areas adjacent to the Warragamba Dam. This preliminary contamination assessment comprised publicly available information and did not include any quantitative analysis based on sampling and laboratory analysis.

Following the public exhibition of the EIS in late 2021, the Department of Planning and Environment (DPE) provided WaterNSW with the submissions made to the EIS with regard to the proposal. Submissions were received from several NSW agencies including the Environment Protection Authority (EPA). The EPA submission provided advice on a range of matters including comments and recommendations relating to the preliminary contaminated land assessment in Chapter 22 of the EIS.

The EPA submission recommended that appropriate contaminated site investigations, carried out by appropriately qualified contaminated land consultants, should be completed covering the areas likely to be disturbed as part of the development to determine what remedial and management measures are required. The EPA advice stated, 'the investigations should assess all relevant media and justify if the proponent believes that groundwater testing is not necessary. Works should also consider whether asbestos is present in any building materials prior to the demolition works'. The letter also advised that a NSW EPA-accredited Site Auditor was recommended to be engaged for the entire project footprint and throughout the duration of the works to ensure that any work required in relation to contamination is appropriately managed, including any unexpected contamination finds, so that there is confidence that the site will be suitable for the proposed use. The letter recommended that the following documents be prepared:

1. A Sampling, Analysis and Quality Plan (SAQP)
2. A Detailed Site Investigation (DSI)
3. Interim audit advice from a NSW EPA accredited Site Auditor

In May 2022, WaterNSW engaged SMEC to carry out this Preliminary Site Investigation (PSI) and separate Sampling, Analysis and Quality Plan (SAQP) focussing on the proposed construction areas (designated Site 1 to Site 5) located adjacent to Warragamba Dam. WaterNSW also engaged Andrew Kohlrusch (EPA accredited Site Auditor). The locations of Site 1 to Site 5 are presented in Figure 1, Appendix A, and additional details relating to each of the sites is presented in Section 2.

This report presents the results of the PSI. The SAQP will be reported separately.

1.2 Project Objectives

The objectives of this PSI were to:

- Assess the potential for contamination to be present at the site from past or present activities (the sites are defined as the proposed construction disturbance areas only - as shown by the coloured polygons presented in Figure 1, Appendix A)
- Provide recommendations on the need for further investigations and/or management based on the findings.

1.3 Definition of Contaminated Land

The NSW *Contaminated Land Management Act 1997* defines contamination of land as *"the presence in, on or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment."*

1.4 Scope of work

To fulfil the objectives within Section 1.3, the following scope of work was carried out:

- A desktop review of a range of historical data sources, including:
 - Review of relevant sections of previous reports and documents made available by WaterNSW
 - Review of published information relating to the site including geological, topographical, and/or land use maps
 - Review of selected historical aerial photographs
 - A search of NSW EPA Contaminated Land and licence records under the *Protection of the Environment Operations Act 1997* (POEO)
 - Search of nearby registered groundwater bores
 - Review of relevant online records
 - Site walkover to assess conditions of the site and surrounds, and potential contamination source/activities
 - Interview with a WaterNSW representative with knowledge of the Sites history.
- Preparation of this report, with reference to relevant sections of the following guidelines:
 - NSW EPA (2020) Contaminated Land Guidelines: Consultants Reporting on Contaminated Land
 - National Environment (Assessment of Site Contamination) Protection Measure (NEPM, 2013).

2 Site Descriptions

2.1 Site information

For the purposes of this PSI, the proposed construction areas have been divided into five main Sites (the Sites), named based on their previous or proposed use, as follows:

- Site 1 – Former painters/grit blasting area
- Site 2 – Proposed vegetation clearance area
- Site 3 – Terraced gardens
- Site 4 – Haviland Park
- Site 5
 - 5a – Materials storage/former housing
 - Site 5b – Heliport/former housing.

The location of each Site relative to Warragamba Dam is shown in Figure 1, Appendix A. Additional focussed site details are presented in Figure 2-1 to 2-5, Appendix A.

A summary of site information for the Sites is presented below in Table 2-1 to Table 2-6.

Table 2-1 Site 1 Summary

Address	Located off W5 Erskine Range Trail, Blue Mountains National Park
Title Identifiers	Lot 1 DP87998
Area	Approximately 38,600m ² (3.86ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	Parts of this area are used by WaterNSW for storage of some equipment related to the dam including a shed (mainly used for rock core storage) with the remainder comprising vacant bushland with some cleared areas. An asphalt surface loop road is located within the central portion of the Site.
Proposed land use	Materials storage and handling area for the proposed dam raising.
Surrounding land use	The Site is immediately surrounded on all sides by dense bushland. Several surfaced and un-surfaced tracks are located to the north and east.

Table 2-2 Site 2 Summary

Address	Includes bushland on both sides of Warragamba dam. The Warragamba River flows through this Site but is excluded.
Title Identifiers	Lot 1 DP87998, Lot 1124 DP1159978, Part of Lot 5 DP248989, Part of Lot 4 DP628780
Area	Approximately 206,400m ² (20.64ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	The majority of this Site comprises bushland with steeply sloping valley sides. A section of asphalt surfaced access road and a former 'Tail Tower' (cable style crane used for original dam construction) are located within the north-western portion of this Site. An access road is also located within part of this Site to the east.
Proposed land use	Vegetation clearance area required for the proposed dam raising
Surrounding land use	Dense bushland is located immediately off-site to the north, south and east. Warragamba dam wall and Lake Burragorang are located off-site to the west. The Warragamba River flows west to east through the central portion of the Site.

Table 2-3 Site 3 Summary

Address	Located off Valve House Road, Warragamba, NSW
Title Identifiers	Part of Lot 1124 DP1159978
Area	Approximately 27, 420m ² (2.742ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	Terraced area associated with the dam, predominantly comprising three levels. Each level is separated from the next by an exposed sandstone cliff face. The lower level comprises an asphalt paved access road with several small building structures (e.g. electrical transformer, electrical building, back-up generator building). The other two levels mostly comprise maintained lawns and gardens.
Proposed land use	Concrete batch plant and materials storage and handling area for the proposed dam raising
Surrounding land use	North: Former hydropower station, and Warragamba River located beyond East: Asphalt surfaced road and dense bush land South: Warragamba Dam emergency spillway West: Warragamba Dam wall with Lake Burragorang located beyond.

Table 2-4 Site 4 Summary

Address	Located between Farnsworth Avenue and Production Avenue, Warragamba, NSW
Title Identifiers	Part of Lot 1124 DP1159978
Area	Approximately 2444m ² (2.444ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	Grassed parkland with scattered trees.
Proposed land use	Concrete batch plant and materials storage and handling area for the proposed dam raising
Surrounding land use	This Site is generally surrounded by an access road, bushland and ancillary infrastructure associated with Warragamba Dam. Workshop areas are located down slope, immediately off-site to the west. Several structures (including a residential dwelling and associated sheds are located immediately off-site to the east). The Warragamba Dam visitor centre is located immediately off-site to the north.

Table 2-5 Site 5a Summary

Address	Located in the vicinity of Twenty Fourth Street and Twenty Third Street, Warragamba, NSW
Title Identifiers	Part of Lot 1124/DP1159978
Area	Approximately 94,360m ² (9.436ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	Predominantly bushland including several vehicle tracks and some cleared areas. A storage area for old equipment associated with the dam is located along the southern and northern edge of the main access road, the equipment generally comprises rusted steel/concrete items. A cleared area in the north-eastern portion of this Site contains a weather station and a small communications building and associated satellite tower. An area used for mulch storage by WaterNSW is located within the north-western portion of the Site.
Proposed land use	Materials storage and handling area for the proposed dam raising
Surrounding land use	Dense bushland bounds the site to the north, east and west. A Sydney Water, water filtration plant is located immediately off-site to the south and outside land operated by WaterNSW.

Table 2-6 Site 5b Summary

Address	Intersection of Production Avenue and Warehouse Road, Warragamba, NSW
Title Identifiers	Part of Lot 1124 DP1159978
Area	Approximately 49,190m ² (4.919ha)
Zoning	SP2 Infrastructure (Wollondilly Local Environmental Plan, 2011)
Current Land use	Generally vacant, grassed area bordered by mature trees with a helicopter landing area located within the central portion of the site. At the time of the Site walkover, the south-eastern portion of the Site appeared to be used for informal car parking.
Proposed land use	Materials storage and handling area for the proposed dam raising
Surrounding land use	Dense bushland surrounds the Site to the east and north-west. A water filtration plant is located off-site to the south west. A grassed parkland area is located off-site to the south.

2.2 Construction details

Based on information provided by a WaterNSW representative, the expected ground disturbance at each Site during the proposed construction phase is summarised in the following sections:

2.2.1 Proposed disturbance (Site 1, Site 3, Site 4, Site 5a and Site 5b)

Our current understanding of the proposed construction activities at these sites is that the areas will mainly be used for storage of construction materials and equipment. As vegetation needs to be removed prior to materials storage, the ground engagement will likely be limited to vegetation/topsoil removal and stockpiling/storage for later use during reinstatement of these areas. Topsoil stripping where required may only be in the upper 0.2m.

Chapter 5 of the EIS (SMEC, 2021) also provides the following information with regards to the proposed activities at Site 3 and Site 4.

The proposed establishment of batching plants at Site 3 and Site 4 is understood to comprise the following:

- Hardstand area with drainage to environmental control ponds
- Concrete testing and geotechnical laboratory
- Weighbridge and office
- Materials storage bins and sheds (for aggregates, sand, fly ash, and other materials)
- Silos, mixers, conveyors, above ground tanks, control facilities and dust control facilities
- Water and material chilling plant
- Connections to communication, power and water supply services
- Other environmental controls if required (for example, noise walls).

2.2.1.1 Proposed disturbance (Site 2 - Proposed vegetation clearance area)

Our current understanding of the proposed construction activities at Site 2 is that vegetation and topsoil would be removed and stockpiled for rehabilitation post construction. The areas will be excavated out or just cleared, dependant on the area/activity (i.e. left and right bank access roads, toe of dam and side walls of auxiliary spillway would need to be excavated), but the access roads to those areas would just have vegetation and topsoil removed and a wearing course placed to create a road.

3 Site history and observations

3.1 General

Site history information was reviewed from the following information sources:

- Previous reports and documents made available by WaterNSW
- Selected historical aerial photographs- (purchased through Lotsearch Pty Ltd)*¹
- Universal historical business directory search (1948 to 1991)
- Selected historical aerial imagery (2005 – 2021) (reviewed via the metromap.com.au website)
- NSW EPA Contaminated Land and licence records under the Protection of the Environment and Operations (POEO) Act
- Selected online records
- Other publicly available information searches
- Site visit and interview with a WaterNSW representative with extensive knowledge of the Sites history

3.2 Site History Summary

Based on the data reviewed, a summary of the site history is provided below with details of specific searches included in subsequent sections. Historical aerial imagery is presented in Appendix B.

Prior to the construction of Warragamba Dam and subsequent flooding of the Burragorang valley, the area proximal to the dam wall comprised steeply dipping sides of the Burragorang river valley surrounded by dense bushland. The flat floodplain at the base of the valley comprised open fields, which were most likely used for grazing.

With reference to the WaterNSW website (watnsw.com.au), Warragamba Dam was a major engineering feat of the mid-20th Century. In 1946 the Warragamba River was diverted so excavation for the dam could start. Trees were cleared from the Burragorang Valley, and two temporary (coffer) dams and a tunnel were built to keep the site dry. During construction more than 2.3 million tonnes of sandstone was removed.

Concrete was mixed on site using 305,000 tonnes of cement and 2.5 million tonnes of sand and gravel. The sand and gravel was transported from McCann's Island in the Nepean River via an aerial ropeway.

The dam was built in a series of large interlocking concrete blocks. Overhead cableways lifted 18 tonne buckets to place the concrete. Ice was mixed with the concrete to control heat generation and prevent cracks. One of the first pre-stressed concrete towers in Australia was built to house the ice-making plant.

It took 1,800 workers to build, most living in an adjacent town specifically created to house them. The township of Warragamba had shops, schools and pubs, at its peak with a population of 3,500.

To get to the work site from Warragamba township, the dam builders used two suspension bridges, one across Folly Creek, upstream of the dam wall, and the other across the Warragamba Gorge just downstream from the dam. These Folly Creek bridge was removed after the dam was built but the bridge over the gorge was kept and incorporated into the beautification works at the dam. In 2001 it suffered damage in a bushfire and was subsequently demolished.

To meet modern dam safety standards, in the late 1980s the dam wall was strengthened and raised by five metres. In the early 2000s an auxiliary spillway was built to divert floodwaters around the dam in a rare and extreme flood so as to protect the dam and ensure it remained safe in an extreme flood. A deep-water pumping station was established in 2006 to allow water to be accessed lower down in the lake during times of drought.

Additional information sourced from the Warragamba Dam 50th anniversary booklet (WaterNSW, 2010) indicates that bush fires have impacted the area around Warragamba dam several times in the areas recent history including December 1957 and notably December 2001 where the booklet notes that the bushfires... 'burned much of the Warragamba village and damaged a number of significant heritage buildings and structures at Warragamba Dam including the suspension bridge, a workshop and an original staff mess and lecture room'.

3.2.1 Site 1 – Former painters/grit blasting area

Earliest available aerial imagery from 1949 shows the Site to mostly comprise dense bush land with some cleared areas including several un-sealed roads. Structures appear in the approximate location of the present-day rock core shed around 1970, with darker ground (possibly associated with known grit blasting activities) appearing around 1978. Circa 1986 the original shed structures appear to have been replaced by one larger shed, and then replaced again in the early 2000's (reportedly following their destruction during the 2001 bush fires).

From approximately 1978 to the present day the areas surrounding the central shed structures appear to have been used for storage of various types of equipment and broadly a similar layout. Between 1999 and 2001 the shed was also used for truck maintenance (and possibly refuelling).

Reports reviewed by SMEC indicate that a portion of land (approximately 8,000m²) located to the west of the existing shed structure and a smaller area to the north of the existing shed area were historically contaminated with heavy metals (copper, lead and zinc) as a result of historical grit blasting activities. In addition, hydrocarbon soil contamination was recorded in areas of visible oil staining.

Several reports discuss the proposed remediation of the grit blast area and proposed construction of a contamination containment cell. A remedial action plan was prepared in 1998 and remedial activities were reportedly carried out (which included scraping visually contaminated soils followed by containment into a lined cell (on-site) (the report is summarised in Section 3.4). The approximate location of the cell is shown in Figure 3, Appendix A. Validation reports for this remediation were reportedly lost during the 2001 bushfires, however a separate letter report from Ken Holmes (Environmental Management Representative at the time of remediation) confirmed the works were completed as per the approved remediation action plan based on his recollection of works.

3.2.2 Site 2 – proposed vegetation clearance area

From circa 1949 to the present day, Site 2 appears to have predominantly comprised dense bushland and steeply sloping sandstone cliffs. Several areas of disturbance and/or construction have occurred in this area over time including a large area of clearing and construction activities associated with the dam wall on the west bank (northern portion of Site 2) from around 1949 to 1955. During this period, it appears that several portions of the sandstone cliffs were removed to facilitate the new dam wall, in addition, the construction of two 'Tail Towers' and a bridge across to the gorge. Several building structures appear adjacent to the river at the base of the valley at this time, the use of these structures is currently unknown.

The proposed access track forms part of Site 2, the western extent of the track is located near to Warragamba village and appears to intercept an area which formerly contained multiple linear structures (1949 to 1978). A WaterNSW representative indicated that these structures were likely large diameter rock core from the original investigations (most were reportedly disposed of). Several linear, NE to SW trending structures were formerly present within the central eastern portion of Site 2 from around 1949 to 1955, these structures may be associated with the western extent of the historical workers camp (formerly located east of the current location of the Warragamba Dam viewing platform).

In 2016, three asbestos impacted areas and a landfill area containing approximately 20 x 44 gallon drums were observed immediately off-site of Site 2. The viewing platform area is registered on the NSW EPA Contaminated Land record, the management class is described as 'Regulation Under CLM Act not required'. The declared area covers the whole of the Lots in this area which partially extend into the nominated Site.

ADE consulting was commissioned by WaterNSW to undertake an Asbestos Materials Clearance Inspection adjacent to the viewing platform. The site inspection was carried out on the 2 November 2016 and concluded that 'visual examination of the area revealed the asbestos containing material debris had been removed from the soil surface to a satisfactory standard; the subject area at the time of inspection was considered safe with regards to asbestos'. This may be limited to surface clearance and not subsurface.

3.2.3 Site 3 – Terraced gardens

The Terraced garden area appears to have been predominantly utilised during the original dam wall construction, during this period, the lower terrace appears to have been utilised for car parking. A 'Tail Tower' structure was formerly located within the second (middle) terrace of Site 2 from around 1949 to 1965. Circa 1965 the middle terrace appears to have been landscaped into the park area observable today. Various smaller building structures have been constructed within Site 3 since 1949, the majority of which are still visible on site today. The small structures located

within the eastern portion of the site are reportedly for storing gardening equipment but are not presently utilised. The eastern extent of Site 3 appears to have remained relatively undisturbed between 1949 and present day, with the exception of a small asphalt surfaced area which comprises the roof of an access shaft (rectangular structure) to a diversion tunnel (related to the original dam construction). A blocked retaining structure is located in the north-western portion of Site 3, the retaining structure reportedly retains a cement stabilised fill, the source of the fill was reportedly from construction of the auxiliary spillway circa 2001. From 2009 to 2011 a large building structure is visible with the western portion of the middle terrace, a WaterNSW representative described this structure as 'temporary site sheds used during the crest gate upgrade project in 2009-2011. Circa 2007, a small electrical transformer was constructed within Site 3. Two existing building structures within the western portion of Site 3 are reportedly an electrical building containing switchboards and a smaller building which contains a reported 200-300 litre above ground fuel tank, both structures appear to have been constructed in the mid 1990's.

3.2.4 Site 4 – Haviland Park

Aerial imagery (1949) appears to show a portion of Haviland Park being used for storage of stockpiles (reportedly a one-week supply of gravel and sand) to supply the concrete laboratory (refer to photograph 4.04, Appendix C).

Several larger building structures appear within the eastern extent of the Site circa 1955 but are not evident in the 1965 aerial image. Circa 1965 the park appears to have undergone some landscaping works to create the present-day park area. Two small structures were formerly present within the south-west portion of the site from around 1965 to 2011. Fill material appears to have been spread across the north-western half of Haviland Park in 2009, a WaterNSW representative advised that the source of the material was from excavations associated with the construction of the WaterNSW offices and visitor centre located immediately to the north-west of Site 4.

A workshop yard located immediately to the west of Haviland Park historically contained two separate fuel storage facilities (one above ground and one below ground), the area was reportedly remediated circa 2004, and this workshop area is located topographically down slope of Haviland Park. Sinclair Knight Merz (1998) provided a brief site history which stated that the area was used for storage of sand and gravel for concrete manufacturing during the original dam construction. A concrete testing lab was situated in the east of the area. The site was levelled with 'clean' imported sands and gravel upon completion of the dam.

3.2.5 Site 5a – Materials storage/former housing

From approximately 1949 to present day, the majority of Site 5a appears to have comprised dense bushland. A tennis court was constructed within the north-east portion of the Site circa 1949 (likely a recreational facility associated with the adjacent former residential area within Site 5b), a weather station area appears to have been constructed circa 1970 and an adjacent small communications hut (suspected to be constructed using asbestos containing materials (ACM)) was constructed circa 1982, all structures were observed during the 2022 site walkover (excluding the tennis courts).

Two areas of possible filling and stockpiling were visible at the site (the western fill area (refer to Figure 3, Appendix A) appears to have been gradually filled between 1960 to 2005 and the eastern fill area appears to have been filled between 1970 to 1986. Several portions of the site appear to have been utilised for equipment storage, for example either side of the main access road (southern portion of the Site) and within the cleared area located in the south-west portion of the site. Anecdotal information from WaterNSW indicated a historical explosives store is located off-site to the south.

3.2.6 Site 5b – Heliport/former housing

Site 5b appears to have been predominantly utilised as a residential area comprising over 50 individual houses at its peak. Most house lots also containing a smaller shed type structure. Construction of the residential area appears to have commenced around 1949 and we understand they were used to house some of the dam construction workers and engineers. Demolition of the houses appears to have occurred in several stages sometime between 1970 and 2005 (most houses were not evident by the mid-1980s). Circa 1982 three additional houses were constructed within the south-eastern portion of the Site but by 2005 all structures had been cleared from the site. With reference to the WaterNSW website (<https://www.watnsw.com.au/supply/Greater-Sydney/safety/warragamba-dam-auxiliary-spillway>) construction of the auxiliary spillway was completed in 2002. Spoil from the construction was reportedly placed at two locations, Site 5b formed the smaller of the two emplacement areas. Aerial imagery from 2009 shows numerous stockpiles of potentially imported fill visible located near to the southern border of the site. Subsequent aerial imagery appears to show this fill material being spread across the southern half of the site. A WaterNSW

representative advised that the source of the material was from excavations associated with the construction of the WaterNSW offices and visitor centre (located north-west of Haviland Park above the auxiliary spillway).

A heliport is visible in the aerial imagery from 2018 but the area may have been used for helicopter landing prior to 2018.

3.3 Aerial Photographs

Aerial photographs for the following years were obtained and reviewed:

- 1949, 1955, 1965, 1970, 1978, 1982, 1986, 1991, 1994, 2007, 2011, 2016 and 2021.

The key observations from these photos have been captured in the site history summary sections above in Sections 3.2.1 to Section 3.2.6. Aerial photographs are presented within the LotSearch report (Appendix B).

3.4 Previous Reports

SMEC received numerous reports from WaterNSW relating to various areas within the vicinity of and including the Warragamba Dam Wall. Only reports and sections of reports which were considered relevant to the Sites covered by this PSI have been included within the following review. Relevant sections of the following reports have been reviewed and summarised:

- IT Environmental (2004), Remedial Action Plan: Former Workshop Yard, Farnsworth Avenue, Warragamba, NSW, 2752. Prepared for Sydney Catchment Authority
- Integrated Environmental (2016), Warragamba Dam - 18th Street and Core Park Rd Asbestos Inspection and Risk Assessment Report Version 2, dated 27 May 2016
- ADE Consulting (2014) Warragamba Dam - Dam Operational Support buildings, workshops etc. - Hazardous Materials Survey Report, dated 13 August 2014
- Various Authors, (1998) [compilation of multiple reports] Warragamba Dam Auxiliary Spillway Contamination Investigations including:
 - Sinclair Knight Merz (1998) Warragamba Dam Auxiliary Spillway Proposed Truck Maintenance and Explosive Storage Area – Environmental Site Investigation
 - Sinclair Knight Merz (1998) Letter report re: Warragamba Specifications
 - Warragamba Dam Left Bank Remediation: Review of Environmental Factors (REF)
 - Sydney Water Memorandum re: right bank contamination (01 July 1998)
- Sinclair Knight Merz (1998), Right Bank Summary History report and Proposed Sampling Regime
- Sinclair Knight Merz (1998) Letter report re: remediation options [referring to Truck Maintenance and Explosive Storage Area]
- Australian Water Technologies (1998) Warragamba Dam Auxiliary Spillway Project 'Right bank' Preliminary Environmental Site Investigation
- Sinclair Knight Merz (1998) Warragamba Dam – Explosives Store and Vehicle Refuelling Area – Left Bank: Remediation Action Plan
- Carey Construction Pty Ltd (1998) Environmental Management Plan – Induction Truck Maintenance and Explosives Storage Area.
- CH2M Hill (2018) Warragamba Viewing Platform and Eighteenth Street – Contaminated Land Management Plan (working draft)
- ADE consulting (2016) Asbestos Material Clearance Report

3.4.1 Remedial Action Plan: Former Workshop Yard, Farnsworth Avenue, Warragamba, NSW, 2752. Prepared for Sydney Catchment Authority (IT Environmental, 2004)

This area is a portion of land outside the Sites being addressed in this PSI but considered relevant to document for completeness.

A Remedial Action Plan (RAP) was prepared for the former workshop yard located at Farnsworth Avenue, Warragamba, NSW (IT Environmental, 2004). The yard reportedly formerly comprised two separate fuel storage facilities (one above ground fuel storage area and one below ground fuel storage area). All tanks were removed in 1996 but residual contamination remained. Contaminated material was used as backfill within the empty tank pit and covered with high density polyethylene (HDPE), imported shale and then re-surfaced with bitumen.

The site history section of the Remedial Action Plan indicates that in December 2001 a bushfire caused considerable damage to buildings at Warragamba Dam. Buildings destroyed by the fire included the main workshop shed, ancillary carport structures and sanitary and kitchen facilities. Issues associated with contamination as a result of the fire (e.g., asbestos debris from old buildings) is not specifically discussed.

Documentation confirming that the remedial activities were carried out has not been made available.

The workshop is located approximately 20m west, and down topographic gradient of Site 4 (see approximate location in Figure 2-3) and contamination (if any) is therefore unlikely to impact on the Sites.

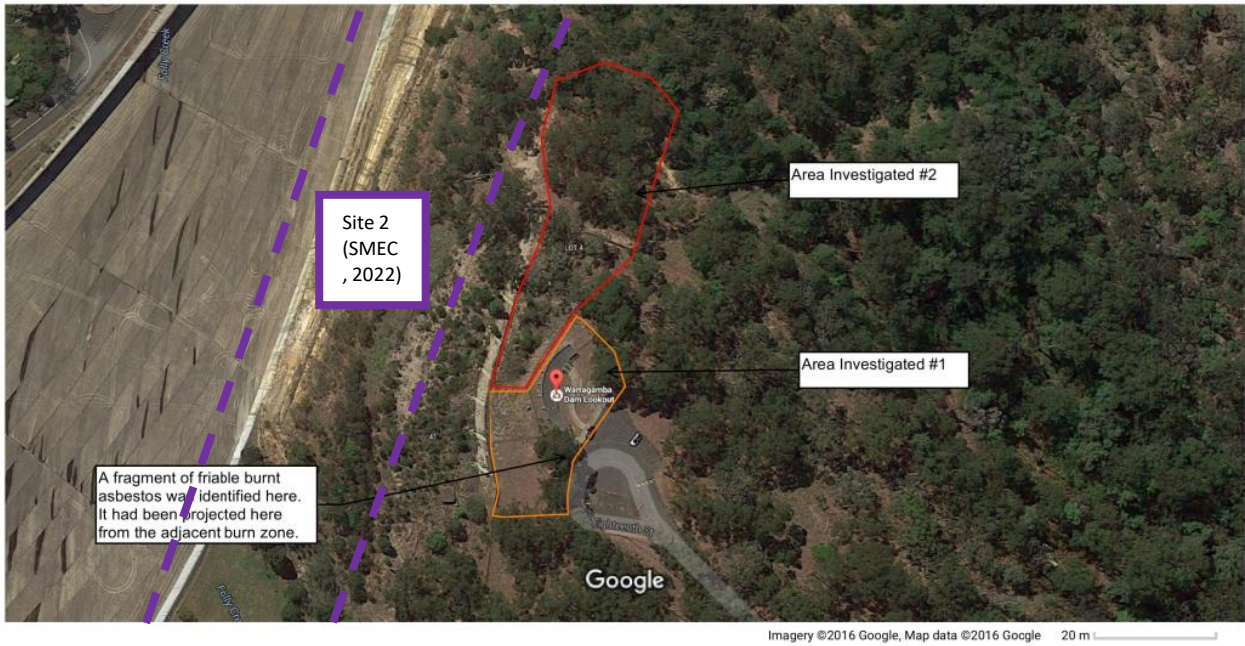
3.4.2 Warragamba Dam - 18th Street and Core Park Rd Asbestos Inspection and Risk Assessment Report Version 2, dated 27 May 2016. Prepared for WaterNSW (Integrated Environmental, 2016)

During hazard reduction burns undertaken on 19 and 20 May 2016 near the Warragamba Dam viewing platform (Eighteenth Street, Warragamba NSW 2752), asbestos containing material (ACM) was identified. Following the discovery, a risk assessment and removal plan was prepared by Integrated Environmental (2016). This area is a portion of land outside the Sites being addressed in this PSI, but considered relevant to document.

The report noted that the area where the ACM was identified during the hazard reduction burn, was previously a residential area that was built during the construction of Warragamba Dam (around the 1940s/50s), and subsequently demolished once the Dam was completed.

With reference to Figure 3-1 and Figure 3-2 below, 'Area investigated #1', 'Area investigated #2' and 'Area investigated #3' are located immediately outside of Site 2. The report states that areas outside of Area #1, #2 and #3 were not investigated. Approximately 500 fragments of cement sheeting were observed within Area #1 some of which was concluded to have been projected here from an adjacent burn zone. A representative fragment was analysed at a laboratory and shown to comprise chrysotile and amosite asbestos, the fragments were considered to be both non-friable and friable. Greater than 1,000 fragments of ACM (non-friable and friable) were estimated to be present at Area #2 and approximately 30 fragments (friable and non-friable) were observed in Area#3.

The report also includes field observations of potential chemical contamination within Area#3 where approximately 20 x 44 gallon steel drums were observed (unknown if drums were empty at time of disposal at this location), a fluorescent light fitting was also observed in this area (potentially contains PCBs), the estimated area of the 'core park road dump zone' is 10,000m². A portion of this area appears to be within Site 2. The report recommended further assessment of this area.



Google Maps



Burn Zone where friable asbestos containing material was identified

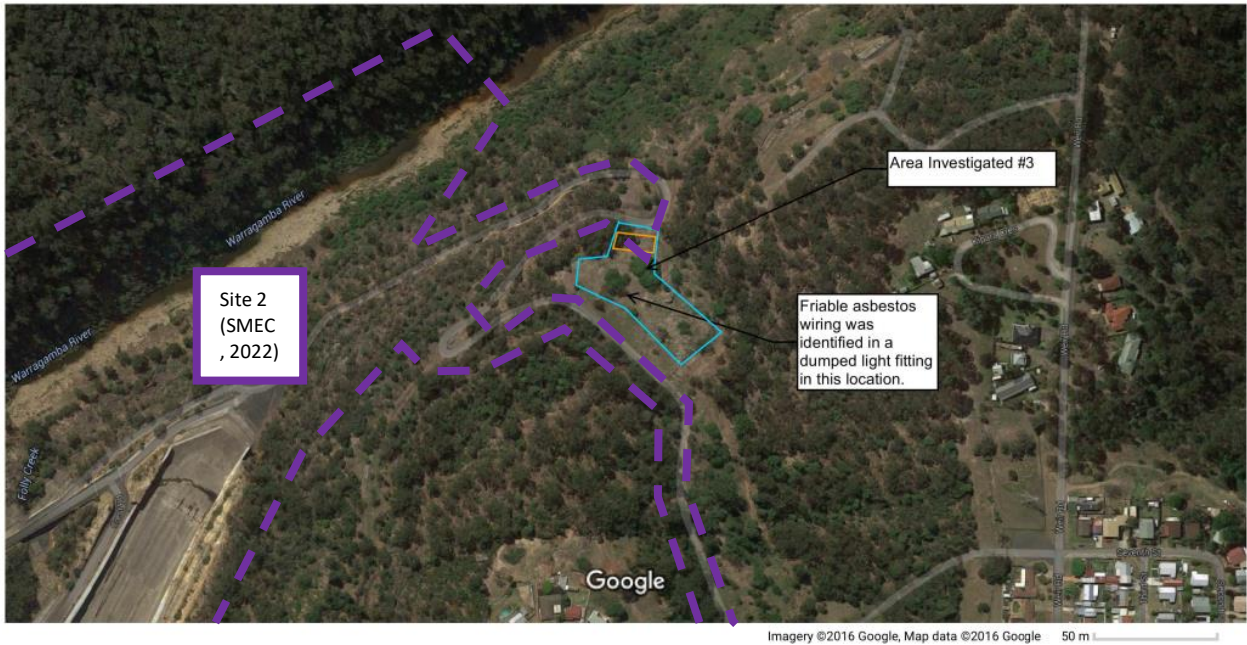


Public Viewing Platform Area where asbestos containing material was identified

Please note that areas outside those outlined on this map were not investigated. The outlined areas represent the scope of this investigation.

Figure 3-1 Figure extract from Integrated Environmental (2016), demonstrating the areas investigated over 19 and 20 May 2016 (Investigation Areas 1 and 2).

Google Maps Core Park Road Dump Zone



Google Maps



Bonded asbestos cement sheeting debris was identified in this location



Areas inspected

Please note that areas outside those outlined on this map were not investigated. The outlined areas represent the scope of this investigation.

Figure 3-2 Figure extract from Integrated Environmental (2016), demonstrating the areas investigated over 19 and 20 May 2016 (Investigation Area 3).

3.4.3 Asbestos Material Clearance Report (ADE consulting, 2016)

ADE consulting was commissioned by WaterNSW to undertake an Asbestos Materials Clearance Inspection at several areas located at Warragamba Dam, Warragamba. One of the areas was located adjacent to the viewing platform ('subject area A – refer to 3-3 below). The site inspection was carried out on 2 November 2016 and concluded that 'visual examination of the area revealed the asbestos containing material debris had been removed from the soil surface to a satisfactory standard; the subject area at the time of inspection was considered safe with regards to asbestos'. The cleared area (subject Area A) includes a portion (but not all of) 'Area Investigated # 1' as described in Section 3.4.2 above.



Figure 3-3 Figure extract from ADE 2016 report, demonstrating the areas investigated.

3.4.4 CH2M Hill (2018) Warragamba Viewing Platform and Eighteenth Street – Contaminated Land Management Plan (working draft)

CH2M Hill were engaged by Sydney Water to prepare a CLMP for Sydney Water owned land near the Warragamba Dam viewing platform, this area had been fenced off due to identified asbestos contamination which was discovered during backburning in 2016, the source of the asbestos was from the demolition of temporary dwellings constructed for dam workers in the 1950's. The report references a previous investigation carried out by WSP (2016) which found widespread ACM contamination (including friable asbestos and asbestos fines) (generally limited to the top 0.2 below ground level. CH2M developed a remedial action plan (RAP) which recommended:

- Viewing platform area – placement of geotextile fabric, capping layer and re-vegetation of publicly accessible areas
- Remainder of site – installation of erosion control to prevent future runoff, and improvements to site security and signage.

The Site boundary is represented by the yellow polygon in Figure 3-4.

As part of the remediation works an emu pick was completed in December 2017 by Enviropacific.

Services at publicly accessible areas on and adjacent to the Site to remove visible asbestos. A clearance certificate was subsequently granted by a qualified hygienist at the completion of the emu pick.

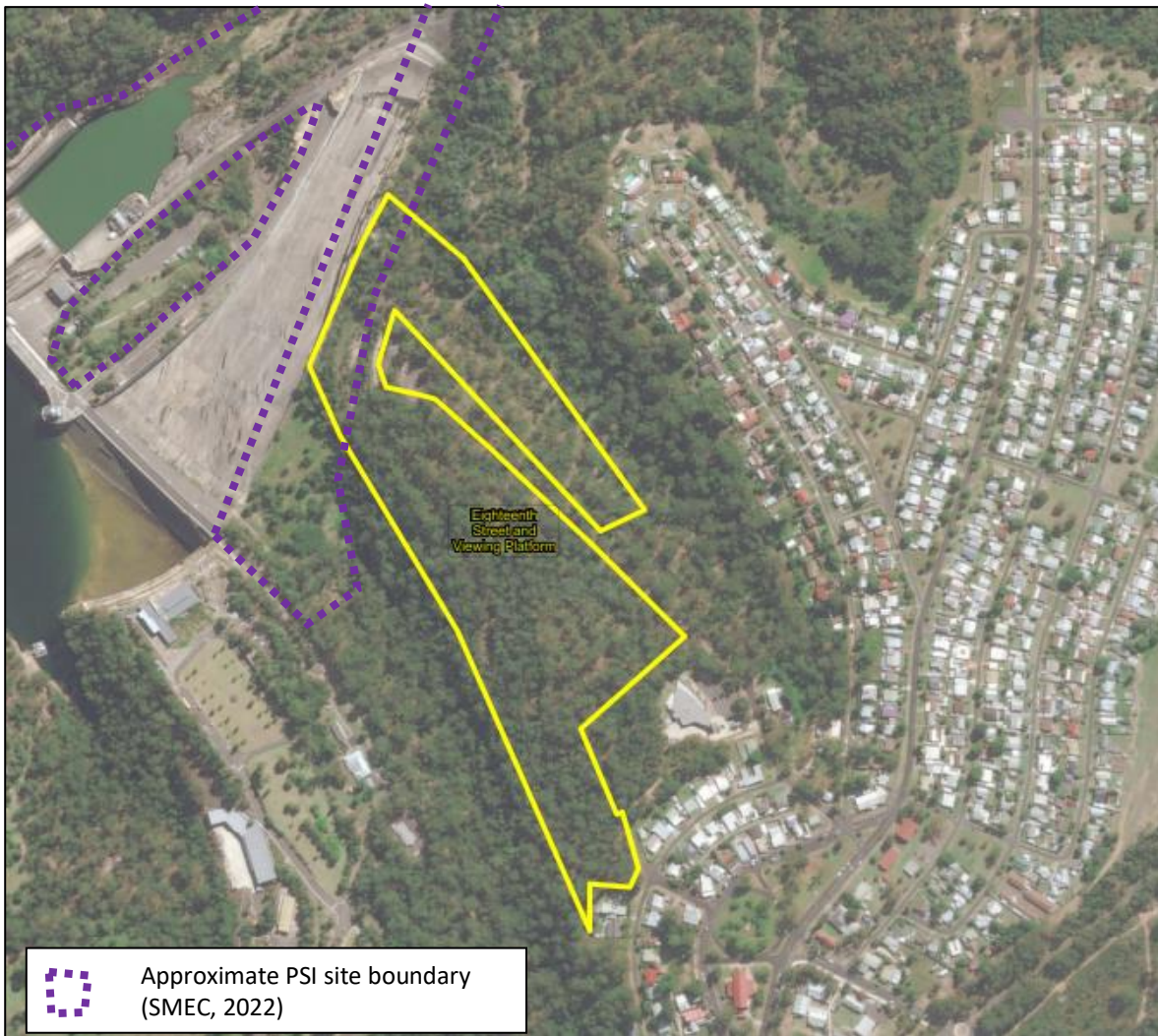


Figure 3-4 CH2M Hill (2018) assessment and remediation area

3.4.5 Warragamba Dam - Dam Operational Support buildings, workshops etc. - Hazardous Materials Survey Report, dated 13 August 2014. Prepared for Sydney Catchment Authority (ADE Consulting, 2014b)

This report includes a Hazardous materials (HAZMAT) assessment of various building structures. Up to five of the structures within the assessment appear to be located within the Sites (two structures within Site 3 and two structures with Site 5b), unfortunately the site location figure provided within the report is unannotated with building names making it difficult to discern which HAZMAT results apply to which structures. The radio repeater structure (referred to in this report as 'former communications hut' (located within the central northern portion of Site 5b) was shown to contain asbestos containing materials (ACM) and lead paints.

3.4.6 Warragamba Dam Auxiliary Spillway Contamination Investigations - December 1998. Prepared for Sydney Catchment Authority (Various, 1998)

The contamination investigations report includes several documents relating to construction works at Warragamba Dam (including the auxiliary spillway construction also refers to Site 1) . A brief summary of relevant documents is provided below:

3.4.6.1 Sinclair Knight Merz Warragamba Dam Auxiliary Spillway Proposed Truck Maintenance and Explosive Storage Area – Environmental Site Investigation (17 February 1998)

This report applies to areas of Site 1 (former painters/grit blasting area). The investigation was undertaken to determine if any measures were required to ensure the site was suitable for use, by the construction contractor for the proposed auxiliary spillway (parking and maintenance of haulage vehicles, refuelling facilities and the storage of explosive material) because of the past activities of Sydney Water at that location. The investigation was initiated

because grit blasting had been previously undertaken in the area and therefore there was a possibility that contaminants may be present. The investigation included soil sampling and analysis. The investigation indicated that:

- Significant metal contamination is apparent over large section of the site which appears to be confined to the surface soils (approx. 8000m² in total)
- Off-site migration of considerable metal contamination currently occurs and has migrated approximately 40m beyond the vegetation line down slope of the grit blasting areas. The contamination in drainage lines off-site presents a potential threat to surrounding water bodies
- Chromium, copper, lead and zinc exceeded Environmental Investigation Level for most surface samples
- The Human Health criteria for industrial land was exceeded for lead at four locations
- Total Petroleum Hydrocarbons (TPH) exceeded thresholds in the NSW EPA Guidelines for Assessing Service Station in areas of visible surface staining
- A Polyaromatic Hydrocarbons (PAH) exceedance of 30mg/kg was registered at one location
- Toxicity Characteristic Leaching Procedure (TCLP) and water leachate analysis was carried out for six surface samples that reported high metal concentrations. The results of the water leachate analysis indicated that there was not a significant problem of metals leaching from the site in the event of rainfall.

3.4.6.2 Sinclair Knight Merz – letter dated 29 June 1998 re: Warragamba Specifications letter

This letter report contained the following additional information relevant to the remedial activities at Site 1 (former painters/grit blasting area):

‘a contamination assessment of the site has confirmed that the site is contaminated by copper, lead and zinc as a result of grit blasting activities carried out on the site in the past. The material is mainly sandy topsoil mixed with black grit material. Contaminated material is distributed over approximately 1ha of the site extending into surrounding bushland and concentrated in drainage lines off-site. Contaminated material will be scraped up from around the site and secured into a cell, which is to be constructed on site. The cell will be strategically placed on-site to ensure that it is on the side of the ridge line which drains away from the water storage areas. From previous investigations it was estimated that approximately 1000m³ of material required securing on site’. The letter report also states that ‘a cell will be excavated to bedrock which was noted to be approximately 1m below the ground surface. The letter also states that the cell will be lined with geotextile fabric at the base and on the sides of the cell...the lining will extend over the edge of the excavated cell. It was then recommended that the cell, once full, be covered with multiple layers, including geo textile, HDPE, topsoil etc. The letter also included Figure 3-5 below which shows locations of metal contamination extent, grit blasting area and the proposed location of the cell.

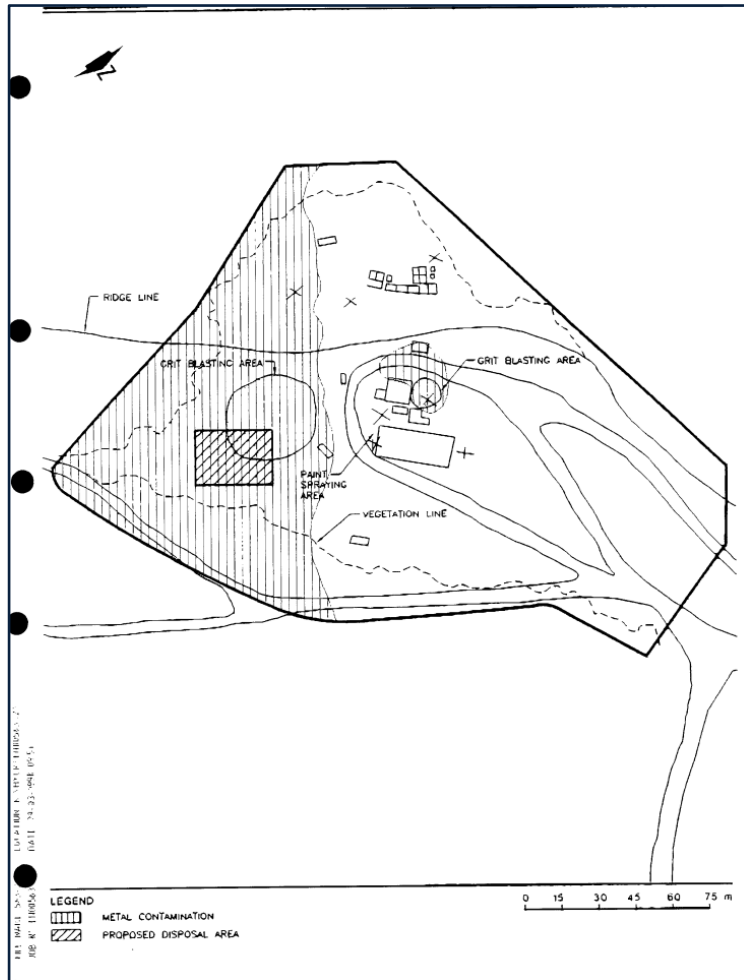


Figure 3-5 Sketch from SKM (1998) letter report showing areas of metal contamination, grit blasting areas and proposed disposal area.

3.4.6.3 Warragamba Dam – Explosives Store and Vehicle Refuelling Area – Left Bank: Remediation Action Plan (Sinclair Knight Merz, 1998)

This report applies to areas of Site 1 (former painters/grit blasting area).

This report included a Remediation Action Plan to address soil contamination of an area formerly known as ‘the painter’s area’, which had been used for 20 years for grit blasting activities. A previous site investigation identified the following contaminants in soils on the site:

- ‘Significant’ soil contamination of copper, lead and zinc related to grit blasting activities and the use of zinc and aluminium based paints.
- Areas of oil staining were tested for petroleum hydrocarbons and PCBs. Hydrocarbons were detected >1000 mg/kg but were only isolated to the surface in a relatively small area. No PCBs detected.
- The Remediation Action Plan outlined the preferred remediation method which was to bury and contain the heavy metal contamination on site in a purpose-built disposal cell. The hydrocarbon impacted material was to be treated using on site bioremediation techniques.

A supplementary letter (dated 2002) was provided with the document retrieval of this report comprising a statement by Ken Holmes who was the Environmental Management Representative at the time confirming the works were completed as per the approved remediation action plan. Ken Holmes also notes that, ‘the remediation involved the excavation of heavy metal contaminated surface soils and burial on site in a clay lined pit. The pit is located under the sound/light berm constructed to minimise the impacts of construction vehicle maintenance activities on Warragamba Village during the construction of the Spillway.

3.4.6.4 Sydney Water Memorandum re: right bank contamination (01 July 1998)

The letter is addressed to SRI [unknown party] from Tim Sheridan (of WaterNSW) regarding 'right bank contamination'. The letter states, 'the results of the historical appraisal indicate that areas within the Spillway alignment may be contaminated with asbestos and hydrocarbons. SKM's proposed sampling regime is designed to try and confirm the presence of contamination and we should await the results of this sampling before quantifying the risks'. A hand written comment at the bottom of the letter indicates that the receiver of the letter agrees with the recommendations with regards to carrying out sampling within the spillway alignment. No additional details are provided.

3.4.6.5 Sinclair Knight Merz (26 June 1998) letter report regarding 'Right bank: Summary History Report and Proposed Sampling Regime This report applies to Site 4 (Haviland Park).

Prior to the construction of the emergency spillway, Sinclair Knight Merz (SKM) were commissioned by Australian Water Technologies to carry out a contamination assessment for Haviland Park, spillway excavation area, site access routes (to the proposed spillway) and vegetation/topsoil emplacement areas.

A site history was compiled, extracts from the SKM site history which are relevant to this assessment are presented below:

- In 1998 the Site was '*being used as a picnic and BBQ area for recreational purposes. During construction of the original dam, the site was used for sand and gravel stockpiles for concrete manufacturing . An aerial ropeway intersected the site which originated from Mc'Canns island where the sand and gravel was obtained. The concrete lab was also situated in the east of the area. The lab was primarily used for strength testing of concrete that was manufactured onsite. Indications from employee interviews was that there was no knowledge of chemicals on the site. The site was levelled with imported material upon completion of the dam*'. It was indicated that the fill material was 'clean' and was mainly sands and gravels. SKM proposed eight test pits within Haviland Park for analyses of contaminants of concern. SMEC do not currently have access to any reports which include the results of the proposed test pitting (if it occurred).
- The following extract refers to the Folly Creek Area (which is understood to be located off-site to the north-east of Site 2) '*Indications from staff employees and review of historical photos detailed large amounts of fill were dumped down the embankment of Folly's Creek. Presently some drums and wire can be seen protruding from the sides of fill. It was also indicated that significant amounts of asbestos sheeting was also dumped in this area*'. This area is understood to be located off-site to the north-east of Site 2 and not directly relevant to this PSI.

3.4.7 Australian Water Technologies: Warragamba Dam Auxiliary Spillway Project 'Right bank' Preliminary Environmental Site Investigation Tender briefing document, April 1998

This document appears to be a tender briefing document issued by Lucinda Maunsell (Australian Water Technologies) to procure a contractor. The scope of works is described as follows, '*prior to the erection of contractors facilities in the area of Haviland Park, the proponent shall investigate whether the land contains landfill or has previously been used for any other purpose listed in Table 1 of the Planning Guidelines for Contaminated Land (Department of Urban Affairs and Planning). Figure 3-6 was included as an attachment to the tender documents, the figure refers to Site 1 as an explosives magazines, vehicle refuelling and maintenance – see image below. SMEC later confirmed with WaterNSW that explosives were not stored at Site 1 and were a significant distance west of Site 1 (offsite).*

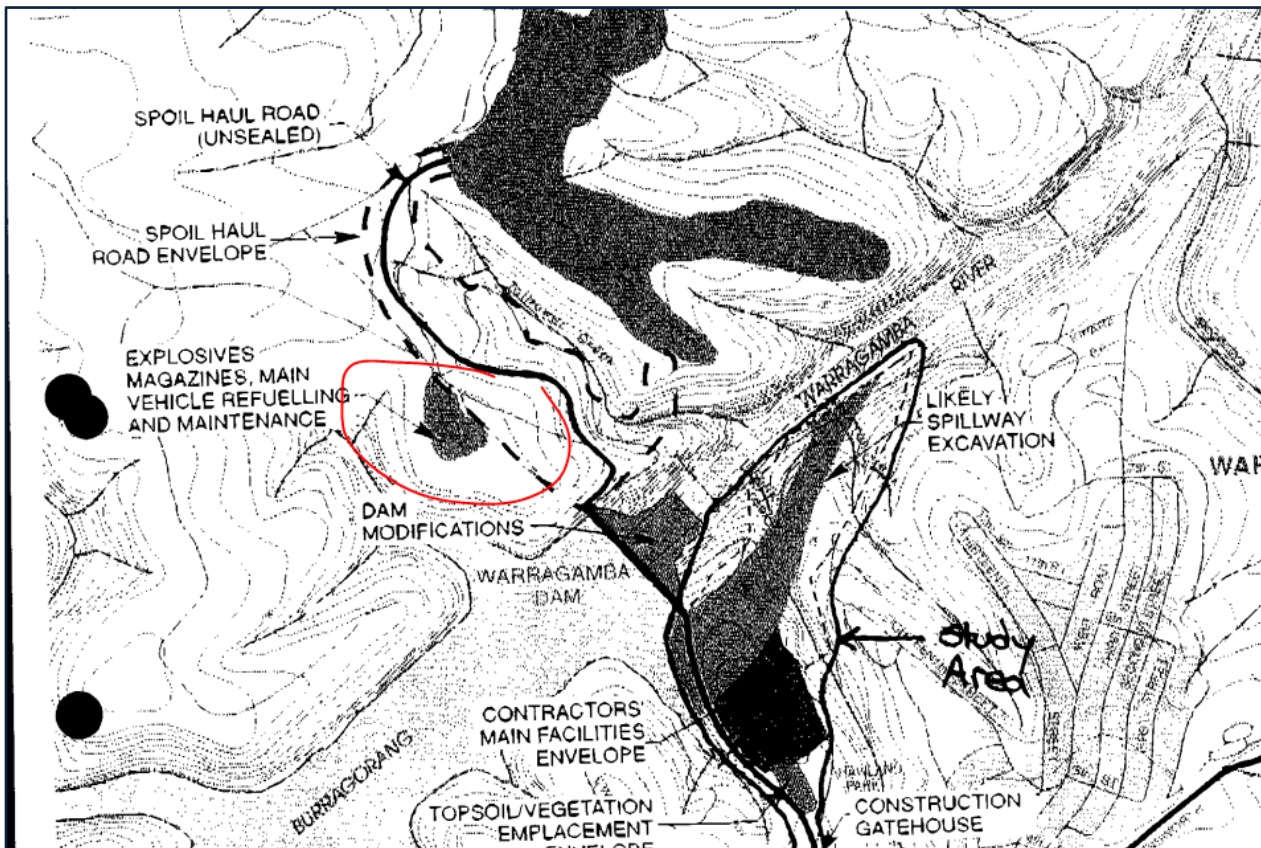


Figure 3-6 Map provided as part of tender briefing documents which describes Site 1 as 'Explosives magazines, main vehicle re-fuelling and maintenance'.

3.4.8 Carey Construction Pty Ltd: Environmental Management Plan – Induction Truck Maintenance and Explosives Storage Area. (16 October 1998)

This Environmental Management Plan does not generally provide information directly relevant to this assessment but includes several sketches showing 'details of works to be performed'. Several sketches/plans (refer to Figure 3-7 to Figure 3-9 below) show the proposed locations for the truck maintenance area and explosives storage area at Site 1 and the proposed location of the contamination cell at Site 1.

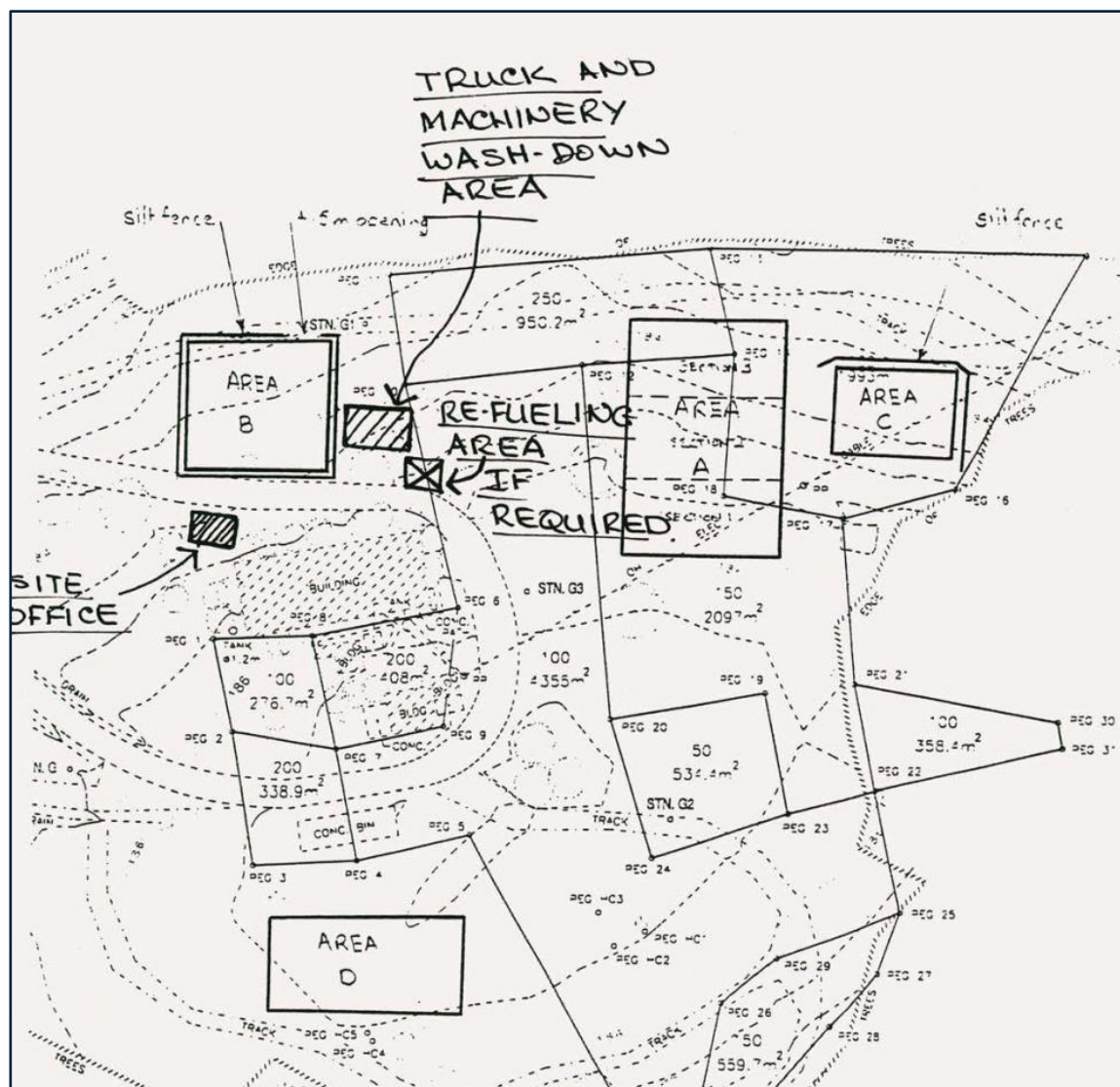


Figure 3-7 (it is unknown what Area A to Area D is referring to (possibly options for the locations of the proposed contamination cell))

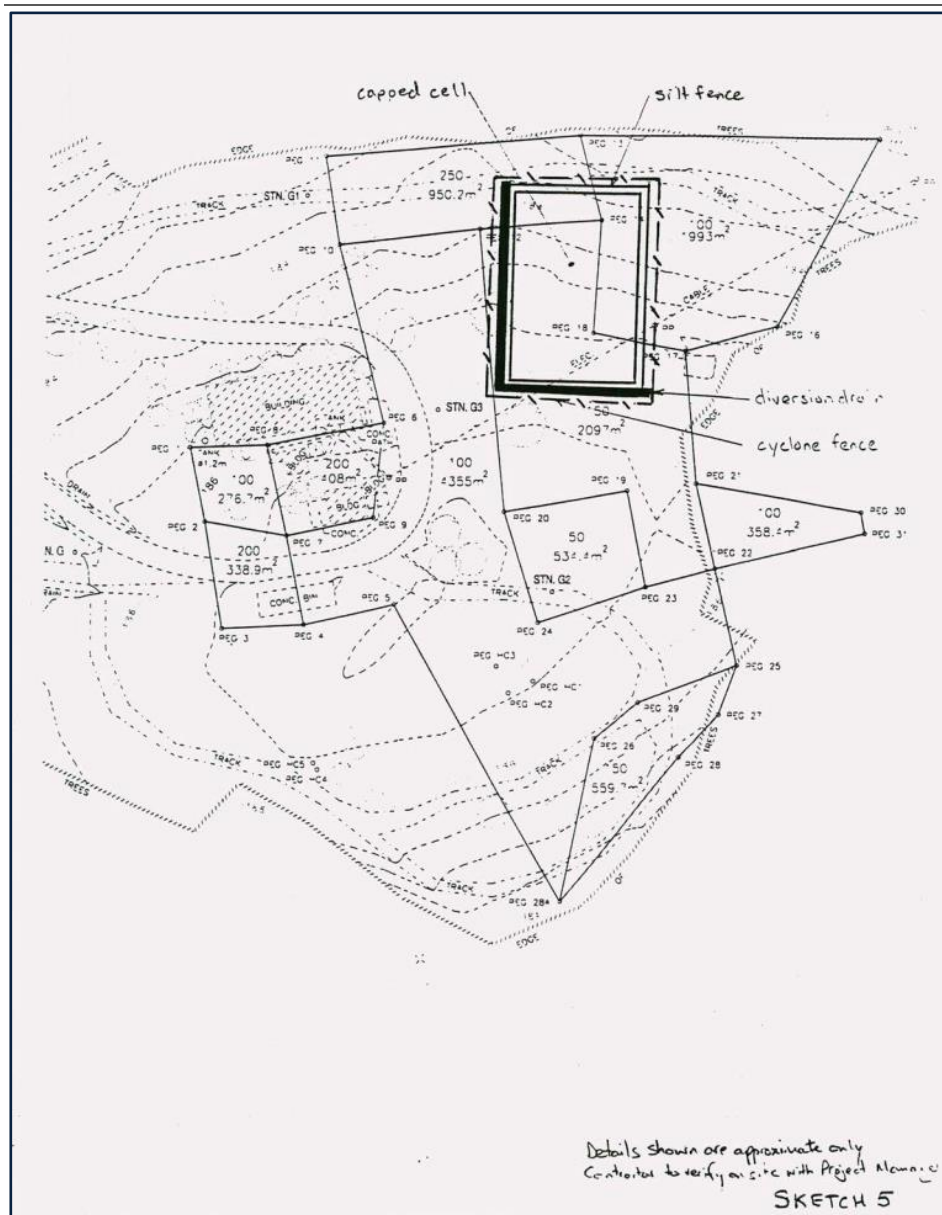


Figure 3-8 – shows proposed location for the contamination cell at Site 1

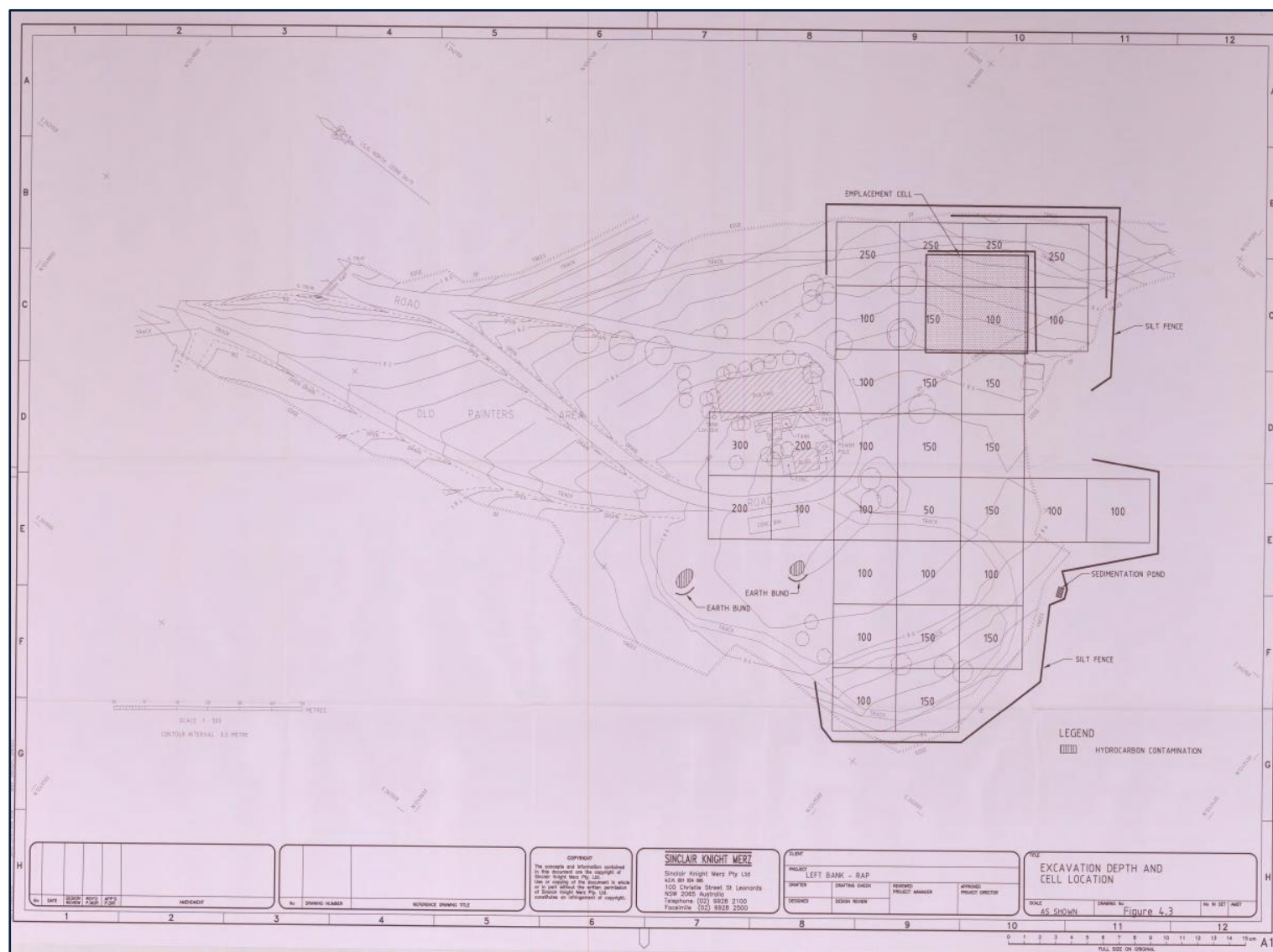


Figure 3-9 – 'excavation depth and cell location

3.5 NSW EPA Records

3.5.1 Contaminated Land Search

A search of the NSW EPA Contaminated Land records was carried out on 13 May 2022. Copies of NSW EPA Contaminated Land search results are provided in Appendix C. The search results indicated two notified sites are located within a 500m radius of the Site. A summary is presented in Table 3-1 and the locations of the two recorded sites relative to the Site is presented on Figure 3-9. Search results are presented within Appendix B

Table 3-1 Summary of notified sites to the EPA

Site name	Ref no.	Address	Activity	Management Class	Status	Location confidence and distance and direction from site
Warragamba dam viewing platform	13492	Eighteenth Street	Unclassified	Regulation under CLM Act not required ²	Current EPA list	Premise match - See table note 1
Megartitty's Creek	13564	Weir Road	Unclassified	Regulation under CLM Act not required ²	Current EPA list	Road match – approximately 10m east of the far eastern extent of Site 2.

Table notes

1 – The mapping provided within the Lotsearch report (Appendix B) indicates that the contamination associated with the Warragamba dam viewing platform extends across the eastern boundary of Site 2 into the site, however, discussions with WaterNSW indicate that this portion of the site will not be disturbed by the proposed construction works.

² Regulation under CLM Act not required = The EPA has completed an assessment of the contamination and decided that regulation under the Contaminated Land Management Act 1997 is not required.

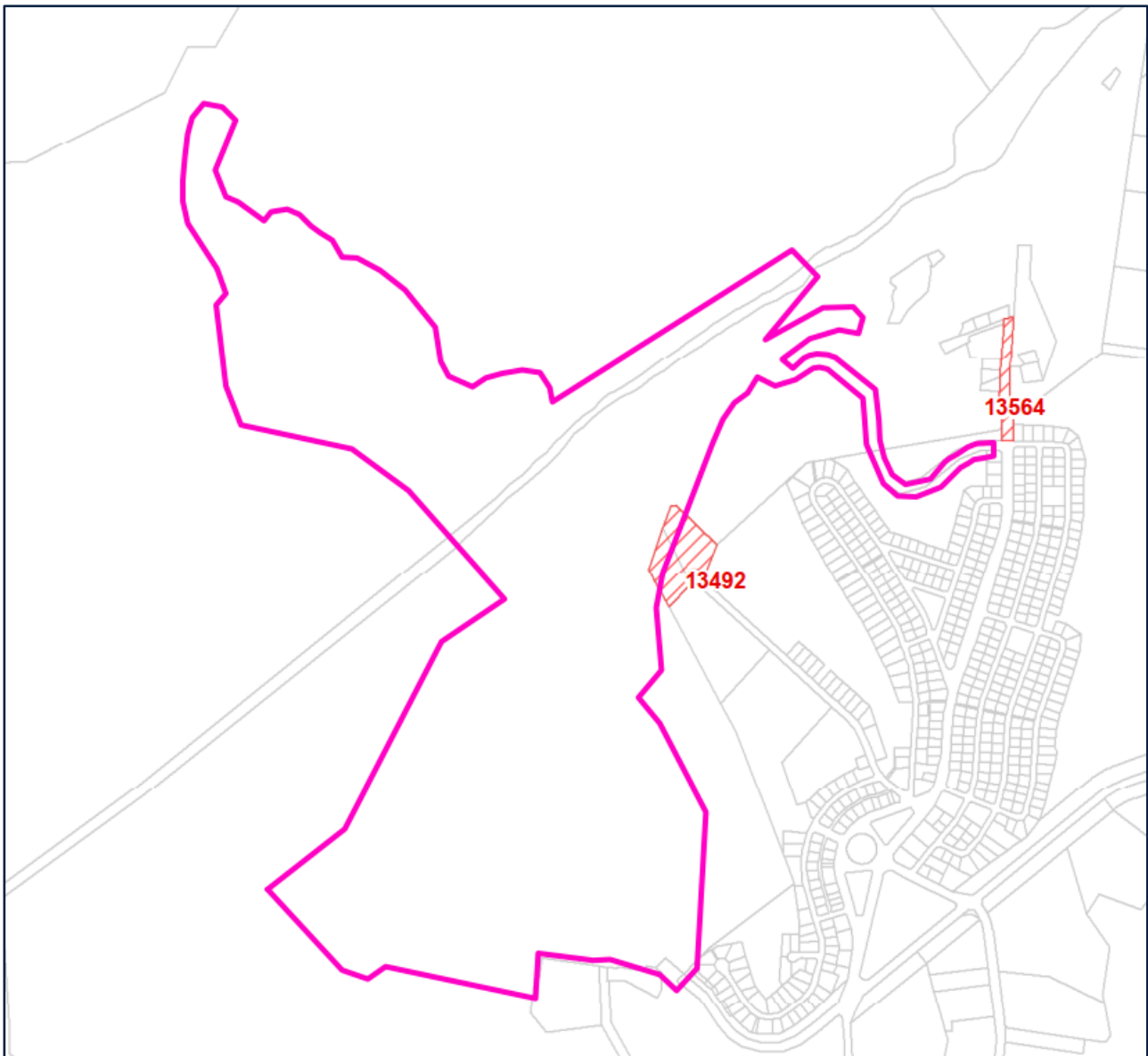


Figure 3-9 Location of NSW EPA contaminated sites relative to the Site

3.5.2 POEO Database Search

A search of the NSW EPA Protection of the Environment Operations (POEO) register indicated that no licensed activities were currently operational within a 500m radius of the Site. Wallacia Water Sewage Treatment system (which currently holds an active license) is located approximately 1km north-east of the Site.

Multiple formerly licensed sites (now revoked or surrendered) were reportedly located on site, including licenses relating to sewage treatment (end of Weir Road), electrical power generation (valve house road), 'other activities' carried out within waterways in the Wollondilly Shire Council area, application of herbicides (relating to waterways throughout NSW), all licenses were reportedly surrendered in 2000.

Search results are presented within Appendix B.

3.6 Review of historical business directory records

A review of historical business directory records from 1948 to 1990 was carried out on 12 May 2022, no results were returned that matched an historical business to a specific property or intersection. Numerous historical business were recorded to be associated with Production Avenue, Warragamba, a review of the various business indicated that it is unlikely for the business types described to be associated with contaminating activities which could likely impact the site, particularly in the context of the proposed construction works (example of business types historically recorded at Production Avenue include e.g. furniture manufacturers/wholesalers, builders suppliers, kindergarten, engineers structural etc).

Search results are presented within Appendix B.

3.7 Interview

An Experienced Environmental Scientist and Principal Environmental Engineer from SMEC attended the Site on 18 May 2022 to carry out a Site walkover of accessible areas of the Sites. Brian Simmons (WaterNSW) was present during the Site walkover and was able to answer questions and provide information about the history of the Sites. Brian has over 20 years knowledge working and involvement with Warragamba dam. Brian Simmons also provided additional historical information post the visit following questions raised by SMEC.

Selected site photographs are included in Appendix C. Figure 2-1 to Figure 2-4, Appendix A shows the photo locations.

A summary of relevant information provided by Brian Simmons is presented below.

Site 1 – Former Painters/grit blasting area

- Brian Simmons was not on site when it was used as a painters/grit blasting area during original dam construction/maintenance
- Clean up as per remedial action plan was carried out in 1998
- Reports for this area have been provided to SMEC
- Brian Simmons was on site when the emplacement cell was being constructed and he pointed to the approximate location where he recalled it was created. He was confident it was west of the earth bund area (approximate location of the cell is provided on Figure 3, Appendix A) *[refer to photograph 1]*
- The cell was excavated into the ground and was not the noise/light mound that is evident there, the mound to the south, west and east of the shed (refer to Figure 3, Appendix A) was reportedly constructed as an earthen sound barrier/used to control surface water runoff
- AbiGroup was a contractor on site and formerly maintained the depot and was responsible for storage of equipment for the ancillary spillway
- A bushfire went through Warragamba on Christmas 2001 and most on-site records were destroyed
- The large shed was burnt out in the bushfire. It was originally metal and timber and was re-built after the fire as per the shed that is there today
- The shed was mainly used for materials storage. Post the 2001 bushfire it has only really been used for rock core storage. Whilst Brian Simmons initially indicated that vehicle maintenance was unlikely to have occurred as there were facilities on the east bank, he later recalled that this may have occurred
- Brian Simmons was not aware of onsite waste disposal areas. There was a landfill in Warragamba not far from the dam, therefore rubbish etc could easily have been taken there
- There was likely a generator to run power to the shed as there was no mains power. The generator would have had a fuel supply but it is not known where within the Site the fuel was stored
- The thick cables stored in the western part of this area (as observed during the site visit) were radial gate cables (from the dam wall) *[refer to Photograph 1.05, Appendix C]*

Site 2 – Proposed vegetation clearance area

- The west bank would have been heavily disturbed during original dam construction and during works for the auxiliary spillway to cut benching for the dam. It is steep and trees are just regrowth
- A cable tower is located on the upper part of the cliff on the western bank. The cable tower was able to move east-to west along a set of tracks, remnants are still visible today. The tower previously supported a cable which spanned to the cliffs on the other side of the valley, and the cable was used to support a cable car to transport materials and supplies etc during the dam wall construction
- There used to be one or more suspension bridges across the river
- The proposed vegetation clearance area is mainly on steep rock cliffs
- Site 2 does not include the Warragamba Dam viewing platform (the area noted in EPA records)
- With regards to proposed construction activities near the tail tower on the 'left bank area', Brian commented, 'abutment gets cut into embankment approx. 50m. Tail tower rail gets extended u/s to allow tower to be moved clear of raised dam
- With regards to some linear structures observed on aerial photography from 1949 to 1970, Brian Simmons commented, *'these are 900mm diameter calyx cores [rock cores] from original dam investigations – mostly disposed of, some remnants remain along boundary lines.'*

Site 3 – Terraced Gardens Area

- At the south-western end there are two building structures. The larger structure closer to the dam is an electrical building which has electrical switchboards *[refer to photograph 3.01, Appendix B]*
- The second building is a back-up power generator for the dam in case of power outage or power shut downs. Brian estimated there may be a 300-400litre diesel above ground storage tank inside that building. Brian confirmed these buildings are not being touched as part of the upgrade works *[refer to photograph 3.02, Appendix B]*
- Around 2008-2009 there was an electrical upgrade for the site and newer transformers were installed across the site
- The upper level is a park and gardens
- Both levels would have been used for construction storage areas during construction of the original dam
- A cable tower crane was located in this area – remnants are still present
- Regarding a rectangular structure within the north-west corner of Site 3 – Brian Simmons commented, 'this is a flat area covered by asphalt, the white rectangular structure is the roof of access shaft to diversion tunnel (from original dam construction)'. This structure will not be disturbed during construction.
- Regarding an area of apparent sandstone blocks in the north-east portion of Site 3, Brian Simmons commented, 'this is the downstream end of the Folly Creek fill - this was a cement stabilised fill that was constructed during the aux spillway work in ~2001. The blocks that you see form the retaining structure at the end of the fill'. This structure will not be disturbed during construction.
- The grassed area within Site 3 was used as a parking area 'at times, temporarily'
- Small building structures located within the north-east extents of Site 3 were reportedly used for storage of equipment by gardeners – currently not used
- With regards to a large structure observed (from aerial imagery on the grassed area of Site 3 circa 2009-2001), Brian Simmons indicated these were temporary site sheds used during crest gate upgrade project in 2009-2011
- With regards to some smaller building structures located on the lower level of Site 3 circa 2019-2021, Brian Simmons indicated these were temporary portable site sheds – placed ad hoc by contractors as and when needed

Site 4 – Haviland Park

- There were some older structures at the eastern end of the park, but these were burnt down in the 2001 bushfires. Structures would have been fibro
- There is an old conveyor tunnel under the park – this was not accessible during the site walkover and nothing is really stored there
- Otherwise this area has just been used as a grassed park to Brian's knowledge

Site 5a – Storage area

- Parts of this area was used for equipment storage – similar to present day. It was not an active work area
- Within the eastern portion of Site 5a, to the north of the access track, there are some concrete plinths and this area used to store 'stop logs' for the dam. These are 27m long steel structures
- Brian indicated that an old explosives store is located downslope to the west, however this building is located off-site and is not in use
- The small hut at top of hill (central northern portion of site adjacent to the weather station) was the communications tower.

Site 5b – Helipad/former houses

- This area formerly comprised houses during and post construction of the dam
- Some houses were demolished in 1998 under proper procedures
- Brian was not sure what procedures were used for demolition and controls and unsure if there were some demolitions earlier to this
- Houses would have been fibro construction
- The property to the south is offsite and owned by Sydney Water – water filtration plant
- With regards to some areas of filling/stockpiling observed from 2009 aerial imagery, Brian Simmons indicated this was material excavated from site when offices were constructed, incl Haviland park – was flattened to disappear under helipad.

Workshops (outside of Site boundaries)

- Brian Simmons took SMEC to the lower workshop (off-site and down slope of Site 4 – Haviland Park), where there were tanks in the past. Brian indicated that the tanks were investigated and remediated as per reports provided
- The upper workshop was not visited but reportedly stores fuel in above ground tanks (diesel and jet fuel for helicopters).

3.8 Online Records

A review of the following online resources was carried out:

- WaterNSW website – Warragamba Site History
- Warragamba Dam 50th anniversary booklet (WaterNSW, 2010).

Key details from the resources are provided in Section 2.3.

3.9 Site observations

An Experienced Environmental Scientist and Principal Environmental Engineer from SMEC attended the Site on 18 May 2022 to carry out a Site walkover of accessible areas of the Sites. The purpose of the Site walkover was to observe Site conditions, visual or olfactory signs of contamination and note potential land use activities that could have resulted in potential site contamination. Selected site photographs are included in Appendix C. No apparent signs of contamination (e.g. dark ground staining, ACM, or unusual odours) were evident in the areas observed and accessed, however, it should be noted that some portions of the Site were not accessible (as described below) and the presence of leaf litter on the ground in some areas prevented observations of the ground surface.

Figure 2-1 to Figure 2-4, Appendix A shows the photo locations and general site walkover observations. Descriptions of topography are described in Section 4.1. An overview of site observations is presented in sections below.

3.9.1 Site 1 – Former painters/grit blasting area

At the time of the Site walkover, Site 1 appeared to be used as a storage area for various pieces of equipment associated with the dam. Clusters of equipment were observed adjacent to the sealed road, including, large bundles of steel rope, large pieces of steel (assumed to be parts/components etc related to operation of the dam), large skip bin, timber etc). A large steel framed shed was observed in the central portion of the Site, the contents of the shed mostly included rock core inside core boxes. The shed was constructed on a concrete slab. Several smaller vacant structures (two portacabins and a small empty shed) were observed to the west of the main storage shed. An earthen bund (ranging from around 2-3m above ground level to around 0.5m above ground level) was observed within the southern portion of the Site. An old silt fence was observed to the south of the earthen bund. There were no apparent surface indicators as to the location of the contaminated cell which is reportedly located within the south-eastern portion of the Site. The perimeter of Site 1 was densely vegetated with trees and bushes, the ground surface in these areas was also covered with leaf litter.

No surface evidence of sandblasting grit was easily evident.

3.9.2 Site 2 – Proposed vegetation clearance area

It was not possible to access the majority of Site 2 because the majority of the Site was densely vegetated and/or comprised steeply sloping cliff faces, however observations were made from the top of the dam wall (which was a good vantage point to get a general appreciation of the area). The majority of the Site appeared to be densely vegetated with mature trees and bushes, sandstone bedrock was observed to be outcropping on the steeply sloping valley sides.

3.9.3 Site 3 – Terraced Gardens Area

Observations of Site 3 were made by looking down onto the Site from the dam wall and by walking over the Site itself. Several structures were observed on the lower terrace, this area was sealed with asphalt. The structures nearest the dam wall reportedly contained electrical switchboards and a backup generator (including fuel tank) although it was not possible to view inside the structures. Several other structures were observed in the north-eastern portion of the Site on the lower level, these structures included a toilet block and shaded picnic area. Several sets of stairways allowed access between the different levels of the terraced gardens. The second level mostly comprised a grassed lawn area (a small electrical transformer was observed on this level within the western portion of the Site). A concrete structure was observed in the floor of this terrace, the structure looked like a typical concrete path but was later understood to be a component of the former 'Tail Tower' structure. Several small building structures (which appeared to be unused) were present within the eastern extent of this terrace – these were later understood for the storage of gardening equipment. Outcropping sandstone bedrock was visible between each terrace.

3.9.4 Site 4 – Haviland Park

Haviland Park was observed to be an open grassed parkland area comprising scattered mature trees and park benches. The area appeared to be well maintained.

3.9.5 Site 5a – Storage area

The majority of the area was densely vegetated and at the time of the walkover and appeared to be either unused bushland or utilised for storage of general equipment (mostly metal components/parts and large concrete/metal pipes associated with the dam. These areas were predominantly stored adjacent to the access road. The western portion of the Site was observed to comprise an area of hummocky ground (assumed historical stockpiling/filling), with some mulch stockpiles also visible. Rock was observed to be outcropping at the ground surface in several area to the south of the access road. The southern portion of the Site appeared to slope away steeply toward the valley below. A weather station area (with a small fenced compound) and an old communications hut and associated aerial tower were observed within the northern portion of the Site. The communications hut appeared to be of fibre cement construction and was labelled with some stickers which warned of the presence of asbestos. Some holes/damage was evident in the fibre cement.

3.9.6 Site 5b – Helipad/former houses

At the time of the walkover, the Site appeared to be a generally vacant, open grassed field area with a helipad area demarcated within the central portion of the Site. Some scattered trees and bushes were observed. The Southern portion of the Site was approximately flat but sloped downwards to the north to a drainage line at the toe of the slope. The northern extent of the Site was not accessed during the walkover due to dense vegetation. Some vehicles were parked along the southern perimeter of the Site.

3.10 Site history data gaps

The following are considered potential historical data gaps:

- The large scale of the Site and the relatively poor quality of some of the historical aerial photographs means that it is difficult to discern every potentially activity at the site, and the exact activity and feature is not known
- Although several available reports refer to Site 1 as a proposed 'Truck maintenance and explosives store area', we have no additional evidence to corroborate this
- Validation reports associated with the remediation at Site 1 were reportedly destroyed during the 2001 bushfires, the only evidence of validation being carried out is a letter report which states that remediation was carried out as per the SKM Remedial Action Plan (RAP)

These site history data gaps inform the assessment for the Site and are considered below.

4 Preliminary Conceptual Site Model

4.1 Topography

Topography details were obtained from publicly available mapping with topographic contours shown in Figures in Appendix A and from site observations.

The Warragamba Dam has been constructed at the base of a steeply dipping river valley, elevations at the top of the valley slopes within the vicinity of the dam typically range from around 180m AHD down to 20m AHD at the valley floor.

A summary of topography at each of Sites 1 to Site 5 is presented below.

Site 1 – Former Painters/grit blasting area

The shed area and immediate surrounds represent a high point in the area (approximately 185m AHD). In broad terms the area housing the shed and loop road were relatively flat with an overall slight slope down to the north. The topography slopes down more steeply past the tree lines to the west, east and south.

Site 2 – Proposed vegetation clearance area

The majority of Site 2 generally comprises steeply sloping sandstone rock faces either side of the Warragamba River and a section of the valley floor (western portion of Site 2). High points are around 175m AHD and 130m AHD for the north bank and south banks respectively, the topography slopes down steeply toward the valley floor on both sides of Site 2 where elevations are typically around 20m AHD. Stormwater run-off at Site 2 would generally be expected to head towards the Warragamba River (orientated NE-SW through the centre of the Site).

Site 3 – Terraced Gardens Area

Site 3 occupies several distinct topographic levels separated by sandstone cliff faces or concrete retaining walls, a stairway links each terrace. The lower terrace is at approximately 60m AHD, the upper level is situated at around 110m AHD in the north-western corner of the Site. Stormwater run-off from Site 3 would generally be expected to flow west/north-west toward the Warragamba River.

Site 4 – Haviland Park

Haviland Park is generally flat at an approximate elevation of 165m AHD. It is located on a crest area with a broad downward slope to the north-west, but slopes down towards the sealed roads which surround the Site on all sides to the east, west and north.

Site 5a – Storage area

The high point at Site 5a is a broad area around the weather station and communication hut (approximately 185m AHD), from this high point, the Site slopes to around 180m AHD in the south and south-eastern portions of the Site before the topography begins to slope fairly steeply along the southern boundary of the Site. Stormwater run-off would be expected to flow south and south-west from the Site.

Site 5b – Helipad/former houses

A broad, relatively flat area occupies the southern half of Site 5b, with this flat area is at an approximate elevation of 180m AHD. The topography in the northern half of Site 5b slopes fairly steeply down to a low point of 155m AHD in the north-eastern corner of the Site. Stormwater run-off would generally be expected to flow towards the south from Site 5b.

4.2 Vegetation

During the site walkover it was observed that large portions of Site 1, Site 2 and Site 5b were densely vegetated with natural or regrowth bushland.

Based on the EIS (SMEC, 2021) most of the vegetation across the relatively level areas of the site is Dry Sclerophyll Forest (Shrubby sub-formation) of common plant community types found in the locality on sandstone ridgetops. Some wet Sclerophyll Forest communities are present in the gullies and one area on the north bank is the Threatened Sydney Turpentine Ironbark Forest community (refer to relevant section of the EIS for additional details). No apparent evidence of die back or vegetation stress due to contamination was noted during the site visit.

4.3 Heritage

With reference to Department of Finance, Services and Innovation 2022 Heritage mapping (accessed 13 May 2022), Haviland Park is listed as a State Heritage Register Item (ID 5051583). The Greater Blue Mountains Area is recorded on the National Heritage List and is located approximately 100m north of the northern extent of Site 1.

4.4 Regional geology

With reference to the Penrith 1:100,000 Geological mapping, Site 1 to Site 5 are all reportedly underlain by Hawkesbury sandstone described as medium to very coarse-grained quartz sandstone with minor laminated mudstone and siltstone lenses.

Some areas of filling have been identified at the site from the site visit and are highlighted in Figure 3, Appendix A.

4.5 Acid Sulfate Soils

Reference to the Atlas of Australian Acid Sulfate Soils 1 (CSIRO, 2013) accessed 27 May 2022, indicates that Site 1 to Site 5 are mapped as having an extremely low (1-5%) probability of Acid Sulfate Soils (ASS) occurrence, furthermore, based on site observations from the site walkover and the topographic elevations of Site's 1 to 5 we consider that ASS materials are unlikely to be present at the sites.

Lake Burratorang (i.e. upstream/to the west of the dam wall) are mapped as having a high probability (>70%) probability of Acid Sulfate Soils occurrence, this area is outside of the Site boundaries for the purposes of this assessment.

4.6 Hydrology and hydrogeology

Based on topographic contour mapping for the site, site observations and with reference to NSW spatial services data set (perennial and non-perennial) water courses (viewed through the MinView website – accessed 27 May 2022), stormwater run-off from Site 1 to Site 5 is generally anticipated to flow downslope toward gulley low points and then eventually discharge (via drainage lines/creeks) into either Lake Burratorang (upstream of dam wall) or into the Warragamba River (downstream of dam wall).

Site 1 to Site 5 are all located proximal to Lake Burratorang, groundwater at each site is therefore expected to be located at approximately the AHD of the surface water of the lake, groundwater levels in the immediate vicinity of the dam and immediately downstream may be elevated above the downstream creek level due to the presence of the dam wall. Groundwater is expected to be located within fractured rock.

4.7 Groundwater Use

A search of registered groundwater bores was carried out on 13 May 2022 (data sourced from Department of Finance, Services and Innovation). The search results are presented in Appendix B. The results indicated that there was one registered groundwater bore (GW075142) located within a 1km radius of the Sites. The bore is located approximately 600m south of the Sites and was reportedly installed to a depth of 246m below ground level (bgl) with a standing water level of 92m bgl. The registered purpose of the bore is for 'monitoring'.

4.8 Contamination Sources-Pathways-Receptors

Contamination source(s), pathway(s) and ecological/human receptor(s) linkages have been assessed based on the Conceptual Site Model (CSM). The following assessment has been undertaken in the context of the proposed activities at each site as described in Section 2.1 and Section 2.2.

4.8.1 Sources

Areas of Environmental Concern (AEC) and Contaminants of Potential Concern (CoPC) were assessed based on Site history information and Site walkover. Identified AEC and CoPC are summarised in Table 4-1 below.

AECs are presented in Figure 3, Appendix A.

Table 4-1 Summary of identified potential AEC and CoPC

No.	AEC / Source(s)	Likelihood of Contamination ¹	Media Potentially Affected	CoPC ³	Comment ¹
AEC 1	Areas near former/existing building structures from weathering and/or ineffective demolition of hazardous building materials.	Low to high (refer to comments column)	Soil	Asbestos Lead (from lead-based paints) Zinc (from weathering of galvanised iron) TRH/TPH (from oils/greases used for Tail Tower track lubrication etc)	<p>Site 1: Structures at Site 1 were reportedly burned down during bushfires in 2001. It is unknown what happened to the remnants of the structures but assumed to be disposed offsite. Some residual surface contamination could remain depending on the effectiveness of previous clean up works. The likelihood of contamination being present is assessed as <u>low-moderate</u>.</p> <p>Site 2 (western area): The majority of structures in this area appear to have been equipment such as a Tail Tower and associated rail tracks (see item 2.01. 2.02, 2.03 to 2.06 – Figure 3 Appendix A). There is some potential for contamination from weathering of these structures/lubrication used on the rail tracks however the likelihood of contamination is assessed to be <u>low</u>.</p> <p>Site 2 (eastern areas): Two clusters of historical structures (unknown use) have been identified within the eastern portion of Site 2 (specifically item 2.08 and 2.07 (refer to Figure 3, Appendix A)), these structures were demolished circa 1965. The area opposite the viewing platform has been reported to contain asbestos and has been capped. The likelihood of contamination at these two areas is assessed to be <u>moderate to high</u>.</p> <p>Site 3: The structures at this site appear to have either been equipment (eg Tail Tower and associated tracks or building structures that are generally still present on the site today), the likelihood of contamination in this area is assessed to be <u>low to moderate</u>.</p> <p>Site 4: Several historical structures have been identified in the eastern portion of Site 4, the majority of which appear to have been demolished circa 1965, due to unknown demolition practices at this time the likelihood of contamination in this areas is assessed to be <u>moderate to high</u>.</p> <p>Site 5a: The only structures identified in this area was the weather station area, the tennis courts and the communications hut, the likelihood of contamination at the tennis court/weather station is considered to be <u>low</u>, however, the communications hut is suspected to contain ACM and potentially PCBs, therefore the likelihood for contamination is assessed to be <u>moderate to high</u>.</p> <p>Site 5b: The majority of this site was historically occupied by a large number of residential and ancillary structures that were demolished in various stages. Due to unknown demolition practices and the number of structures historically present at the site, the likelihood of contamination is assessed to be <u>high</u>.</p>
AEC 2	Historical and/or existing equipment storage areas (from weathering of equipment stored on unsealed ground for long periods) and historical construction areas (e.g. from equipment/machinery leaks and/or other general construction practices)	Low	Soil	Heavy metals, asbestos, TRH, BTEX, PAH, heavy metals	Multiple storage areas were identified across the Sites, the majority of items stored in these areas appeared to be steel objects/parts associated with the dam wall, timber, concrete/steel pipes etc. For the most part these objects were observed to be stored on un-sealed ground and there is some potential for weathering of these objects to have led to some contamination of shallow surface soils, however the likelihood is assessed to be <u>low</u> for all sites as the materials were most likely inert.
AEC 3	Areas of stockpiling/filling (from materials of unknown origin and/or quality)	Low to moderate (refer to comments column)	Soil	Heavy metals PAHs, TRH, BTEX, PCB, OCP, OPP, asbestos (+ others depending on source)	<p>Site 1: the identified areas of stockpiling/filling within area have the potential to have been impacted with known contamination at this Site, the likelihood of contamination is assessed to be <u>moderate</u>.</p> <p>Site 2 and Site 3: the site history review did not indicate any areas of filling/stockpiling</p> <p>Site 4: Two areas of filling were identified within Haviland Park, the filling appeared to have occurred circa 2009 and anecdotal evidence indicates the source of the fill was from beneath the Warragamba Dam visitor centre, several structures were historically located at the location of the visitor centre, due to unknown demolition practices, these fill materials are of unknown quality, therefore the likelihood of contamination is assessed to be <u>moderate</u>.</p> <p>Site 5a: Two areas of filling have been identified. The filling area in the western portion of the Site (item 5a.04) appears to have a long history of filling/ground disturbance and stockpiling (from circa 1960 to 2005). Due to the unknown quality of fill or exact activities the likelihood of contamination is assessed to be <u>moderate</u>. The eastern area of filling (item 5a.02) is suspected to comprise materials sourced from the clearing of the trees in this area circa 1970-1986, therefore the likelihood of contamination is assessed to be <u>low</u>.</p>

No.	AEC / Source(s)	Likelihood of Contamination ¹	Media Potentially Affected	CoPC ³	Comment ¹
					Site 5b: The fill identified at Site 5a (placed circa 2007-2009) was anecdotally sourced from the construction of the visitor centre, for the same justifications provided for Site 4, the likelihood of contamination in this fill material is considered to be low .
AEC4	Fuel storage/re-fuelling from possible leaks and/or spills	Low	Soil	TRH,TPH, BTEX, PAH, lead	Site 3: An above ground fuel tank (200-300 litres) is reported to be at the back up generator within a small structure . This is a well maintained area and managed by WaterNSW, therefore the likelihood of contamination is assessed to be low . Site 4: Re-fuelling of helicopters apparently occurs at the grassed helipad area. Based on the small volumes of fuels involved and no evidence of leaks or spills the likelihood is considered to be low .
AEC5	Electrical sub-station from possible leaks/spills of insulation oils	Low (refer to comments column)	Soil	TRH	Site 3: A small electrical transformer was identified., Anecdotal information indicates that transformer was constructed circa 2007. No evidence of leaks was observed during the Site walkover, the likelihood of contamination is assessed to be low .
AEC6	Contamination containment cell located within Site 1 (comprising grit blasting waste known to be contaminated with lead, zinc and copper and hydrocarbons).	High	Soil	lead, chromium, zinc, copper	Site 1: The exact location of the containment cell is currently unknown; however, the cell is known to contain soil contaminated with lead, zinc, copper, chromium and hydrocarbons. The likelihood for contamination is assessed to be high .
AEC7	Area of potential metal contamination associated with former grit blasting activities (isolated areas of hydrocarbon contamination were also historically identified in this area).	Moderate	Soil	Lead, copper, zinc, chromium	Site 1: This area was reported to have metal contamination from past grit blasting activities and reportedly remediated in 1998. However, the 2001 bushfires destroyed the validation reports. A single letter report was reviewed which indicates that the area was remediated as per the remediation action plan (RAP), the RAP indicates that the proposed remediation was to scrape shallow soils and place into an on-site lined cell. Validation of the area was reportedly carried out by visual assessment only (i.e no validation sampling). Based on the data gaps relating to the remediation and validation of this area, we assess the likelihood of residual contamination to be moderate . .
AEC8	Core park road dump area (reported to contain approximately 20 x 44 gallon drums and light fittings – unknown if any remediation has occurred	Moderate to high (refer to comments column)	Soil	Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn), PAHs, TRH, BTEX, PCB, OCP, OPP, asbestos (+ others depending on waste types)	Site 2: A report by Integrated Environmental (2016) describes observations of a dumping area (mostly considered to be off-site to the east of Site 2, but a portion of the dump area may cross into Site 2) (refer to Figure 3-2), appendix A. The waste area was observed to contain 20 x 44 gallon drums which previously contained unknown liquids, the likelihood of contamination is considered to be moderate to high .

Notes:

1. This is our qualitative assessment of likelihood of contamination being detected from the data reviewed, not financial or other risk associated if contamination were to be detected. The likelihood of contamination has been assessed based on our current understanding of the proposed future use of each site during construction.

2. Heavy metals (arsenic, chromium (III&VI), copper, lead, mercury, nickel, zinc) TRH (Total Recoverable Hydrocarbons), BTEX (benzene, toluene, ethylbenzene, xylene), PCB (polychlorinated biphenyl's), PAH, (Polycyclic Aromatic Hydrocarbons), OCP (Organochlorine Pesticides), OPP, (Organophosphorus Pesticides).

The workshop area located approximately 25m west of Haviland Park was previously investigated and (reportedly remediated), based on the reported remediation and location of the workshop area in comparison to Haviland Park (located down topographic gradient) the workshop area is unlikely to represent a viable source of contamination to Site 1 to Site 5b.

SMEC queried WaterNSW with regards to use of herbicides and pesticides at the Site, a WaterNSW representative stated that 'WaterNSW undertake routine weed control on all their sites using targeted/selective methods'.

4.9 Exposure pathways

The pathways of exposure consist of:

- A transport mechanism
- A route of exposure.

Based on Site information, there is potential for the following contamination pathways to exist at the Site:

- Disturbance of potential soil contamination and exposure by ingestion, dermal contact or inhalation
- Air transport of particulates (dust) and exposure by inhalation
- Migration of contaminated run-off and exposure of down gradient ecological receptors (aquatic and terrestrial ecosystems).

4.10 Potential receptors

4.10.1 Human receptors

Based on the information available, potential human receptors have been assessed to include:

- Construction workers during construction phase
- Future Site maintenance/operational workers and visitors.

4.10.2 Ecological receptors

Ecological receptors may include:

- Terrestrial and aquatic organisms and plants (on-site and off-site)

Based on our current understanding of the proposed construction activities at the Sites (generally comprising topsoil removal and/or vegetation clearance) interaction with groundwater during construction is considered to unlikely.

4.10.3 Potential source-pathway-receptor linkages

Potential source-pathway-receptor (S-P-R) linkages are where soil, surface water and/or groundwater contamination (if present) has the potential for adverse impact on human health or ecological values for the Site via complete exposure pathways.

Based on the findings of the PSI there are a number of plausible source-pathway-receptor linkages for the site (in the context of the proposed construction activities) as presented within Table 4-2.

Table 4-2 Potential contamination source, pathway and receptors

Source		Potential Pathway		Potential Receptor(s)
Primary	Secondary	Scenario	Exposure Pathway(s)	
<ul style="list-style-type: none"> Contaminants associated with AEC 1, AEC2, AEC 3, AEC 4, AEC 5, AEC 6, AEC 7, AEC 8 	<ul style="list-style-type: none"> Soil contamination 	<ul style="list-style-type: none"> Direct exposure during excavation/stockpiling of contaminated soils Surface water runoff from excavated/exposed soils during construction impacting down-gradient soils and surface waters 	<ul style="list-style-type: none"> Dermal contact Inhalation of soil dust and/or fibres Incidental ingestion (humans and animals) Absorption (plants) 	<ul style="list-style-type: none"> Future Site maintenance/operational workers and visitors Construction workers during construction phase Terrestrial and aquatic organisms and plants (on-site and off-site) Surface waters (on-site and off-site)

Table notes

This table has been completed in the context of our current understanding of proposed disturbance to each of the Sites (proposed activities are summarised in Section 2.2), should proposed construction activities differ to those specified in Section 2.2 this assessment will need to be reviewed in the context of these activities.

5 Conclusions and Recommendations

5.1 Conclusions

Based on the data reviewed, the site history indicated that:

5.1.1 Site 1 – Former painters/grit blasting area

Earliest available aerial imagery from 1949 shows the Site to mostly comprise dense bush land with some cleared areas including several un-sealed roads. Structures appear on-site around 1970, with dark ground staining (possibly associated with known grit blasting activities) appearing around 1978. The 2001 bushfires caused the destruction of the majority of on-site structures, a large steel framed shed was later re-built, The shed is predominately used for the storage of rock core.

Reports reviewed by SMEC indicate that a large portion of land (approximately 8,000m²) located to the west of the existing shed structure and a smaller area to the north of the existing shed area were historically contaminated with heavy metals (copper, lead and zinc) as a result of historical grit blasting activities. In addition, hydrocarbon soil contamination was recorded in areas of visible oil staining. A remedial action plan was created and remedial activities were reportedly carried out (which included scraping visually contaminated soils into a lined call (on-site). Validation reports were reportedly lost during the 2001 bushfires, however, one letter report indicates that remediation was carried out as per the remedial action plan.

5.1.2 Site 2 – proposed vegetation clearance area

From circa 1949 to the present day, Site 2 appears to have predominantly comprised dense bushland and steeply sloping sandstone cliffs. Several structures were constructed in the western extent of the Site to support the original dam wall construction (e.g. Tail Tower). Two clusters of historical structures (eastern portion and northern portion of site respectively) were formerly present at the Site until demolition circa 1965.

In 2016, three asbestos impacted areas and an open landfill area containing approximately 20 x 44 gallon drums were observed immediately off-site of Site 2.

5.1.3 Site 3 – Terraced gardens

The Terraced garden area appears to have been predominantly utilised during the original dam wall construction, during this period, the lower terrace appears to have been utilised for car parking. A 'Tail Tower' structure was formerly located within the second (middle) terrace of Site 2 from around 1949 to 1965, circa 1965 the middle terrace appears to have been landscaped into the park area observable today. Various smaller building structures have been constructed within Site 3 since 1949, the majority of which are still visible on site today.

5.1.4 Site 4 – Haviland Park

Earliest available aerial imagery appears to show a portion of Haviland Park being used for storage of stockpiles (reportedly a one-week supply of gravel and sand) to supply the concrete laboratory (refer to photograph 4.04, Appendix C).

Several larger building structures appear within the eastern extent of the Site circa 1955 but disappear prior to the 1965 aerial image. Circa 1965 the park appears to have undergone some landscaping works to create the present-day park area. Two small structures were formerly present within the south-west portion of the site from around 1965 to 2011. Fill material appears to have been spread across the north-western half of Haviland Park in 2009, a WaterNSW representative advised that the source of the material was from excavations associated with the construction of the WaterNSW offices and visitor centre located immediately to the north-west of Site 4. A workshop area (with known historical contamination issues associated with above and below ground fuel tanks) is located immediately off-site to the east but is considered to be topographically lower than Haviland Park and unlikely to be a valid contamination source for the site.

5.1.5 Site 5a – Materials storage/former housing

From approximately 1949 to present day, the majority of Site 5a appears to have comprised dense bushland, including a weather station and an adjacent small communications hut (suspected to be constructed using asbestos containing materials (ACM)).

Several areas of possible filling and stockpiling are visible at the site. Several portions of the site appear to have been utilised for equipment storage, for example either side of the main access road (southern portion of the Site) and within the cleared area located in the south-west portion of the site. An historical explosives store is located off-site to the south.

5.1.6 Site 5b – Heliport/former housing

Site 5b appears to have been predominantly utilised as a residential area comprising over 50 individual houses at its peak, each house appears to also be associated with a small shed structure. Construction of the residential area appears to have commenced around 1949 and we understand they were used to house some of the dam construction workers. Demolition of the houses appears to have occurred in several stages between 1978 and 2005. It is unknown if any remediation occurred at this Site following the demolition of the residential structures. More recently, fill materials appear to have been imported to the Site and used for landscaping, some of the fill reportedly came from the auxiliary spillway construction, and some also reportedly came from construction of the visitor centre, although other sources are possible.

A heliport is visible in the aerial imagery from 2018 but the area may have been used for helicopter landing prior to 2018.

Several data gaps currently exist, including:

- The large scale of the Site and the relatively poor quality of some of the historical aerial photographs means that it is difficult to discern every potentially activity at the site, and the exact activity and feature is not known
- Although several available reports refer to Site 1 as a proposed 'Truck maintenance and explosives store area', we have no additional evidence to corroborate this
- Validation reports associated with the remediation at Site 1 were reportedly destroyed during the 2001 bushfires, the only evidence of validation being carried out is a letter report which states that remediation was carried out as per the SKM Remedial Action Plan (RAP)
- *The mapping provided within the Lotsearch report (Appendix B) indicates that the contamination associated with the Warragamba dam viewing platform extends across the eastern boundary of Site 2 into the site, however, discussions with WaterNSW indicate that this portion of the site will not be disturbed by the proposed construction works.*

Based on the Site history and observations, eight potential areas of environmental concern (AEC) and potentially contamination sources were identified, including:

- AEC 1 - Areas near former/existing building structures
- AEC 2 - Historical and/or existing equipment storage areas
- AEC 3 - Areas of stockpiling/filling (unknown origin and/or quality)
- AEC 4 - Fuel storage/re-fuelling from possible leaks and/or spills
- AEC 5 - Electrical transformer from possible leaks/spills of insulation oils
- AEC 6 - Contaminated cell located within Site 1 and known asbestos contaminated area located immediately off-site (to the east) of Site 2
- AEC 7 - Area of potential metal contamination associated with former girt blasting activities
- AEC 8 - Core park road dump area.

Potential Areas of Environmental Concern associated with the above sources were identified within various Sites.

Our qualitative assessment of the potential for contamination to be present within the various identified Areas of Environmental Concern ranged from low to high (most were low to moderate). A preliminary conceptual site model

was prepared in the context of the proposed use of these areas for construction lay down areas and plausible source-pathway-receptor linkages were identified.

5.2 Recommendations

Based on the findings of this PSI, further stages of investigation are required to assess the site with respect to contamination. Intrusive investigations will be required to assess and characterise the site with respect to contamination, fill data gaps, develop the CSM and assess the need for remediation/management with respect to the proposed use of the site during construction. This should be carried out by developing a Sampling, Analysis and Quality Plan and then implementing this plan through a Detailed Site Investigation (DSI).

Based on the anticipated depth to groundwater which is relatively deep in fractured rock, and identified relatively shallow 'top down' contamination sources, direct assessment of groundwater is not considered to be warranted at this stage.

6 References

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